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1. ARMAMENT SYSTEMS

1) Bomb Rack for 250 kg Bombs

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Introduction: This paper is based on the title of my bachelor's thesis. I am going to present the main features, major components and the principle of operation of the ejector rack.

The ejector rack was designed for specific combat aircraft, like F-16 Fighting Falcon and it is a device used on military aircraft to securely carry and release bombs, missiles, or external fuel tanks. Unlike simple gravity-release racks, ejector racks use a pneumatic, pyrotechnic, or gas-dynamic system to actively push the payload away from the aircraft, ensuring a clean and safe separation.

Methods and Results: The bomb rack of my bachelor's thesis is made for F-16 Fighting Falcon and it is suspended from Stations 3, 4, 6 and 7 in a Wing Weapon Pylon. This is a Standard Wing Weapon Pylon (SWWP is capable of release Smart bombs) with a training Bomb GPS guided. A flagged safety pin is inserted in the MAU 12 to prevent accidental movement of the internal hook linkage during ground operation. Furthermore, the ejector rack is suspended at station 5 in a Centerline pylon and it mounts in both pylons, using four bolts and four self-locking nuts. All pylons contains holes that access the replaceable components and adjustment points within the MAU 12.

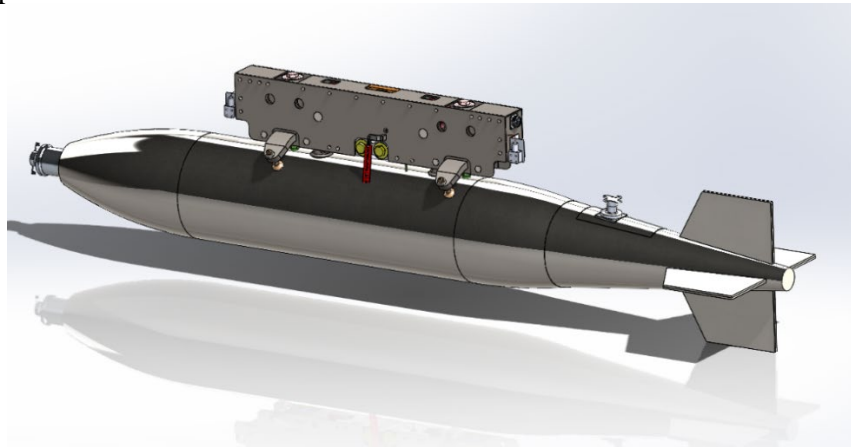


Fig.1: 250 kg bomb suspended on the ejector rack

This ability of carrying, arming, release and eject properly one given load is made through mechanical and electrical components. Weapons are suspended between one of two sets of retractable hooks spaced 14 and 30 inches apart, these hooks are connected by a linkage system to a center pivot arm, which allows manual hook operation during loading. Four adjustable sway braces on the MAU 12 help to secure the weapon during flight by preventing side-to side motion.

Conclusions: In conclusion, the ejector rack is a highly reliable and widely used suspension and release system for air-to-ground munitions and external fuel tanks.

Keywords: *ejector rack, bombs, missiles, external fuel tanks, guided, pylon, hooks.*



2) Implementation of 3D printed components in modern handguns GLOCK 17 CASE STUDY

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Introduction: The use of additive manufacturing (3D printing) in the defense industry has evolved from prototyping to functional applications, including weapon systems. This study explores the integration of 3D printed components in short firearms, focusing on the Glock 17, a widely used handgun. The aim is to evaluate the safety and performance of certain non-critical components when replaced by polymer-based 3D printed alternatives.

Methods and Results: An initial theoretical analysis covered the evolution of 3D printing in the armament field, highlighting benefits such as reduced production cost, rapid prototyping, and weight optimization, as well as drawbacks like lower mechanical resistance and thermal limitations. Using SolidWorks, a 3D model of the Glock 17 was created, incorporating a custom-designed polymer printed frame and recoil spring guide rod. Material selection was based on comparative mechanical properties (PLA, PETG, Nylon). Simulations involved static loading and motion analysis of the recoil system, focusing on spring stiffness, sliding friction, and overall kinematic behavior. Results indicate that while metallic components remain irreplaceable in high-stress areas (barrel, slide), 3D printed parts can perform reliably in structurally passive zones, provided optimal material and geometry are used.

Conclusions: 3D printing technology holds potential in the controlled implementation of parts in firearms, especially for prototyping, training models, or emergency replacement. However, its use is currently limited by mechanical and thermal constraints. Simulations suggest that for Glock 17, components such as the frame and spring guide can be successfully 3D printed without compromising safety during low-intensity use.

Acknowledgements: Cpt.lect.univ.dr.ing. Haller Laviniu

Keywords: 3D manufacturing, Glock 17, handgun, SolidWorks, safety, prototyping.

References:

- [1] „Îndrumar de laborator sisteme de armament” – Laviniu-Octavian HALLER
- [2] „ARME DE CALIBRU MIC. Studii și cercetări” – Marius Valeriu CÎRMACI-MATEI
- [3] „Bazele construcției și proiectării armamentului automat” – Sebastian VERBONCU
- [4] „O abordare fundamentală asupra sistemelor de armament” – Laviniu-Octavian HALLER

3) The Influence of Recoil on Shooter Performance

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Introduction: Recoil represents a significant aspect in the operation of firearms, with direct effects on shooter performance, accuracy, and physical effort. A comprehensive understanding of the interaction between recoil, weapon characteristics, and shooter physiology is essential to minimize its adverse effects. This thesis analyzes the main factors that influence recoil behavior, presents recoil reduction devices, and discusses how recoil affects shooter performance and weapon control.

Methods and Results: The research involved a comprehensive analysis of the parameters that influence firearm recoil and their effects on shooter performance. Based on this analysis, several conceptual approaches were formulated to improve recoil management and reduce its negative impact on the shooter.



The proposed concepts include:

- *Consideration of weapon-related parameters:* Factors such as weapon weight, and moment of inertia, which are known to influence recoil behavior and shooter stability.
- *Recoil reduction solutions:* Various devices such as recoil pads, muzzle compensators, and other systems designed to minimize felt recoil and improve weapon control.
- *Examination of recoil effects on the shooter:* Focuses on how recoil influences accuracy, physical effort, and control, considering individual shooter characteristics and specific firing conditions.

Conclusions: This study shows the important role that recoil has in how a shooter handles and controls a firearm. By analyzing factors such as weapon weight, balance, and ammunition type, it becomes easier to understand what influences recoil and how it can be reduced. The review of recoil-reducing devices also explains how they can improve comfort and accuracy during shooting. The results support the idea that better recoil control leads to improved shooter performance and safer, more effective weapon use.

Acknowledgements: Col. prof. univ. dr. ing. Marius-Valeriu CÎRMACI-MATEI.

Keywords: *Recoil reduction system, shooting performance, shooter-rifle interaction, center of mass, MOI of the weapon.*

References:

- [1] M. E. LaFiandra, A Tool for Calculating the Center of Mass and Moment of Inertia of Small Arms Weapons, July 2008
- [2] M. K. Blankenship, M. R. Evans¹, COL Stephen A. M. Murphy, S. H. Isome, M. P. Dinauer, W. Harper³ S. Ortega, Shoulder-Fired Weapons With High Recoil Energy: Quantifying Injury And Shooting Performance, May 2004
- [3] Ferguson, N.R. Jenzen-Jones with Jonathan, A Guide to the Identification of Small Arms and Light Weapons

4) Experimental Study on the Impact Phenomena Between Small-Caliber Ammunition and Protected Targets

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Introduction: This paper presents an experimental study on the behavior of various protected targets, such as bulletproof vests and helmets, when subjected to impacts from different caliber ammunition. Given the increasing importance of individual ballistic protection on the modern battlefield, a comprehensive understanding of the interaction between small-caliber projectiles and contemporary ballistic protection equipment is essential.

Methods and Results: The experimental study, conducted under controlled safety conditions in a specialized shooting range, examines the performance of two types of individual ballistic protection – ballistic vests and ballistic helmets – when impacted by various types of ammunition – 7.62×39 mm, 9×19 mm, .357 Magnum, and 5.56×45 mm. The study aims to observe and analyze their behavior and determine specific performance parameters.

Using a high-speed camera, the impact phenomena and the behavior of the ammunition can be precisely tracked, while the camera's control software enables the extraction of various parameters, such as bullet trajectory, velocity and acceleration. A post-test analysis is performed to evaluate materials behavior, focusing on aspects such as traumatic imprint, bullet penetration, and material fracture. The results obtained provide valuable data that can contribute to the development of ballistic protection configurations with enhanced performance.



Conclusions: The experimental study emphasizes the importance of adapting protection configurations based on the characteristics of the ammunition encountered on the battlefield. Furthermore, the high-speed videos offer a clear insight into rapid phenomena that are often beyond the capabilities of the naked eye to capture. This paper contributes to improving the selection and arrangement of materials in individual ballistic protection equipment, potentially leading to enhanced designs.

Acknowledgements: The experimental tests were conducted with the logistical support of TACTICAL LIFE S.R.L.

Keywords: *ballistic protection, vests, helmets, small-caliber ammunition, high-speed camera.*

References:

- [1] National Institute of Justice. *Ballistic Resistance of Body Armor, NIJ Standard-0101.06*. U.S. Department of Justice, 2008;
- [2] Brown, D. H. K., & Carruthers, J. A. W., *Modern Body Armour and Helmets*, Argos Press, 2004;
- [3] Dorrzapf J.-J., *La Balistique des projectiles. Analyse – Aspects theoriques et pratiques*, France, 2017.

5) Brief evolution of belt-fed machineguns and the constant recoil stock

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Introduction: This presentation is a 2 part project . The first part takes about the longevity of the belt-fed mechanism in machineguns and the other part is a self-made innovative stock for a machinegun-type weapon system to prove there are a lot of things that can still be improved to this ever aging mechanism .

Methods and Results: By using the vast knowledge related to firearms I posses from the internet and from the Basics of Weaponry lectures I will present a brief history and evolution of belt-fed machineguns in which I will talk about the reliability of this system and how small innovations slowly changed this weapon system while keeping it close to the original machineguns. After with the knowledge acquired during my one and a half years in the MTA I will present one of my personal ideas of how to innovate this weapon system consisting in a spring suppressed stock.

Conclusions: This weapon system won't fall out of relevancy any time soon and as the time passes it will evolve with the conditions and requirements of the future .

Keywords: *belt-fed , weapon system , evolution.*

References:

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- [2] Col. conf. univ. dr. Adrian Stroea & Lt. Col. Gheorghe Băjenaru „Artileria Română În Date Şi Imagini “;
- [3] Cpt. lect. univ. dr. ing. Laviniu-Octavian Haller “Indrumar De Laborator Sisteme De Armament 2021”.

6) Study of a Database for Aerial Shooting

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Introduction: This paper presents a comprehensive computational approach for generating and analyzing adimensional ballistic functions databases used in projectile trajectory modeling. The study aims to establish optimal mathematical representations for trajectory parameters across varied initial conditions, creating a unified framework for ballistic



calculations that can be applied in multiple scenarios without recalculating complex differential equations.

Methods and Results: Our methodology involved developing a MATLAB-based computational model that systematically evaluates trajectory parameters across varied initial conditions (velocity, angle, and form coefficient) at different altitudes.

The computation was structured in three main stages: trajectory simulation using differential equations, extraction of reference points, and polynomial approximation of adimensional functions.

Statistical analysis of the coefficient matrices revealed consistent patterns across parameter variations, confirming the stability of the adimensional approach. The polynomial representation achieved a mean approximation error below 1.5% compared to direct numerical integration, validating the approach's accuracy.

The resulting unified table of adimensional functions provides a computationally efficient alternative to traditional methods, reducing trajectory calculation time by approximately 95% while maintaining acceptable accuracy for most practical applications.

Conclusions: The study successfully established a comprehensive database of adimensional ballistic functions that effectively decouples the complex dependencies between initial conditions and trajectory outcomes. The polynomial representation of these functions provides a practical tool for rapid trajectory calculations without sacrificing significant accuracy. This approach is particularly valuable for applications requiring real-time trajectory predictions or when computational resources are limited. Future work will focus on extending the model to include atmospheric variations and additional aerodynamic effects.

Keywords: *Adimensional functions, Ballistic trajectories, Polynomial approximation, Computational modeling, Trajectory database, Projectile dynamics.*

7) Construction and Materials of Barrels for Artillery Guns and Portable Weapons

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Introduction: Armament barrels are subjected to extreme pressure and temperature stresses. This study analyzes the optimal materials and technologies for artillery barrels and portable weapons, integrating experimental data from mechanical and thermal tests.

Methods and Results: Mechanical tests at room temperature:

1. We analyzed carbon steels (0.6-0.7% C) and wolfram alloyed steels (0.65% C, 2% W), subjected to heat treatments:
 - Baking at 900°C + tempering at 500-600°C.
 - Flow limit: 50-55 kgf/mm².
 - Breaking strength: 70-90 kgf/mm².
 - Steels with 10-14% Mn showed exceptional wear resistance due to their special structure.
2. Comparative prolonged shooting tests:
 - Under identical conditions:
 - Standard carbon steel: 15,000 shots.
 - Specially-treated steel: only 5,500 shots (37% of standard steel performance).
3. Tests at high temperatures (400-700°C):
 - Decrease the flow limit:
 - Carbon steel: from 61 kgf/mm² (20°C) to 15 kgf/mm² (700°C).
 - Cr-Ni steel: only 40% reduction at 700°C.



- Cold treatments become ineffective above 400°C.
- 4. Material purity analysis:
 - The removal of phosphorus, sulfur and gases (oxygen) reduced the formation of microscopic inclusions.
 - The degreased steels showed reduced wear by 20-30%.
- 5. A comparison of cooling systems:
 - Water-cooled pipes (200°C): longer lifetime.
 - Air-cooled pipes (700°C): 3-4 times shorter lifetime.

Conclusions: The study highlights the complexity of the choice of materials for barrels, where factors such as chemical composition, heat treatments and operating conditions play crucial roles. Cr-Ni alloyed and high manganese steels offer the best performance, but require further research to optimize the processing.

Keywords: *Gun barrels, Alloy steels, Heat treatment, Wear, Ballistic tests, Heat resistance.*

References:

- [1] W.Schwinning. *Constructia si Materialul Tevilor pentru Gurile de Foc de Artilerie si Armament Portativ*, Institutul de Documentare Tehnica, Bucharest, 1955.

8) The Influence of Propellant Ballistic Parameters on the Morphology of Firing Marks

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Introduction: This study aims to investigate the formation of firing marks left on ammunition by small-caliber firearms, focusing on the interactions between the weapon's internal components and the cartridge during the firing process. Understanding how various firearm categories produce distinct ballistic signatures is essential in forensic ballistics and firearm identification.

Methods and Results: The research analyzes how different constructive solutions and individual wear characteristics of firearm components—such as the firing pin, breech face, extractor, and ejector—generate unique marks on ammunition. These marks result from mechanical interactions during firing, influenced by factors such as component geometry, material hardness, surface condition, and operational stress. Additionally, the study explores the influence of propellant parameters on the force distribution affecting these components. A correlation is drawn between ballistic pressure values and the depth, shape, and position of the resulting firing marks.

Conclusions: The study confirms that each firearm leaves a unique set of firing marks on used ammunition due to both its mechanical construction and wear profile. These marks are significantly influenced by internal ballistic parameters, especially chamber pressure. The findings support the use of firing marks as reliable evidence in firearm identification and criminal investigations.

Acknowledgements: Cpt. lect. univ. dr. ing. Haller Laviniu-Octavian.

Keywords: *Ballistic fingerprint, Firing marks, Internal ballistics, Ammunition analysis, Forensic science.*

References:

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9) Interior and Exterior Ballistics Study for the 100mm Model 1977 Anti-Tank Gun

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Introduction: This study aims to analyze the key factors influencing the accuracy of the 100mm Model 1977 anti-tank gun. The focus is on interior and exterior ballistics, examining the projectile's movement within the barrel and its trajectory after leaving the muzzle. The research also evaluates how barrel wear and external environmental conditions impact precision.

Methods and Results: To assess these effects, various calculation models were considered:

- **Empirical Models:** Based on experimental data and simplified equations;
- **Semi-Empirical Models:** Incorporating both theoretical principles and experimental validation;
- **Analytical Models:** Utilizing thermodynamic and fluid dynamics equations to predict projectile behavior.

For interior ballistics, simulations indicate that increased chamber volume can reduce projectile velocity, affecting accuracy. In exterior ballistics, factors such as wind speed, air temperature, and atmospheric pressure contribute to deviations in projectile trajectory.

Conclusions: The study highlights the importance of maintaining barrel integrity and optimizing firing conditions to ensure precision. Implementing advanced monitoring systems for barrel wear and environmental adjustments can significantly enhance the performance of the 100mm Model 1977 anti-tank gun.

Keywords: *Interior Ballistics, Exterior Ballistics, Anti-Tank Gun, Projectile Accuracy, Barrel Wear.*

References:

- [1] M. Cvetković, Internal ballistics;
[2] T. Vasile, Balistica interioara a gurilor de foc;
[3] Ballistics Theory Design of Guns and Ammunition, Taylor, 2007.

10) CAD/CAE Models for Firearm Mechanisms

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Introduction: This paper presents the digital reconstruction of a technical mechanism through a parametric 3D model developed using CAD tools. The modeling process focuses on reproducing the internal geometry and functional interfaces of the main components, ensuring mechanical consistency and virtual operability. This virtual representation allows for enhanced understanding of system behavior, supports preliminary validation of functional sequences, and provides a platform for further simulation and optimization tasks.

Methods and Results: The model was created in SolidWorks, focusing on the primary moving components. The assembly was developed using appropriate geometric constraints, ensuring the accurate alignment and interaction of parts during motion. A motion study simulating the reload cycle was prepared, capturing the movement of components driven by various internal forces characteristic to the operating mechanism. The digital representation



allows for the analysis of internal motion sequences and the study of how mechanical parts interact during the weapon's operation. This approach is particularly relevant in the context of firearm systems, where safety, reliability, and performance must be assessed early in the design process.

Conclusions: The development of virtual models highlights the relevance of CAD/CAE tools in understanding design logic, internal operation, and the kinematic behavior of firearm mechanisms. Such models can support optimization, modernization, or integration into complex platforms, while also enabling scenario-based analysis and engineering validation without the need for physical prototypes.

Acknowledgements: Col. prof. univ. dr. ing. Marius-Valeriu CÎRMACI-MATEI.

Keywords: *CAD Modeling, Mechanical Systems, Firearm Mechanisms, Virtual Simulation, CAE Tools, Motion Study.*

References:

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11) Multiple Launcher for 122 mm Unguided Rocket Projectiles

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Introduction: This paper is based on the research I have conducted so far as part of my bachelor's thesis. As the title suggests, I will present the design and mechanisms of a 122 mm caliber unguided rocket launcher. I will also describe its operating principles.

Methods and Results: The 122 mm unguided rocket launcher is a versatile weapon system designed to provide close air support and rapid strike capabilities against ground targets. This type of launcher can be adapted for mounting on modern aerial platforms such as the F-16 fighter jet or the IAR-330 Puma SOCAT attack helicopter, thus enhancing the effectiveness and operational range of these aircraft in both offensive and defensive missions.

Its adaptability and firepower make it ideal for rapid response missions. When paired with modern aircraft, it ensures effective engagement of enemy ground targets.

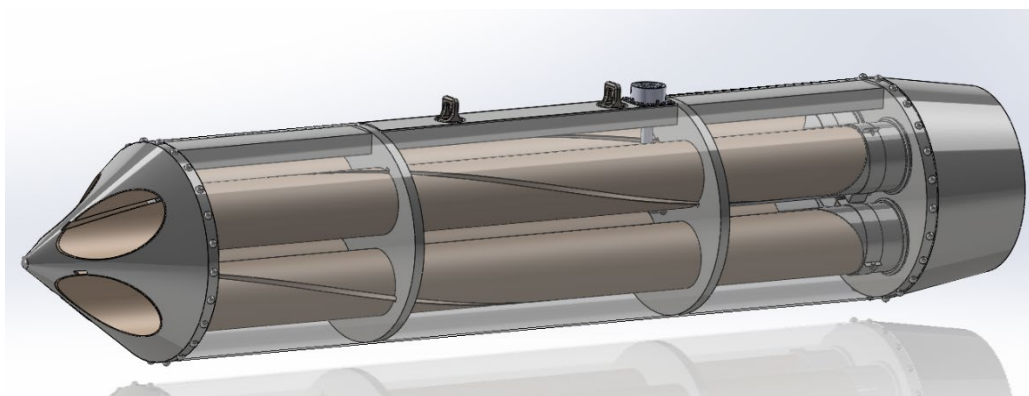


Fig. 1: Multiple launcher for 122 mm unguided rocket projectiles

Built from materials resistant to high temperatures and mechanical stress, the launcher is designed to carry and fire multiple rockets in a short period of time. The rockets used are



typically of the HE (high-explosive) or HEAT (high-explosive anti-tank) type, offering high penetration and destructive capability against armored or fortified targets.

Conclusions: Integration of this system on the F-16 or IAR-330 is achieved through standardized hardpoints, and the launcher is controlled via the aircraft's weapon system. Due to its simplicity and effectiveness, this type of launcher remains a reliable solution for tactical air support missions, including neutralizing enemy positions, destroying armored vehicles, or suppressing enemy fire.

Keywords: *armament, rockets, launcher, unguided, close air support, F-16.*

12) Studies on the Stability of a Large-Caliber Self-Propelled Armament System

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Introduction: Modern self-propelled artillery systems rely heavily on their ability to maintain firing stability to ensure precision, crew safety, and overall effectiveness. This research focuses on the Romanian TR-85M1 tank and its integrated 100 mm gun system, evaluating the mechanical and dynamic behavior during firing. A comparative overview with international systems—such as the Leopard 2 (Germany), M1 Abrams (USA), and K9 Thunder (South Korea)—highlights both the strengths and development areas of Romanian engineering.[1]

Methods and Results: The TR-85M1 is equipped with a rifled 100 mm gun, capable of direct and indirect fire, supported by a recoil absorption system, monobloc barrel, vertical wedge breech, fume extractor, and muzzle brake. Its performance is complemented by a semi-automatic loading mechanism and a modern fire control system, ensuring effective combat operation under variable conditions. The gun system uses several projectile types, including high-explosive, armor-piercing, and training rounds, with muzzle velocities ranging from 600 to 900 m/s.

From a stability standpoint, the study delves into the longitudinal, transverse, and dynamic behaviors during firing. Theoretical modeling and performance equations assess recoil effects, oscillation patterns, and inertial forces acting on both the barrel and vehicle chassis. Key indicators such as recoil impulse, angular deviation, oscillation damping, and terrain inclination limits were analyzed.

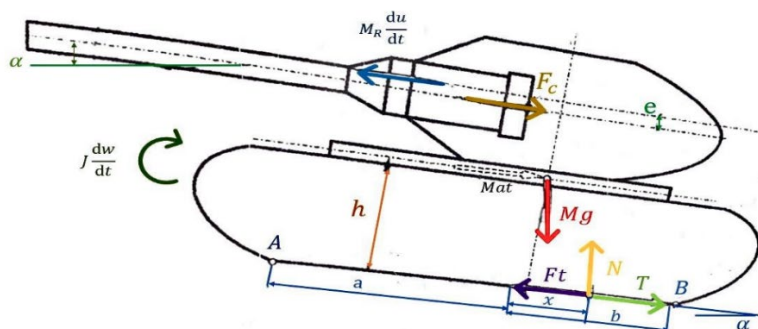


Fig. 1: Schematic representation of the forces acting on a self-propelled gun during recoil while firing longitudinally in motion [2]

The TR-85M1 demonstrates sufficient static stability, supported by hydropneumatic suspension and robust chassis architecture. However, dynamic stability—particularly under continuous fire or uneven terrain—reveals areas where improved damping and advanced recoil



systems (seen in the K9 Thunder or Leopard 2) could enhance performance. The analysis also covers the concept of double recoil, which is present due to unblocked suspension systems during firing. Oscillations transmitted through the turret structure and firing mechanisms can affect long-term mechanical integrity and firing accuracy if not adequately managed. [1] [2]

Conclusions: The TR-85M1's main gun offers a functional balance between firepower and recoil management. While the platform ensures basic stability under combat conditions, further improvements in dynamic control—rigidization, suspension locking systems, and advanced stabilization—would bring it closer to modern standards observed in Western systems. The findings emphasize the importance of structural rigidity, precise recoil absorption, and damping calibration for optimizing both safety and accuracy.

Acknowledgements: Scientific Coordinator, Col. Prof. Univ. Dr. Ing. Pamfil Șomoiaș.

Keywords: *Gun stability, recoil dynamics, TR-85M1, 100 mm tank gun, dynamic oscillation, self-propelled artillery.*

References:

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13) Multifunctional fuze for a cluster bomb

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Introduction: This paper is based on the title of my bachelor's thesis. I am going to present a constructive solution for an electric fuze intended to equip a cluster bomb with sequential dispersal.

An analysis of recent military conflicts highlights the increasing use of bombs and submunition dispensers with combined or specialized effects. Although submunitions offer reduced precision, this is offset by their wide dispersal area.

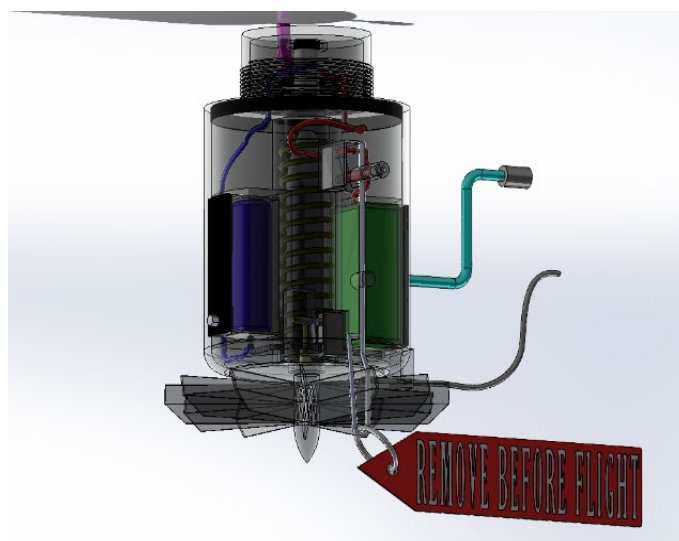


Fig. 1: Multifunctional fuze



Methods and Results: The implementation of programmable sequential dispersal patterns for submunitions necessitates a fundamentally redesigned fuze architecture that differs significantly from conventional solutions. The system comprises two principal components: the main fuze body and the arming vane mechanism.

The fuze body serves as the central housing unit integrating all safety systems, control electronics, and interface connections, while the arming vane provides the primary safety function. System operation relies on two critical subsystems: an electronic control module and a dedicated power supply.

The electronic module generates precisely timed firing pulses that initiate the sequential dispersal of submunition packages through electric matchheads, which convert electrical energy to thermal activation energy according to pre-programmed sequences established during mission planning. The power supply ensures autonomous operation after the dispenser achieves safe separation from the delivery platform.

Conclusions: These subsystems interface through multiple redundant safety circuits and high-reliability connectors designed to military specifications for fail-safe performance. The entire architecture represents a significant advancement in controlled submunition deployment technology, offering enhanced reliability and mission flexibility compared to previous generation systems.

Keywords: *fuze, cluster bomb, submunition, sequential dispersal.*

14) Evaluation of the Dispersal Characteristics of Aviation Dispensers with Submunitions

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Introduction: This paper presents a comprehensive study on the dynamic behavior of a submunition dispenser system during its deployment phase, with a particular focus on the influence of aerodynamic forces and inertia on its motion.

Methods and Results: A mathematical model has been developed to capture both translational and rotational dynamics, aiming to replicate real-world conditions as closely as possible. A statistical approach was employed to analyze the system's response under varying initial parameters and external conditions, providing insights into stability, performance variability, and sensitivity to design choices.

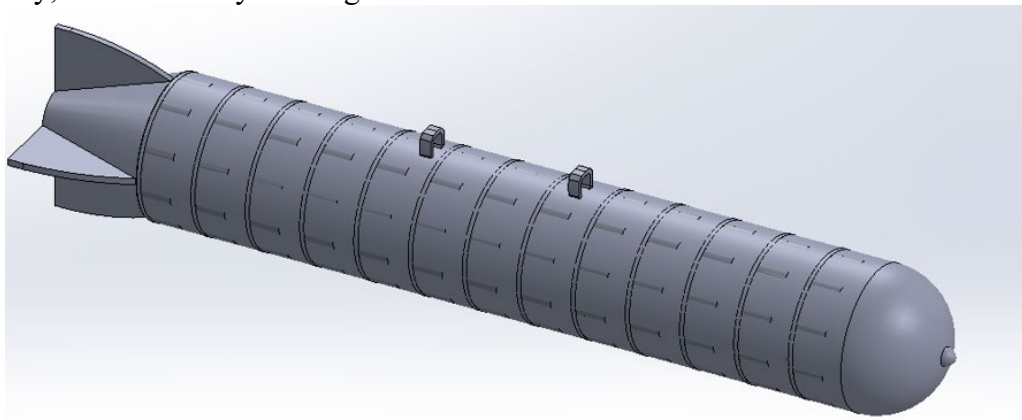


Fig.1: Aerial dispenser



Special attention is given to the ejection model, as it represents a critical parameter that directly affects the dispersion pattern and efficiency of submunition deployment.

Numerical simulations were carried out in MATLAB, which served as the primary platform for solving the system's differential equations and visualizing the time evolution of key parameters.

Conclusions: The results align with theoretical expectations and emphasize the importance of accurate modeling in achieving reliable and predictable dispersion behavior. This work not only deepens the understanding of the complex dynamics involved but also provides a solid foundation for the optimization of dispenser systems through data-driven and statistically-informed design strategies.

Keywords: *Submunition, dispenser systems, statistical approach, ejection model, dispersion analysis, MATLAB simulations.*

15) Integrated System Based on Night Vision/Observation Equipment

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Introduction: Night vision and targeting equipment are essential components in modern surveillance and fire control systems, playing a critical role in military applications. The development of these systems has focused on improving accuracy and reliability in detecting targets under low-light conditions. Modern systems integrate thermal imaging sensors to provide a clear battlefield image, enabling target identification, tracking, and engagement with high precision.

Methods and Results: The research focuses on infrared imaging technologies, selecting an uncooled thermal detector operating in the long-wave infrared (LWIR) spectral band, 8–12 μm . A microbolometric focal plane array (FPA) with a resolution of 640×512 pixels was chosen due to its compactness and compatibility with third-generation thermal imaging standards.

In this study, the design and analysis of the night vision/observation system were conducted using **Zemax OpticStudio**, an advanced platform for optical system modeling and optimization. Through Zemax, optical paths and system performance were simulated, focusing on key parameters such as field of view, infrared radiation transmission, and optical aberration correction. The optical configuration was optimized to maximize image resolution and minimize radiation losses. The designed objective has a focal length of 100 mm and an entrance pupil diameter that ensures an angular field of view sufficient for both reconnaissance and targeting functions. Materials like germanium and zinc sulfide (ZnS) were selected due to their high transmittance in the LWIR range. The optical layout was carefully optimized to reduce aberrations, maintain high modulation transfer function (MTF) performance, and meet the resolution demands imposed by the sensor. Spot diagrams and field curvature were analyzed to ensure that image quality remains consistent across the entire field.

Conclusions: Implementing an integrated night vision/observation system, optimized through advanced optical analysis in Zemax OpticStudio, provides a significant strategic advantage in military applications. By utilizing an efficient optical design and modern infrared detection technologies, this system ensures superior target observation and engagement capabilities. The obtained results confirm the importance of using optical simulation software in the design of optoelectronic systems, allowing performance optimization before physical implementation.



Acknowledgements: I would like to thank my scientific coordinator, Col. (r) Prof. Univ. Dr. Ing. Ioan Vedinaș, for his guidance and support throughout the project.

Keywords: *Night vision, thermal imaging, optoelectronics, Zemax OpticStudio.*

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16) Impact Dynamics and Armor Penetration of Modern Projectiles:

A Comparative Study

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Introduction: The effectiveness of modern armored vehicles depends significantly on their ability to withstand kinetic energy penetrators. This study examines the penetration characteristics of four types of projectiles—30mm M928 APFSDS-T, 90mm M690 APFSDS-T, 40mm CTA APFSDS-T, and 12.7mm M2 Ball—at various firing distances (0m, 500m, 1000m, 1500m, and 2000m). The primary objective is to analyze impact pressure, penetration depth, and required armor thickness across different materials, including mild steel, Rolled Homogeneous Armor (RHA), and aluminum alloy (Al5083). Additionally, the study assesses the tactical implications of replacing legacy armored vehicles with modern alternatives.

Methods and Results: The analysis begins by calculating the dynamic pressure generated upon impact and comparing it with the Hugoniot Elastic Limit (HEL) of the target materials. This approach ensures a more accurate assessment of material response to high-velocity impacts, as HEL provides a better measure of resistance to penetration than conventional yield strength.

Next, the absolute and normalized penetration depths are determined using empirical models, considering factors such as entrance effects and potential cavitation. The minimum required armor thickness to stop each projectile is calculated using the Recht and Ipson models, assuming a rigid penetrator. Additionally, penetration predictions based on the AR and AT models are compared with initial results to validate the findings and highlight model limitations.

The results indicate significant differences in penetration capabilities depending on projectile type, impact velocity, and target material. The study confirms that higher velocity, armor-piercing fin-stabilized discarding sabot (APFSDS-T) projectiles exhibit superior penetration performance, while material properties play a crucial role in determining armor effectiveness.

Conclusions: This research underscores the necessity of using HEL rather than yield strength when evaluating armor penetration resistance. The findings provide valuable insights for armor design and military vehicle survivability, enabling better protection strategies against modern kinetic threats. The comparative assessment of legacy and modern vehicles highlights the benefits of advanced armor configurations in enhancing battlefield survivability, particularly against high-velocity penetrators. These insights support informed decision-making in vehicle modernization programs and armor material selection.

Acknowledgements: Cpt.lect.univ.dr.ing. Cîrneanu Andrada-Livia.

Keywords: *Kinetic impact, armor penetration, high-velocity projectiles, ballistic protection, penetration modeling, military vehicles.*



17) Development of an Unguided 122 mm Rocket

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Introduction: This paper presents the design and development of an unguided 122 mm rocket, created as part of my bachelor's thesis, specifically intended for *air-to-surface deployment*. Unlike traditional ground-launched artillery rockets, this model has been engineered for *aerial launch* from fixed-wing aircraft or rotary platforms, addressing the specific aerodynamic and operational challenges associated with airborne release.

Methods and Results: The rocket is equipped with a *prefragmented high-explosive (HE) warhead*, designed to deliver lethal effects against unarmored targets, light structures, and enemy personnel. The warhead contains approximately 6.5 kg of cast TNT and is initiated via a point-detonating impact fuse. The casing incorporates *preformed steel fragments*, ensuring uniform dispersion upon detonation and maximizing lethality within an effective radius of around 12 meters.



Fig. 1: 122 mm air-to-surface unguided rocket with prefragmented HE warhead

To ensure aerial compatibility, the rocket was developed with a fixed fin stabilization system optimized for *high-speed aerial release* and operation across a range of angles of attack. The propulsion system consists of a single-stage solid-fuel rocket motor capable of delivering sufficient thrust for short-to-medium range strikes (approximately 5–10 km), depending on launch parameters.

Conclusions: In conclusion, this project outlines the key phases in the development of a 122 mm unguided rocket adapted for *air-to-surface missions*, with an emphasis on the efficiency of the prefragmented warhead, aerodynamic behavior in flight, and integration with current aerial weapon systems.

Keywords: *air-to-surface rocket, unguided munition, prefragmented warhead, solid propulsion, aerial launch, aerodynamic stability, aircraft armament.*

18) Fusion of Night and Thermal Images

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Introduction: Night vision and thermal images are extensively used in military operations, as they help in mission planning and execution tasks. Image fusion effectively combines information present in each type of images.

Methods and Results: This research explored two wavelet-based image fusion approaches for night vision and thermal images namely wavelet transform fusion and region-based fusion. Morphological methods designed to improve the image segmentation step were considered to improve image contrast and a global image quality index was applied to



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investigate the information content improvement resulting from the fusion process. Finally, a MATLAB-based graphical user interface was designed to assist the user in evaluating the benefits of the fusion process. Results showed the selection process is able to narrow to the best fused image with a satisfactory accuracy.

Conclusions: We conducted this research to enhance the effectiveness of night vision and thermal imaging in military operations. By exploring wavelet-based fusion techniques, we aimed to improve image clarity, contrast, and information retention, ultimately aiding mission planning and execution. The development of a MATLAB-based interface further ensured practical usability, allowing users to assess and select the best-fused image efficiently.

Acknowledgements: Col. Prof. dr. ing. Vedinaş Ioan.

Keywords: *Image fusion, Night vision, Thermal imaging, Wavelet transform, Military operations.*

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2. ENERGETIC MATERIALS AND AMMUNITION

1) Immediate Detection Methods for Chemical Agents

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Introduction: The rapid detection of chemical agents is crucial for ensuring public safety, military defense, and environmental protection. Various methods have been developed to enable immediate identification of hazardous substances.

Methods and Results: Among the most effective detection techniques are colorimetric sensors, electrochemical detectors, and spectroscopy-based methods. Colorimetric sensors change color upon contact with specific chemicals, providing a quick and cost-effective solution. Electrochemical sensors detect agents through conductivity changes, offering high sensitivity and real-time monitoring. Spectroscopy techniques, such as infrared (IR) and Raman spectroscopy, allow non-contact identification by analyzing molecular signatures. Additionally, portable gas chromatography-mass spectrometry (GC-MS) systems enable precise field analysis. Recent advancements in nanotechnology and artificial intelligence further enhance detection accuracy and response speed.

Conclusions: The integration of these detection methods into wearable devices and autonomous drones enhances rapid response capabilities. Effective deployment is essential for first responders, military personnel, and industrial safety teams to mitigate chemical threats efficiently.

Keywords: *Chemical detection, sensors, spectroscopy, electrochemical methods, public safety, nanotechnology.*

2) Research on the Use of Perforated Plates as Applique Armour for Armoured Vehicles

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Introduction: Applique add-on armour represents an attractive method to increase the passive protection of armoured vehicles. A major concern remains the additional weight, which may overload automotive components, compromising mobility and reliability. Hence, these armour types must exhibit superior mass efficiency compared to conventional steel or aluminium alloy structures. Since armoured vehicles are often exposed to automatic weapons fire, multi-hit resistance becomes essential. However, brittle materials such as ceramics—despite their popularity—show poor performance under such conditions. Brittle fractures have also been observed in hard aluminium and steel plates under similar impact scenarios.

Methods and Results: To address the challenge of brittle fracture and ensure improved multi-hit performance, the use of perforated plates is investigated. These plates show potential due to their ductility and crack propagation behavior, which often leaves larger intact areas post-impact. Additionally, the geometry of the perforated plate introduces bending stresses in the projectile's core—typically made from hardened steel—potentially causing it to fracture and reducing its penetration capability. The study evaluates the influence of geometrical factors (thickness, hole diameter, spacing), mounting configurations (rigid, angled, suspended), and material properties (strength, ductility), with a focus on commercially available steels. This



approach offers a viable alternative when specialized armour steel is unavailable. Unlike prior studies, this paper serves as a practical guide for optimizing unhomogenous armour systems.

Conclusions: Perforated plates offer a promising solution for lightweight, multi-hit-resistant applique armour. Their mechanical behavior and energy dissipation mechanisms suggest improved ballistic efficiency, particularly in conditions where resource availability and operational mobility are critical factors.

Acknowledgements: Col.prof.univ.dr.ing. Rotariu Adrian.

Keywords: *applique armour, perforated plate, ballistic protection, multi-hit resistance, high-strength steel.*

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3) Design of a Pyrotechnic Flashbang System Attached to a Drone

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Introduction: The increasing need for non-lethal intervention methods in public disturbance scenarios has led to the development of innovative technologies for law enforcement and security forces. This paper explores the design of a pyrotechnic flashbang system integrated into a drone, providing an effective and remotely deployable solution for dispersing crowds and neutralizing threats.

Methods and Results: The system aims to enhance tactical flexibility and operational safety by allowing intervention forces to deploy flashbang munitions from an aerial platform, minimizing direct confrontation and reducing risks to both officers and civilians. The design includes targeting accuracy, deployment mechanisms, and safety protocols to ensure controlled and effective operation.

Conclusions: This research highlights the potential of drone-based intervention tools in modern security operations, presenting a scalable, adaptable, and effective alternative to traditional riot control methods. The findings contribute to the advancement of drone technology in law enforcement, emphasizing efficiency, precision, and reduced collateral damage in critical intervention scenarios.

Acknowledgements: Cpt.conf.univ.dr.ing.Pulpea Bogdan.

Keywords: *drone, flashbang, pyrotechnic, law enforcement, riot control.*

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4) Unconventional Systems on IEDs

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Introduction: Improvised Explosive Devices (IEDs) represent one of the most significant asymmetric threats of the 21st century. Widely used in terrorist attacks, irregular armed conflicts, and sabotage operations, IEDs are explosive systems assembled from commercial or repurposed military components. They are specifically designed to inflict destruction, cause loss of life, and induce psychological destabilization. Unlike conventional munitions, IEDs are typically assembled and triggered using unconventional means, such as pressure switches, motion sensors, remote control devices, mobile phones, or improvised timers. This versatility, combined with ease of assembly and concealment, makes them particularly dangerous and difficult to detect.

Methods and Results: Recent statistics and international reports indicate that IEDs are the leading cause of fatalities in terrorist attacks, responsible for a significant proportion of casualties in conflict zones across the Middle East, Africa, and South Asia. From a defense and security perspective, understanding the operating principles and initiation mechanisms of these devices is essential for developing effective countermeasures, early detection systems, and neutralization procedures.

The main objective of this paper is to design and test several constructive solutions for IED initiation systems, focusing on the technical and functional diversity of these mechanisms. The study explores the particular characteristics of each type of initiation method analyzed—ranging from radio-controlled triggers to systems activated by shock, pressure, or timed delay. Conceptual models and functional prototypes were developed and tested under controlled laboratory conditions, with emphasis on reliability, reaction time, sensitivity to accidental activation, and technical complexity.

Testing was conducted in a safe environment, adhering to safety standards for working with pyrotechnic materials or their simulated equivalents. The results provide a clear perspective on the advantages and limitations of each initiation system analyzed and can serve both educational purposes and professional applications in the fields of defense, national security, and civil protection.

This paper contributes to a deeper understanding of IED systems and offers a technical framework for developing new training, simulation, and mitigation approaches against this modern threat. The full results of the study are presented in the following chapters.

Conclusions: The study of Improvised Explosive Device (IED) initiation systems is not only a technical challenge but also a strategic necessity in modern asymmetric warfare and counter-terrorism operations. The insights gained through the design and controlled testing of various initiation mechanisms offer valuable knowledge for both preventive and responsive measures. By analyzing the functional characteristics and vulnerabilities of different initiation methods, this work lays the groundwork for improved detection, training, and neutralization techniques. Ultimately, the findings presented contribute to enhancing operational safety, informing tactical decision-making, and supporting the continuous development of technological solutions aimed at mitigating the impact of IED threats.

Acknowledgements: Col.Prof.Dr.Ing Liviu-Cristian MATACHE.

Keywords: *Improvised Explosive Devices (IEDs), Initiation Systems, Asymmetric Threats, Counter-Terrorism, Prototype Testing.*

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5) Identification of Chemical Warfare Agents in Biomedical Samples

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Introduction: This paper focuses on the analysis and detection of exposure to chemical warfare agents from biomedical blood and urine samples, with an emphasis on Novichok agents. The paper was developed following participation in a biological test aimed at identifying certain chemical warfare agents to which the population was exposed in a given scenario.

Methods and Results: Various methods are used for identification depending on the biomarkers targeted, namely different types of preparation of biomedical samples specific to the analytical technique used, such as: separation by gas chromatography (GC) or liquid chromatography (LC) and detection by tandem mass spectrometry (MS-MS). The results obtained consist of identifying the targeted compounds whose concentrations are particularly low, in the order of ppm (parts per million).

Conclusions: In conclusion, the problem within the given scenario was successfully resolved by identifying the chemical warfare agents to which the population was exposed. It was proven that the exposed individuals were primarily intoxicated with Novichok agents (A-230 and A-234) following a terrorist attack, and thus, specific measures were taken to eliminate any type of interstate conflict.

Acknowledgements: Cpt.conf.univ.dr.ing. Gabriela TOADER.

Keywords: *chemical, agents, Novichok, biomedical, blood, urine.*

6) Interior Ballistics Analysis of Multi-Perforated Grains Using the "Iymed" Method

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Introduction: This paper investigates the interior ballistic behavior of a propellant with a progressive burn profile. The main objective is to model the combustion process for a grain that undergoes fragmentation during its burn cycle.

Methods and Results: A two-phase burn model is implemented, where the combustion characteristics such as burned fraction, relative web thickness, and form function coefficients are analyzed separately before and after the onset of fragmentation. The simplified *Iymed* method is employed to derive analytical expressions that describe the evolution of gas pressure and projectile acceleration during each combustion phase.

The developed model was applied to a 155 mm howitzer using a propelling charge composed of seven-perforation elements made from JA2. The calculation results were compared with data obtained from live-fire tests.

Conclusions: As a conclusion, this approach enables an accurate representation of grain burning behavior and supports the development of predictive models for high-efficiency artillery propellants charges as long as is the fastest way to solve the interior ballistic problems.

Acknowledgements: Col.Prof.Univ.Dr.Ing. Adrian ROTARIU.

Keywords: *Ballistics, Propellant, Grain, Combustion.*

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7) Theoretical and Experimental Study on the Initiation of High Explosives by Impact

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Introduction: This paper investigates the behavior of various types of explosives subjected to high-energy jet and kinetic projectile impacts, aiming to assess their sensitivity, detonation thresholds, and overall stability. The research focuses on unconventional initiation methods, including high-pressure water jets, kinetic bolts, and shaped charges (cumulative jets), which are used to trigger explosive reactions in controlled scenarios. Such methods are relevant in military applications, explosive ordnance disposal (EOD), and safety testing of energetic materials.

Methods and Results: A series of experimental tests were conducted in a live-fire testing range, where selected explosives were exposed to both liquid and solid high-velocity impactors. These included high-pressure water jets, steel bolts, and shaped charge jets. The behavior of the explosives was analyzed using shock wave theory and detonation physics (detonics), with a particular focus on pressure front propagation, initiation delays, and energy distribution within the target material.

Using theoretical modeling based on shock dynamics and detonics equations, the pressure and temperature conditions during impact were estimated and correlated with observed detonation or failure to initiate. This allowed for the comparison between predicted theoretical thresholds and experimental outcomes, highlighting both consistent patterns and deviations.

The results contribute to a deeper understanding of impact-induced initiation phenomena in energetic materials. They offer valuable insight into the design of safer explosive systems, controlled neutralization methods, and the development of predictive models for non-conventional initiation scenarios. The combined theoretical and experimental approach reinforces the applicability of shock wave analysis in assessing explosive response to high-energy mechanical stimulation.

Conclusions: The conducted study highlights the critical role of impact dynamics and shock-induced initiation in the behavior of explosives subjected to unconventional triggering methods. By combining theoretical analysis with experimental testing, the research validates the applicability of detonics and shock wave theory in predicting initiation thresholds and explosive responses. The observed correlation between kinetic impacts and detonation behavior provides a foundation for developing safer handling protocols and optimized initiation systems. Furthermore, the insights gained can support the advancement of simulation models and diagnostic tools used in both defense and civil protection domains. Ultimately, this work enhances our understanding of the complex mechanisms governing non-conventional explosive initiation and offers practical guidelines for future technological applications.

Acknowledgements: col. prof. dr. ing. Liviu Cristian MATACHE.

Keywords: *Explosives, Shock Wave Theory, Detonics, Impact Initiation, Shaped Charges.*

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8) Composite Materials for Radiation Shielding

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Introduction: Radiation protection is a major challenge in various fields, including the aerospace, medical, nuclear, and scientific research industries. Uncontrolled exposure to high-energy ionizing radiation, such as X-rays, gamma rays, neutrons, or cosmic radiation, can have harmful effects on human health, leading to severe conditions such as carcinogenesis, cellular mutations, and organ failure. Traditionally, researchers have explored the use of heavy metals or their composites for radiation shielding. However, heavy metal-based protective equipment is often bulky and generates more penetrating secondary radiation, necessitating an additional protective layer, which increases both cost and weight.

Methods and Results: In this context, polymer matrix composites (PMCs) have been identified as promising solutions for developing effective, lightweight, and flexible shielding structures capable of attenuating ionizing and space radiation. This paper focuses on analyzing the use of these materials for radiation shielding, including protection against X-rays, gamma rays, neutrons, and cosmic radiation. The physical and chemical properties of the polymer matrix and reinforcement materials, such as carbon fibers, glass fibers, and specialized additives, are discussed. Additionally, different types of radiation and the mechanisms by which they can be absorbed or reflected by composite materials are presented.

A key aspect of this research is the evaluation of the performance of these composites in radiation protection, through the analysis of experimental studies and theoretical models developed to quantify their efficiency. Furthermore, the paper explores the potential applications of composite materials in the construction of protective equipment, particularly in aerospace and medical fields, where radiation shielding is crucial.

Conclusions: The study results suggest that polymer matrix composites represent an efficient and innovative solution for radiation protection, offering significant advantages in terms of reduced weight, flexibility, and production costs. However, to become a widely viable option, further improvements are needed regarding their performance, especially under extreme temperature conditions and intense radiation exposure. This paper contributes to the understanding of the role of composite materials in radiation shielding, providing a solid foundation for future research and developments in this innovative field.

Keywords: *radiation shielding, polymer composites, ionizing radiation, aerospace protection, lightweight materials.*

9) Hydrogels for CBRNE applications

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Introduction: MXenes, a class of two-dimensional transition metal carbides and nitrides, have gained significant attention due to their excellent electrical conductivity, mechanical strength, and tunable surface chemistry. This study explores the synthesis, characterization, and application of MXene-functionalized hydrogels for CBRNE defense.





Initially, MXenes—materials derived from selectively etched MAX phases—are chemically treated with hydrofluoric acid to remove interlayer aluminum and form conductive, high-surface-area flakes. Subsequently, a critical step involves functionalizing these MXene flakes using 3-Aminopropyltriethoxysilane (APTES), (3-Mercaptopropyl)trimethoxysilane (MPTMS), and 3-Glycidoxypropyltrimethoxysilane (GPTMS), as well as silver nanoparticles. The core hydrogel formulation relies on polyvinyl alcohol (PVA), hydroxyethyl cellulose (HEC), and various acrylic monomers to create a crosslinked, water-retentive network. A photoinitiator-based curing process is employed to shape and stabilize the hydrogel within custom molds, ensuring uniform structure and tailored mechanical properties. The incorporation of MXene flakes improves mechanical strength, electrical conductivity, and thermal stability, while the optional addition of silver nitrate confers potential antimicrobial effects. Characterization encompasses spectral (FTIR), microscopic (SEM), and mechanical (tensile, compression, shear) analyses, focusing on how functionalization drives enhanced rigidity, swelling behavior, and overall durability. By integrating functionalized MXenes into polymeric hydrogels, this work delivers a robust platform for advanced protection and decontamination materials suited to critical CBRNE scenarios.

Methods and Results: $\text{Mo}_2\text{Ti}_2\text{AlC}_3$ precursor was etched with HF to produce MXenes, then functionalized using (3-Mercaptopropyl)trimethoxysilane, 3-Glycidoxypropyltrimethoxysilane, or 3-Aminopropyltriethoxysilane. These modified flakes were dispersed in a polyvinyl alcohol/hydroxyethylcellulose solution with acrylic monomers, sonicated, degassed, and UV-cured into hydrogels (some doped with silver nitrate). SEM imaging was used to examine the morphological transformations of MXenes after HF etching and silane functionalization, revealing more pronounced layer delamination and uniform dispersion within the hydrogel network. Meanwhile, FTIR spectra confirmed validating successful surface modification and enhanced potential for crosslinking with the polymer matrix.

Conclusions: Selective etching and silane-based functionalization of MXenes yield hydrogels with stronger, more resilient networks. Epoxy groups greatly enhance mechanical stability, amine-functionalized systems swell rapidly, and silver doping confers promising antimicrobial effects. Overall, these advanced materials show strong potential for CBRNE applications.

Acknowledgements: Conf. dr. ing. Aurel Diacon.

Keywords: *Hydrogel, Mxene, Functionalization, Nanoparticles.*

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10) Low-Toxicity Irritant Tear Gas Munition for Crowd Control

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Introduction: Capsaicin-based lachrymatory ammunition represents a class of non-lethal irritant munitions increasingly employed by law enforcement and military forces worldwide for crowd control and riot suppression. Derived from chili peppers, capsaicin is the





active chemical responsible for the intense irritation and temporary incapacitation experienced upon exposure. Unlike traditional chemical irritants such as CS (2-chlorobenzalmalononitrile) or CN (chloroacetophenone), capsaicin-based ammunition is often perceived as a safer and more environmentally friendly alternative due to its natural origin and biodegradability.

Methods and Results: Upon deployment, capsaicin-based munitions disperse aerosolized particles that interact directly with sensory neurons, particularly affecting the mucous membranes of the eyes, nose, throat, and respiratory tract. This interaction triggers a severe inflammatory response characterized by intense burning sensations, excessive tearing, coughing, respiratory distress, and temporary blindness. These symptoms rapidly incapacitate affected individuals, thereby providing law enforcement agencies with a tactical advantage in restoring public order without causing permanent harm or long-lasting injuries.

Research into capsaicin-based ammunition highlights its effectiveness in diverse operational scenarios, including urban crowd management, hostage situations, and prison riots. The primary advantage of capsaicin ammunition lies in its rapid onset and reversibility, with symptoms typically subsiding within 30 to 60 minutes following exposure and subsequent decontamination. Nevertheless, challenges associated with its usage include potential variability in individual sensitivity, environmental factors affecting aerosol dispersion, and ethical concerns regarding potential misuse and the infliction of unnecessary suffering.

Conclusions: Ongoing advancements in formulation and delivery mechanisms seek to optimize the balance between efficacy and safety, reducing unintended consequences while maximizing tactical effectiveness. Further research continues to evaluate the physiological effects, optimal concentrations, and deployment techniques of capsaicin-based irritants, ensuring alignment with international human rights standards and promoting responsible use in law enforcement operations.

Keywords: *capsaicin ammunition, non-lethal weapons, crowd control, lachrymatory agents, riot suppression.*

11) Analytical Techniques Used to Determine the Characteristics of Energetic Materials

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Introduction: This paper focuses on physico-chemical and explosive characterization of new energetic compounds.

Methods and Results: Energetic materials, including explosives, propellants, and pyrotechnics, require rigorous characterization to ensure performance, stability, and safety. Various analytical techniques are employed to determine their physical, chemical, and thermal properties. Spectroscopic methods such as Fourier Transform Infrared Spectroscopy (FTIR) and Raman Spectroscopy help identify functional groups and molecular structures. Chromatographic techniques, including High-Performance Liquid Chromatography (HPLC) and Gas Chromatography-Mass Spectrometry (GC-MS), are used to analyze composition and detect impurities. Thermal analysis methods like Differential Scanning Calorimetry (DSC), DTA (Differential Thermal Analysis) and Thermogravimetric Analysis (TGA) assess decomposition behavior and stability. Additionally, impact, friction, and electrostatic sensitivity tests evaluate the mechanical and safety characteristics of energetic materials. To examine the surface morphology and microstructure of energetic materials was used SEM (Scanning Electron Microscopy) that can be combined with Energy Dispersive X-ray Spectroscopy (EDS) to analyze the elemental composition of the sample.





Conclusions: In conclusion, the integration of these analytical techniques provides a comprehensive understanding of energetic materials, aiding in their formulation, quality control, and risk assessment.

Acknowledgements: Coordinator teacher: Col.prof.univ.dr.ing. Traian Rotariu.

Keywords: *explosives, analytical techniques, characterization, spectroscopic, chromatographic, thermal.*

12) Characterization and Behavior of Pyrotechnic Formulations in Electrical Initiators

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Introduction: Pyrotechnic mixtures consist of solid fuel and oxidizer components, designed to generate various effects upon ignition, including light, heat, smoke, and sound. The presence of an oxidizer enables combustion independent of atmospheric oxygen. Military specifications categorize these mixtures as substances undergoing controlled combustion, producing heat, noise, or electromagnetic radiation. The verifications will be realized on a few similar models of the NH-PC electric ignition squib, which is designed for equipping the fuze of the 9M37M rocket.

Methods and Results: The purpose of this study is the development and characterization of a few pyrotechnic compositions I'm using as initiators in the ignition squib.(chemical mixture, performance etc. in a generalized way)

As an introduction of my thesis, I will highlight physics aspects that are governing the initiation system, I will detail common phenomena of the pyrotechnic mixtures, and some physics behind it. A basic introduction in initiation systems I find necessary to show as well: Couple electrical initiators and tests governing their performance will be displayed; Details about the pyrotechnic and energetic materials that were used will be also shown. Ultimately, these characterized properties will be used to assess the suitability and potential performance of the developed pyrotechnic compositions within specific ignition squib applications.

I will analyze combustion properties, the heat of combustion (Q_c) and specific volume (V_s) (which were experimentally determined). An adiabatic calorimeter was used for Q_c , and a gasometer for V_s . Duplicate tests, each using approximately 2 grams of the composition, were performed under vacuum conditions for each measurement.

The tests were done according to STANAG 4515, STANAG 4556, STANAG 4487.

Conclusions: By testing these key parameters, adequate and safe usage of the initiators will be provided (storage, usage, firing).

Acknowledgements: Cpt.Conf.Univ.dr.ing. Pulpea Bogdan.

Keywords: *pyrotechnic compositions, ignition squib, initiators, combustion properties, military ordnance.*

References:

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- [2] STANAG 4515(2); *Explosives, Thermal Analysis Using Differential Thermal Analysis (DTA), Differential Scanning Calorimetry (DSC), Heat Flow Calorimetry (HFC) and Thermogravimetric Analysis (TGA)*; NATO Standardization Office: Brussels, Belgium, 2015;
- [3] STANAG 4556; Ed. 1, *Explosives, Vacuum Stability Tests*. NATO Standardization Office: Brussels, Belgium, 1999;
- [4] Seung-Gyo Jang, Dong-Seong Kim: *Understanding aging characteristics of a pyrotechnic initiator through performance modeling in Closed Bomb Tests* (May 2024);
- [5] Bisheng Tan, Zhipeng Li, Xudong Guo, Jingming Li, Yong Han Xinping Long: *Insight into electrostatic initiation of nitramine explosives* (2017).



3. CONSTRUCTIONS AND FORTIFICATIONS

1) Considerations Regarding the Design of a Building for the Military High School in Constanța

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Introduction: In this presentation I will present the calculation stages of a school building that is provided with a library, a study room and laboratories at ground level and 4, respectively 6 floors for classrooms.

Methods and Results: The design of the high school building follows structural engineering principles to ensure safety, functionality, and durability. The building consists of four floors in the middle and six floors on the sides, with a reinforced concrete structure, including walls, columns, beams, and slabs designed to withstand both vertical and lateral loads. The ground floor houses essential facilities such as a library and laboratories, providing a dedicated space for research and practical learning. The upper floors consist of classrooms, each designed to accommodate an optimal number of students while ensuring proper ventilation, natural lighting, and accessibility.

The structural calculations included load assessments based on national building codes, seismic analysis to ensure stability, and material optimization to balance cost and performance. A combination of reinforced concrete shear walls and moment-resisting frames was used to enhance seismic resilience. The foundations were designed considering soil conditions to prevent settlement issues. The architectural layout ensures efficient circulation and emergency evacuation routes.

I used specific engineering calculation programs such as ETABS, XTRACT, AUTOCAD, but also EXCEL. I started by pre-dimensioning the structural elements, then calculating the rest of the elements.

Conclusions: In conclusion, the completion of this construction will solve the problem of the shortage of classroom spaces, dedicated research spaces and space for study.

Acknowledgements: Lect.univ.dr.ing. MURZEA Patricia.

Keywords: *High-school, , library, classrooms, laboratories.*

2) The Design of an Apartment Building

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Introduction: This paper presents a detailed approach to the structural design of a residential building with a height regime of Basement+Ground Floor +5 Floors, located in Ramnicu Sarat , Buzau County.

Methods and Results: The structural system consists of reinforced concrete walls and frames , the enclosures and partitions are made of autoclaved aerated concrete. First, i defined the dimensions of the structure and developed an arhitectural plan that meets the project requirements. The building includes four apartments with two rooms and four apartments with three rooms on each floor. Then, i predimensioned the structural elements and carried out



resistance and stability checks. All calculations and designs were performed in accordance with the applicable norms and regulations.

The programs used in the development of this project were the following:

Etabs (structural program which provides results in terms of modal response, stresses and deformations), Matchad (mathematical engineering software, which facilitated calculations), AutoCad (a CAD program used for 2D and 3D construction plan design, where some architectural and structural drawings were created), Xtract (software for sectional analysis, used to extract the specific equation for calculating the moment capacity in the M-P curve for wall calculations) and Excel (for data centralization and processing).

Conclusions: In conclusion, the purpose of this presentation is to highlight the structural design process and how it aligns with the architectural requirements.

Acknowledgements: Lect. univ. dr. ing. Murzea Patricia.

Keywords: concrete, structural elements, architectural plan, programs.

3) Designing a Storage Warehouse with a Minimum Plan Dimension of 25x60 m, Located in the Town of Târgu-Jiu

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Introduction: Urban warfare poses unique challenges for soldiers, including confined spaces, limited visibility, dense civilian populations, and extreme stress. The psychophysiological state of soldiers is a critical factor in their ability to perform effectively in these challenging conditions. This thesis proposes new concepts for urban warfare support systems that enhance situational awareness, reduce risk of casualties, and increase operational effectiveness, with a particular focus on monitoring and supporting the soldier's psychophysiological state.

Methods and Results: The project's plan dimensions are approximately 25x60 meters, providing the necessary space for efficient storage operations. The design includes essential related areas such as storage rooms, access zones, and support spaces to ensure smooth logistics and functionality. The layout is optimized for maximum storage capacity while maintaining compliance with local regulations.

The upper structure will be made of precast concrete columns, onto which the following metal trusses will be attached: upper sole with HEA300 profiles, lower sole with HEA280 and, uprights with Tp 80x80x5, profiles, and diagonals with dimensions and profiles of Tp 180x10, Tp 80x80x8, and Tp 140x140x6.3. To stiffen the assembly, TUBO-type bracing will be used. The metal elements will be made from OL 44 (S275) steel profiles. The perimeter closure of the structure is made with sandwich panels. The roof structure was constructed in two pitches.

Unlike a concrete structure, the pressure is applied locally, which is why isolated foundations are sufficient.

Conclusions: In conclusion, the solutions adopted aim to achieve a functional and efficient project that meets the requirements of the National Administration of Penitentiary.

Acknowledgements: Col. Dr. Eng Catalin Baci.

Keywords: steel, storage, warehouse, isolated foundations, sandwich panels.

References:

- [1] SR EN 1992 - 1 - 1 - 2004;
- [2] P 100 - 1 - 2013;
- [3] CR 2 - 1-1. 1-2022;
- [4] Eurocod 1.



4) Designing a Building for the Purpose of a Detention Facility to Accommodate Inmates in Compliance with Modern Security and Human Rights Standards in Giurgiu City, Giurgiu County

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Introduction: This paper presents the process of designing the construction of a seven-storey prison with ground floor and basement, located in Giurgiu.

Methods and Results: The construction is designed for class a-II importance, with a design ground acceleration of 0.25g and a corner period of 1.00 seconds. the construction is designed according to current standards, for which a geotechnical study has been carried out.

The structure has the height regime S+P+7E+ER, with a level height of 3m for each floor. The maximum height is 24.00m.

The prison's architecture is designed to provide inmates with access to education, medical care, religious services, and creative activities while maintaining a secure environment. The building is designed to comply with fire regulations, allowing for safe and efficient evacuation in case of an emergency.

For the structural calculations, the following programs were used: ETABS: structural program which provides results in terms of modal response, stresses and deformations, Mathcad: mathematical engineering software, which facilitated calculations, AutoCAD: a CAD program used for 2D and 3D construction plan design, where some architectural and structural drawings were created, Xtract: software for sectional analysis, used to extract the specific equation for calculating the moment capacity in the M-P curve for wall calculations.

The structural design aims for regularity and even distribution, enabling direct and efficient transmission. The primary goal is to prevent the formation of critical zones where excessive plastic deformations or stress concentrations could lead to premature failure or cracking.

The foundation is connected to the suprastructure in a way that is maintained a uniform distribution of seismic forces throughout the building.

Conclusions: In conclusion, the present project includes the steps aimed at designing a prison designed according to current standards.

Acknowledgements: profesor Mota Florin.

Keywords: *construction; acceleration; deformations; building; seismic; design.*

References:

- [1] P100-1/2013 - "Cod de proiectare seismică - partea I - prevederi de proiectare pentru clădiri";
- [2] CR 0 – 2012 - „Cod de proiectare. Bazele proiectării structurilor în construcții”;
- [3] CR_2-1-1-2022 “Pereti din beton armat”.

5) Designing a Building with the purpose Headquarters of the General Inspectorate for Emergency Situations from Bucharest

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Introduction: The purpose of this work is to design the center of the General Inspectorate for Emergency Situations, with office spaces, located in Bucharest.

Methods and Results: The project was initiated in response to the increasing number of employees, necessitating the creation of office spaces that meet the highest standards for productivity and efficiency.



The process began with the pre-sizing of structural elements, which were then input into the Etabs calculation program. Following this, the type of structure was determined—a dual-type structural system with predominant walls.

Next, rigorous verifications were carried out, including resistance checks to assess the natural vibration modes. The first two modes exhibited translational behavior, while the third mode displayed torsional characteristics. Additionally, displacement and ductility checks were conducted.

After completing these verifications, the structural calculations were performed, leading to the reinforcement of the structural elements based on the obtained forces.

Conclusions: In conclusion, the need for this project goes beyond merely creating modern and efficient workspaces; it also ensures structural safety and resilience in accordance with current standards. In this context, an IGSU (General Inspectorate for Emergency Situations) center would be essential for managing emergencies, providing rapid response in case of disasters, and efficiently coordinating resources. Given the importance of such a center, its integration into the project would significantly enhance safety and protection for both employees and the wider community.

Acknowledgements: Mr.lect.univ.dr.ing. Cotovanu Anabella.

Keywords: *Cafeteria, building, study zone.*

References:

- [1] P100-1/2013 – "Cod de proiectare seismică - partea I - prevederi de proiectare pentru clădiri";
- [2] CR 0 – 2012 – "Cod de proiectare. Bazele proiectării structurilor în construcții".

6) Design of an Aircraft Hangar for Recreational Flights at Târgu Mureș Airport

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Introduction: By acquiring new aircraft for recreational flight, there is now a need for a dedicated hangar to store them safely. The hangar is located at the Târgu Mureș Airport and has the capacity to store 7 aircrafts.

Methods and Results: The project has plan dimensions of approximately 32x56 meters, providing space for aircraft storage along with a changing room, restroom, and deposit area. The superstructure consists of HEB-profile steel columns supporting metal trusses, with the upper chord made of HEA 240 and HEA 260 profiles, the lower chord using HEA 240 profiles, vertical members of TP 120x10, TP 100x8 and TP 80x5 and diagonals of TP 80x8, TP 70x8, and TP 70x4. To ensure structural stability, TUBO-type bracing will be used, with all metal elements fabricated from OL 44 (S275) steel profiles. The perimeter is enclosed with sandwich panels, and the roof structure features two slopes. Unlike concrete structures, where loads are distributed more evenly, the steel frame applies concentrated loads, making isolated foundations sufficient for support.

Conclusions: After several optimization efforts, I developed a structure that achieves optimal functionality.

Acknowledgements: Col. dr. ing. Catalin Baci.

Keywords: *Hangar, steel, aircraft, sandwich panels.*



7) Design of a Service Apartment Building with a Height of 2 Basements + Ground Floor + 9 Floors, in the Municipality of Bucharest

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Introduction: The current research follows the steps taken in the process of designing a service apartment building with the **2S+P+9ET** height regime in the municipality of Bucharest, in accordance with Romanian structural and seismic design norms, while also meeting European living standards. In doing so, it provides optimal living conditions for the officers of the Bucharest garrison.

Methods and Results: The research was conducted in compliance with Romanian norms and involved the use of multiple software tools, including Etabs for the structural design of the building's superstructure, AutoCAD for the architectural layout, XTract for sectional analysis. Throughout the process, key local terrain factors—such as snow distribution, freeze/thaw depth, seismic mapping, corner period, and wind intensity—were carefully considered. Several structural alternatives were examined and subjected to behavioral, strength, and efficiency tests, with two solutions receiving a focused comparison to identify the most suitable option. Additionally, because these were military buildings, specific design requirements had to be observed to ensure full compliance with relevant standards.

Conclusions: The results obtained from the research helped in choosing the most suitable and efficient structural and architectural solution that corresponds with the receiver's needs "The Ministry of Internal Affairs".

Acknowledgements: Lt. Florin Moța.

Keywords: *Bucharest, Etabs, garrison, design, seismic mapping.*

References:

- [1] SR EN 1992 - 1 - 1 – 2004;
- [2] P 100 – 1 – 2013;
- [3] CR 2 – 1-1. 1-2022;
- [4] Eurocod 1;
- [5] NP24 – garage norm.

8) Headquarters of the Inspectorate for Emergency Situations

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Introduction: The purpose of this paper is to present the method of conforming a new building with the function of the Headquarters of the General Inspectorate for Emergency Situation, located in Bucharest and the way of dimensioning the structural elements.

Methods and Results: The need for the project arose due to the increase in the number of employees. Thus, the project began by establishing an architecture conducive to the creation of offices in which employees can carry out their activities at the highest standards.

The calculation began by pre-sizing the structural elements and entering them into the Etabs calculation program. The next step was to establish the type of structure, this being a dual-type structural system with predominant walls, because in both directions the walls take more than 50% of the basic shear force.

The calculation continued by performing resistance checks that were carried out both to verify the natural vibration modes, these being translational on the first two modes in a



percentage greater than 65% and torsion for the third mode as well as displacement and ductility.

Based on the efforts obtained from the checks, we started reinforcing the structural elements.

Conclusions: Through this building, the staff of the General Inspectorate will benefit from the best working conditions in order to develop performance and the attractiveness of working in the General Inspectorate for Emergency Situations.

Acknowledgements: Cotovanu Anabella.

Keywords: *dual-type structural system with predominant walls, structural elements.*

9) The Design of the Resistance Structure of a Data Center S+G+6F

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Introduction: The purpose of this paper is to present an optimal structural design of a data center with a height regime of Basement+Ground Floor+6 Floors, located in the municipality of Bucharest that respects the Romanian norms and is up to the European standards.

Methods and Results: The project aims to create a safe and efficient space for hosting critical IT equipment, taking into account the requirements for structural strength and protection against natural risks, such as earthquakes and extreme weather conditions.

For carrying out this project, advanced design methods were used, such as ETABS for structural analysis and dimensioning of the building's elements, AutoCAD for creating detailed architectural and structural plans, MathCAD for performing structural calculations, and Xtract for extracting data and conduct dynamic analysis. These software tools enable accurate simulations of the structure's behavior in various loading scenarios and ensure compliance with national and European standards.

Regarding functionality, the data center is designed to provide optimal operating conditions for IT equipment, including an efficient cooling system, continuous power supply, and fire protection. Additionally, security systems are integrated to protect both the equipment and the personnel, including access control measures and continuous monitoring. These features ensure a stable and efficient operating environment, which is essential for the uninterrupted functioning of the IT infrastructure, capable of handling the challenges of a dynamic urban environment like Bucharest.

Conclusions: In conclusion, the design of the data center successfully combines advanced structural engineering techniques and cutting-edge software tools to create a safe, reliable and efficient facility for hosting critical IT infrastructure that drives modern businesses and services.

Acknowledgements: Cpt.lect.univ.dr.ing. Cotovanu Anabella

Keywords: *data centre, structural analysis, software tools, functionality.*

References:

- [1] P100-1-2013- "Seismic design code- Section I- Design Requirements for Buildings"
- [2] CR2- "Design Code for Reinforced Concrete Structural Wall Buildings"
- [3] Eurocode 1-1.1- "General actions- Specific weights, self-weights, live loads for buildings"



10) A New Material?

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Introduction: Cob houses are dwellings built from a mixture of clay, sand, straw, and water, offering an ecological and sustainable alternative to conventional building materials. This project explores the benefits and limitations of cob construction, analyzing factors such as durability, energy efficiency, and resistance to extreme conditions. Within the project, I will present the structural behavior in the event of an earthquake, as well as the tests used to determine the performance of these houses, such as compression resistance tests, water absorption, etc. The goal of this project is to demonstrate the viability of cob houses as an environmentally friendly, healthy, and affordable housing option, offering solutions to improve their performance.

Methods and Results: I started by drawing a parallel to the city of Shibam, Yemen, known as the "Manhattan of the Desert." It is famous for its mudbrick skyscrapers, some of the oldest and tallest buildings of this kind in the world, dating back to the 16th century. The buildings in Shibam range from 5 to 11 stories high, constructed exclusively from mudbrick (a mixture of clay, straw, and water). Shibam is a remarkable example of ecological engineering and sustainable urbanism, demonstrating how traditional architecture and seemingly fragile materials can effectively withstand not only climatic challenges but also the passage of time.

I continued by explaining the construction process of cob houses. These are built from a natural mixture of clay, sand, straw, and water, offering an ecological and sustainable alternative to conventional materials. The clay ensures the cohesion and stability of the walls, the sand prevents cracking, the straw provides mechanical strength and thermal insulation, and the water helps to homogenize the composition. Sometimes, lime or other natural substances are added to improve resistance to moisture. The construction process begins with site preparation, selecting a solid foundation made of stone or concrete to protect against moisture, followed by the preparation of the cob mixture. This is done by manually combining the materials until a homogeneous composition is obtained, which is then layered to form the walls. Each layer must be left to partially dry before applying the next one. As the walls are built up, wooden frames for doors and windows are integrated. The roof, made of wood, tiles, or thatch, has steep slopes to protect the structure from the elements. Finally, a layer of clay or lime plaster is applied, and the finishes may include natural paints and pigments derived from the earth.

It is also necessary to mention some tests that can be conducted both on the material and on the structure itself. These include the soil composition test, plasticity and cohesion test, shrinkage test, compressive strength test, water absorption test, erosion test, and shear strength test.

Shake table tests on a one-third scale cob structure (NED University) simulated the El Centro 1940 earthquake at intensities from 25% to 200%. Cracks first appeared at 100% excitation, worsening as acceleration increased, with significant damage at 200%. Maximum accelerations recorded were 0.65 g (in-plane) and 0.57 g (out-of-plane), with torsional effects causing uneven roof displacements. Despite damage, the structure continued dissipating energy. A UBC study suggested cob buildings could withstand an 8.0 magnitude earthquake.

Regarding legislation, although there are no specific regulations for earth-based constructions, complying with legal procedures and general construction standards allows for the authorization of such buildings. The current legislation does not include specific norms for cob constructions or other earth-building techniques. However, any construction work is



permitted only with a building permit, in accordance with Law No. 50/1991 on the authorization of construction works.

Conclusions: In conclusion cob buildings represent an ecological, affordable, and sustainable alternative to conventional constructions, offering natural thermal insulation, durability, and a reduced environmental impact. Studying historical examples like Shibam, Yemen, we see that natural materials can last for centuries if properly designed and maintained. Tests on compression, water absorption, erosion, and shear strength confirm the material's durability, while seismic simulations show that cob structures can remain standing even during strong earthquakes. Research and testing suggest that, although the material requires adequate protection against moisture, it can provide remarkable structural safety and thermal comfort. Thus, cob is not just a relic of the past, but a practical solution for the future, combining tradition with the principles of sustainable construction.

Acknowledgements: Anabella Cotovanu.

Keywords: *Cob, earth buildings, sustainability and resilience, alternative housing.*

References:

- [1] <https://casedinlut.ro/detalii-tehnice/intretinere-prevenire/S;>
- [2] https://www.researchgate.net/publication/329581384_Dynamic_Testing_of_Seismic_Resistant_Cob_Structure_for_Post-Earthquake_Reconstruction;
- [3] <https://www.discovermagazine.com/technology/its-time-to-rethink-the-cob-house;>
- [4] [https://www.youtube.com/watch?v=awuoRYrdWT8.](https://www.youtube.com/watch?v=awuoRYrdWT8)

11) General Details on the Structure of Fortifications and Modern Construction Methods

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Introduction: Fortifications are perhaps some of the most important constructions during emergency situations that occur, most of the time, unexpectedly. Although their frequency is low, the responsibility of engineers to build them is immense. The location of the fortifications, the dimensioning of the component elements and the quality of execution are the key requirements for their efficiency. Nowadays, shelters of this type have evolved a lot in terms of technology, being able to "camouflage" through irregular shapes, the dissipation of radar waves, but also the application of materials that absorb radar waves.

Methods and Results: The fortifications have an extremely vast history, just like the history of wars conducted throughout humanity. The instinct for survival has indirectly driven people to create "hiding places"—first from wild animals, then from human enemies. Thus, fortifications evolved from the simplest forms, such as those made of wood, earth, stone, and brick, to the period of weapons of mass destruction, including chemical, biological, and nuclear weapons (being made of concrete, steel, etc.).

Currently, fortifications can be defined as military structures made of earth, stone, concrete, metal, or other resistant materials, primarily intended to protect human lives. However, they can also serve as strategic locations for gaining advantages in battle. Fortifications are classified as follows:

- for sheltering combat means;
- for command and observation points;
- shelters;
- permanent fortifications.



The defining characteristic of fortifications compared to other constructions is the application of dynamic forces at the structural level in the form of shock waves resulting from impacts with projectiles, bombs, or nuclear ammunition explosions. The following is an example of how to determine the protective thickness against penetrating radiation.

$$h = 3.3 * d_{\gamma} * \log \frac{D_{\gamma}}{D_{ad}}$$

d_{γ} - the thickness of the layer (in cm) for which the radiation dose is reduced by half

D_{γ} - radiation dose (roentgens)

D_{ad} - permissible radiation dose after passing through the obstacle

As modern technology elements applicable to current fortifications (specifically bunkers), there are materials that can adapt to the landscape, combining photochromic and thermochromic technology (structures with microcapsules containing active pigments, polymer panels with variable texture); materials with ultra-low thermal conductivity (silica aerogel, high-density polyurethane foam, etc.) and materials used for Faraday cages (conductive paints, fine metal mesh, metal plates, etc.).



Fig. 1. Old german military bunker [2]

Conclusions: As I stated in the introduction, fortifications play a crucial role in protecting human life against the enemy. Safety and survival chances increase directly proportional to the proper design of such a structure. As construction engineers within a militarized system, it is our duty to ensure the necessary protection while also staying up to date with modern materials that can optimize the construction of fortifications.

Acknowledgements: Coțovanu Anabella.

Keywords: fortification, protection, shelter, structure, explosion.

References:

- [1] Josan Miron. *Fortificații permanente*. Academia Militară, București, 1977;
- [2] <https://www.dronestagr.am/old-german-military-bunker> ;
- [3] <https://www.microcapsulepigment.com/>.

12) Design of an administrative building located in the Municipality of Bacau

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Introduction: This work aims to design a modern office building that meets the needs of the employees of the National Administration of Penitentiaries while complying with modern norms and standards.

Methods and Results: This project focuses on the architectural and structural design of a contemporary office building consisting of five levels: four above ground floor, a ground floor, and a basement. The basement is strategically designed to incorporate a shelter for protection against aerial threats, adhering to modern safety and regulatory requirements.

A defining architectural element of this structure is its curtain wall system, which optimizes natural light penetration, enhances thermal efficiency, and contributes to an advanced aesthetic profile. This system also allows for a more adaptable interior layout by reducing the reliance on load-bearing perimeter walls.



The design process utilized advanced industry-standard software to ensure precision and efficiency. AutoCAD was used for architectural drafting and spatial planning, while Etabs facilitated structural performance analysis, ensuring the building's resilience to various loads. Xtract provided detailed sectional evaluations, enhancing the accuracy of material assessments, and Excel alongside Mathcad were used for data processing and centralization.

Through these methodologies, the project successfully merges architectural intent with structural feasibility, ensuring compliance with contemporary building standards while optimizing functionality and resilience.

Conclusions: The structural elements have been carefully dimensioned according to calculated loads, ensuring both durability and performance under operational conditions. Furthermore, the overall design of the building guarantees a safe, comfortable, and efficient working environment for the employees of the National Administration of Penitentiaries, meeting modern occupational standards and workplace quality criteria.

Acknowledgements: Col. Baci Cătălin.

Keywords: *Bacău, office, air shelter, curtain walls.*

References:

- [1] P100-1/2013 - "Cod de proiectare seismică - partea I - prevederi de proiectare pentru clădiri";
- [2] CR 0 – 2012 - „Cod de proiectare. Bazele proiectării structurilor în construcții”;
- [3] CR_2-1-1-2022 “Pereti din beton armat”;
- [4] Eurocod 1: „Acțiuni asupra structurilor”.

13) Structural Design and Analysis of an Administrative Building in Bârlad

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Introduction: The development of modern administrative buildings requires a well-planned structural design to ensure stability, functionality, and compliance with current regulations. This thesis focuses on the design of an eight-story administrative building in Bârlad, incorporating a reinforced concrete structural system.

Methods and Results: The project involves advanced structural analysis and design techniques, utilizing specialized software such as AutoCAD, ETABS, Xtract, Excel, and Word for calculations, modeling, and documentation.

The structural system consists of reinforced concrete beams, columns, slabs, and structural walls, ensuring adequate load-bearing capacity and lateral stability. The vertical structural elements (columns and walls) efficiently transfer gravitational and lateral loads to the foundation, while the horizontal elements (slabs and beams) distribute forces across the structure.

The analysis and design are conducted using ETABS, which facilitates the evaluation of seismic behavior, internal force distribution, and deflections under various load conditions. The material properties and reinforcement details are further analyzed using Xtract, enabling precise assessment of the nonlinear response of structural elements. The AutoCAD platform is employed for developing detailed architectural and structural drawings, ensuring accuracy in the construction documentation. Additionally, Excel is used for optimizing calculations and verifying compliance with design standards.

A key aspect of the project is ensuring compliance with national and international building codes, particularly regarding seismic design, serviceability limits, and structural durability. Given the multi-story configuration of the building, careful attention is given to



lateral stiffness, story drift limitations, and load path continuity to enhance overall performance and safety.

Conclusions: This thesis demonstrates the methodological approach for designing a reinforced concrete administrative building, emphasizing structural integrity, efficiency, and regulatory compliance. Through advanced software tools and rigorous structural analysis, the project ensures that the building meets the required safety and serviceability criteria. The use of modern design techniques and comprehensive numerical modeling contributes to a reliable and efficient administrative structure in Bârlad.

Acknowledgements: Mr. BULIGA Dan.

Keywords: *civil engineering, administrative building, structure, concrete.*

14) Residential Building Design and Structural System Overview

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Introduction: The residential building, located in Sannicolau Mare, Romania, represents a modern approach to urban living, designed to blend functionality, sustainability, and comfort. With a focus on quality materials and innovative architectural solutions, this project offers residents a unique living experience that harmonizes with its surrounding environment. The design prioritizes both aesthetic appeal and practicality, creating a welcoming space for individuals and families alike.

Methods and Results: The structural concept of this residential building was developed around a design featuring 2, 3, or 4-bedroom apartments. The building consists of three distinct sections, each equipped with its own staircase and elevator for enhanced accessibility. The apartments are spacious and comfortable, meeting both European and Romanian standards, ensuring a high-quality living environment for residents. This design focuses on functionality, safety, and comfort, making it an ideal choice for modern urban living.

The project was conducted keeping in mind the local terrain conditions, of which the most important were the snow distribution, the freeze/unfreeze depth, the seismic mapping, the corner period and the wind intensity.

After conducting a series of tests, calculations, and comparisons, the final shape and structural system of the building were determined. The design ensures optimal efficiency, with a focus on durability and cost-effectiveness, while maintaining the highest standards of safety and comfort. The structural system was carefully selected to maximize energy efficiency, reduce maintenance costs, and provide long-term sustainability, ensuring a reliable and practical solution for modern living.

Conclusions: The purpose of this project is to meet the operational needs of the structures under the jurisdiction of the Ministry of National Defense and to comply with the current regulations regarding operational safety and user comfort.

Acknowledgements: Mr. Dr. Eng. Dan-Ilie Buliga.

Keywords: *Sannicolau Mare, residential, housing, design, military.*



15) Research Regarding the Design of a Service Housing Block, with Apartments and Parking in the Basement, Located in the City of Roman

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Introduction: This research outlines the process of designing a modern residential building block located in the city of Roman, developed in accordance with current Romanian structural and seismic design codes, as well as European standards for living quality. The building is intended to serve as service apartments for military personnel, offering safe, functional, and comfortable living spaces, while also optimizing structural performance and material efficiency.

In this presentation, we will address the steps involved in the sizing, structural analysis, and necessary checks required to ensure compliance with all relevant safety and comfort standards.

Methods and Results: The building features a Basement + Ground Floor + 6 Upper Floors (S+P+6E) height regime, with the basement level serving as a parking garage to meet residents' practical needs.

The structural system is based on reinforced concrete structural walls, chosen for their high seismic resistance, structural efficiency, and adaptability to the building's functional and architectural layout. Each typical floor includes six apartments, while the ground floor contains five apartments, accommodating access, technical, and common spaces.

The design process began with establishing the architectural concept and structural dimensions, followed by pre-dimensioning of structural elements, and seismic resistance verifications in line with Romanian norms. The necessary quantities of reinforcement were then calculated for some structural components.

For efficient and accurate design, a range of specialized software was employed: AutoCAD for architectural and technical drawings, ETABS for structural analysis, XTRACT for detailed sectional analysis, EXCEL and MATHCAD for centralizing and verifying calculation data.

Conclusions: The results obtained from the structural analysis confirmed that the reinforced concrete wall system is the optimal solution, meeting both seismic safety and functional requirements for this type of residential building. The final design achieves an effective balance between structural safety, material efficiency, architectural flexibility, and aesthetic considerations, fully aligned with the beneficiary's expectations.

Acknowledgements: Prof. MOȚA Florin.

Keywords: *Roman, design, Etabs, parking, dimensions, resistance.*

References:

- [1] P 100 – 1 – 2013;
- [2] CR 2 1 – 1 -1. 1-2022;
- [3] SR EN 1992 – 1 – 1 -204;
- [4] CR-1-1-3.



16) Design of an Administrative Pavilion for the Special Telecommunications Service in Craiova

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Introduction: This paper presents the structural design of an administrative pavilion with the height regime Basement + Ground floor + 8 Floors (S+P+8E) located in Craiova. The building addresses the growing need for office spaces by the Special Telecommunications Service (STS) due to personnel expansion and aims to provide optimal working environments and support continued regional development in Dolj County.

Methods and Results: The designed pavilion comprises a parking area in the basement and office spaces distributed across the eight floors above ground. Perimeter walls are constructed of Autoclaved Aerated Concrete (BCA), while interior partitions are made of lightweight gypsum board. Each floor features balconies, and the building is topped by a non-circulable flat roof terrace. Access to the building is centrally positioned, flanked by staircases and lifts on both sides to ensure efficient vertical circulation.

For structural analysis and design, I utilized specialized software tools such as ETABS, XTRACT, AUTOCAD, EXCEL, and MATHCAD. The process involved initial pre-dimensioning of structural elements, followed by detailed structural calculations, respecting established engineering methodologies.

Conclusions: The successful implementation of this administrative pavilion will effectively resolve the shortage of office space faced by the expanding workforce of the Special Telecommunications Service in Craiova, thereby enhancing operational efficiency and supporting ongoing development in the region.

Acknowledgements: Cpt. Dr. Ing. Anabella COTOVANU.

Keywords: *Administrative pavilion, Structural design, Special Telecommunications Service, Office space, Craiova.*

17) Design of an Accommodation Pavilion with a Height Regime of S+P+8E for the Military School of Warrant Officers and Non-Commissioned Officers of The Land Forces "Basarab I" in Pitesti

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Introduction: In this presentation we will discuss the process of sizing, structural calculation and checks required for the design of an accommodation pavilion for military students.



Methods and Results: The resistance structure will be made of structural walls and reinforced concrete frames, consisting of 8 floors with a basement and a ground floor. The closures and compartments will be made of autoclaved cellular concrete. We started by establishing the dimensions of the structure and an architectural plan, after which we pre-dimensioned the structural elements, followed by stability and resistance checks, later calculating the required amount of steel from the structural elements. We started by establishing the dimensions of the structure and an architectural plan, after which we pre-dimensioned the structural elements, followed by stability and strength checks, subsequently calculating the required amount of steel from the structural elements. All of this being used according to the norms and regulation in force.

I used specialized software for structural analysis and design of resistance elements, ETABS, for calculation I used Mathcad, and for the drawing part I used AutoCAD.

Conclusions: This type of project involves specific aspects related to the safety and comfort of the military who carry out their service.

Acknowledgements: Mr.lect.univ.dr.ing. BULIGA DAN-ILIE.

Keywords: *Accommodation pavilion, military, concrete, structural elements, dimension, resistance.*

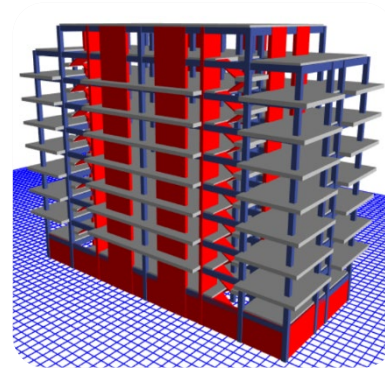


Fig. 1: View of the structural design of the pavilion

18) Research on the Structural Design of a Hotel

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Introduction: This paper proposes a detailed approach for the structural design of a hotel in Bucharest.

Safety, functionality and aesthetics were considered. In the design process I tried to ensure that the structural elements fit perfectly with the architectural design and the functional requirements are met.

Methods and Results: The building will have the height regime S+P+6E, the resistance structure will be made of reinforced concrete frames and walls, perimeter closures and interior partitions with BCA walls, and the roof will be of non-circular terrace type. The pavilion will be provided with an access staircase and two elevators. The construction will have a modern architecture that will fit in with the existing constructions.

The project begins with the architectural design, the evaluation of permanent, variable and exceptional loads, the pre-dimensioning of the structural elements, the realization of the geometry of the structural model and then the dimensioning of the structural elements.

The structural modeling was done with the help of the ETABS calculation program, the calculation notes with the help of the MATHCAD and EXCEL programs and the drawn part was done in AUTOCAD.

Conclusions: The purpose of this presentation is to capture the way of designing a building from the architectural design to the dimensioning of the structural elements.

Acknowledgements: Lt. ing. Moța Florin.

Keywords: *Hotel, Design, Building, Structure, Structural, Program.*



19) Design of an Administrative Building with Basement (S), a Ground Floor(P) and 6 Upper Floors from Buzau

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Introduction: The building is designed to meet the specific functional, aesthetic, and technical requirements of STS, an important Romanian governmental institution responsible for secure communications. The project takes into account modern architectural trends, sustainability principles, and the integration of cutting-edge telecommunications infrastructure. The design process explores aspects such as space optimization, structural integrity, and compliance with regulations.

Methods and Results: Using the designing app Etabs, so the structure is verified. The footprint of the building is 50x21 m, with 6 floors and a basement. Due to the dimensions, and to help with accessibility for people with disabilities, the building is compliant with 2 sets of stairs and 1 elevator. For the meetings, I have designed a spacious conference room to provide a pleasant space for interaction. The conference room is strategically located within the building to ensure both accessibility and a quiet, focused environment. The layout is carefully planned to accommodate various meeting types, from small discussions to large conferences..

The building has been designed with a structural system of reinforced concrete frames, and structural walls in order to have a better earthquake response and also have a low consumption of materials.

The designing started with the concept of the building and defining its openings, then giving the facts already established I did a preliminary sizing of the structural elements in the following order: the slab, the beams on each direction, the columns, the stairs, and finally the walls.

After analysing the loads of the building itself, the loads added due to the usage of it, the snow that may lay on the roof and the finishing products, I estimated the earthquake response using the method of spectral forces and the method of equivalent forces. With all these assets introduced in Etabs, I am now able to calculate the reinforcement of the elements that have been sized.

There was a set of first verifications of the structures results, I checked if the whole building worked and if its mass was trained.

Conclusions: The design of the office building for the Special Telecommunications Service (STS) in Buzău successfully integrates modern architectural concepts with technical and functional requirements. By emphasizing security, efficient use of space, and sustainability, the project provides a suitable environment for STS personnel and their sensitive operations.

Acknowledgements: Lect.univ.dr.ing. MURZEA Patricia.

Keywords: *Architecture, reinforced concrete, seismic design, telecommunications, structural analysis.*

References:

- [1] P100-1/2013 – "Cod de proiectare seismică - partea I - prevederi de proiectare pentru clădiri";
- [2] CR 0 – 2012 – "Cod de proiectare. Bazele proiectării structurilor în construcții".



20) Building a New Gymnasium at Boboc, "Traian Vuia" Military School

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Introduction: By the need of a more performant location to do sports for the Ministry of National Defense, the necessity of a multipurpose gymnasium has arisen. The gymnasium is located at 'Traian Vuia' Military School at the Boboc garrison and has the capacity to host multiple recreational and training activities.

Methods and Results: The project's plan dimensions are approximately 35x45m and provide the necessary space for doing sports, as well as the following related rooms: changing rooms, restrooms, and storage rooms.

The upper structure will be made of U profile steel columns, onto which the following metal trusses will be attached: upper sole with 2U 240x15 profiles, lower sole with 2U 240x15 and 2U 140x15 profiles, uprights with 2U 140x15, 2U 160x15, 2U 180x15 profiles, and diagonals with dimensions and profiles of Tp 180x10, Tp 180x6.3, and Tp 100x6.3. To stiffen the assembly, TUBO-type bracing will be used. The metal elements will be made from OL 44 (S275) steel profiles. The perimeter closure of the structure is made with sandwich panels. The roof structure was constructed in two pitches.

Unlike a concrete structure, the pressure is applied locally, which is why isolated foundations are sufficient.

Conclusions: In conclusion, the solutions adopted aim to achieve a functional and efficient project that meets the requirements of the Ministry of National Defense.

Acknowledgements: Col. Dr. Eng Catalin Baci.

Keywords: *Steel, gymnasium, sports, isolated foundations, sandwich panels.*

21) Designing a Building with the Purpose of a Diner, Study Hall And Kitchen for 1000 Students of "Stefan cel Mare" National College from Campulung Moldovenesc

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Introduction: "Stefan cel Mare" National Colleges cafeteria has at this moment a capacity of serving 500 students on the same time, and does not have a destined area for studying. This paper presents a solution for both these problems, and also a zone for teachers to dine in.

Methods and Results: Using the designing app Etabs, so the structure is verified. The footprint of the building is 42x30 m, with 5 floors and a basement. Due to the dimensions, and to help with accessibility for people with disabilities, the building is compliant with 2 sets of stairs and 2 elevators. For the food there are 2 designated elevators next to the serving area.

On the last floor the building is laid to group study rooms, but also a free zone area for studying in the digital library.

The building has been designed with a structural system of reinforced concrete frames, and structural walls in order to have a better earthquake response and also have a low consumption of materials.

The designing started with the concept of the building and defining its openings, then giving the facts already established I did a preliminary sizing of the structural elements in the



following order: the slab, the beams on each direction, the columns, the stairs, and finally the walls.

After analysing the loads of the building itself, the loads added due to the usage of it, the snow that may lay on the roof and the finishing products, I estimated the earthquake response using the method of spectral forces and the method of equivalent forces. With all these assets introduced in Etabs, I am now able to calculate the reinforcement of the elements that have been sized.

There was a set of first verifications of the structures results, I checked if the whole building worked and if its mass was trained.

Conclusions: After tries of optimizing its results, I reached a structure optimal for its purpose.

Acknowledgements: Mr.lect.univ.dr.ing. BULIGA Dan-Ilie.

Keywords: *Cafeteria, building, study zone.*

References:

- [1] P100-1/2013 – "Cod de proiectare seismică - partea I - prevederi de proiectare pentru clădiri";
- [2] CR 0 – 2012 – "Cod de proiectare. Bazele proiectării structurilor în construcții".

22) Design of a Food Service Building with a Banquet Hall in Ploiești, Prahova County, with a Height Regime of B+G+5F

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Introduction: This paper presents the design of a food service building with a banquet hall in Ploiești, Prahova County, with a height regime of B+G+5F. The project aims to integrate a modern, efficient, and functional complex, intended for both gastronomic activities and event organization. Emphasis is placed on compliance with safety, hygiene, and energy efficiency regulations, in accordance with current legislation [1].

Methods and Results: The project is located in an urban area, considering both architectural and functional aspects. The building structure includes a basement dedicated to storage and technical installations, a ground floor with a kitchen and dining areas, and five floors housing event halls, administrative areas, and auxiliary facilities [2].

The adopted technical solutions focus on optimizing spaces and ensuring efficient functional circuits for staff and customers. The project incorporates modern materials and sustainable technologies, aiming to reduce energy consumption and increase the durability of the construction [3].

Conclusions: This study provides an integrated solution for designing a multifunctional food service building, adapted to the current requirements of the HoReCa sector. Through its approach, the project contributes to the development of local infrastructure and the improvement of services offered in Ploiești.

Acknowledgements: Lecturer PhD Eng. Dan-Ilie BULIGA.

Keywords: *Food service building, banquet hall, architectural design, sustainability, urban planning regulations.*

References:

- [1] **NP 051-2012**, Normative regarding fire safety of buildings, Ministry of Regional Development and Public Administration, Bucharest, Romania, 2012;
- [2] **P100-1/2013**, Seismic Design Code – Part 1: Design Provisions for Buildings, Ministry of Regional Development and Public Administration, Bucharest, Romania, 2013;
- [3] **SR EN 1991-1-4:2005**, Eurocode 1: Actions on Structures – Part 1-4: General Actions – Wind Actions, European Committee for Standardization (CEN), Brussels, Belgium, 2005.



23) Design of an office building with a height regime of 2 basements + ground floor + 8 floors, located in the city of Focșani

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Introduction: This paper aims to design a modern office building in the city of Focșani, with a height regime of 2 basements, ground floor, and 8 floors. The increasing demand for functional and energy-efficient office spaces has led to the need for integrating architectural and engineering solutions that comply with both national and international standards, as well as sustainability requirements.

In this context, the project analyzes multiple aspects, including structural stability, environmental impact, user safety, and interior space optimization. Additionally, emphasis is placed on the use of modern materials and advanced construction technologies to ensure energy efficiency and occupant comfort. The study proposes a design that meets current real estate market needs while providing an adaptable and ergonomic work environment.

Methods and Results: For this project, advanced computer-aided design (CAD) methods, structural simulations, and energy performance analyses were employed. Structural modeling was conducted using specialized software, allowing for testing the building's behavior under various scenarios, including seismic actions and extreme weather conditions.

One of the primary objectives of this project is to ensure compliance with current construction regulations and urban planning guidelines, while also incorporating innovative design solutions that enhance functionality and environmental performance. The office building will be designed to accommodate multiple businesses, providing modern and flexible workspaces that meet the growing demand for high-quality office environments.

The results indicate that the proposed solutions significantly contribute to reducing energy consumption and optimizing operational costs. By integrating these innovative elements, the building is designed to meet modern safety and sustainability standards while providing a comfortable and efficient workspace.

Conclusions: The study highlights the feasibility of implementing an architectural and structural design that meets the current demands of the office market. The use of advanced design and analysis methods has allowed for the identification of solutions that optimize both initial construction costs and long-term expenses related to maintenance and energy consumption.

The proposed building offers a modern work environment characterized by flexibility, efficiency, and sustainability. The project demonstrates that by applying innovative technologies and careful planning, it is possible to develop office spaces that successfully combine aesthetics, functionality, and environmental responsibility.

Acknowledgements: Lect. univ. dr. ing. Patricia MURZEA.

Keywords: *Building design, Office building, Sustainability, Etabs.*

References:

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- [2] P100-1-2013;
- [3] CR2-1-1. 1-2022;
- [4] Eurocod 1.



4. MILITARY ENGINEERING AND GEOMATICS

1) Identification of Risk Areas at the Border, Migration Routes, Through the Interpretation of Satellite Images

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Introduction: The aim of this paper is to identify the risk areas at the border, with a focus on migration routes, using satellite images, topographical maps and vector data. The final product will be a map showing these elements, obtained after processing and analyzing the data collected.

Methods and Results: For the identification of risk areas at Romania's external border and the main routes of illegal migration, a digital elevation model, open-source vector data, and vectorized data derived from satellite images will be used. These datasets will include information on the road network, classified based on its importance, forested areas, pastures, and built-up areas within the analyzed region. By correlating satellite imagery with field data, the study aims to provide a detailed understanding of the dynamics of illegal migration and the factors influencing these routes.

The collected information will be processed using specialized programs for geospatial data analysis and management. Through the digital elevation model, the surface will be classified based on the slope angle. This classification, combined with the natural features of the terrain, will allow the generation of a raster layer illustrating terrain visibility. In the final stage, a terrain mask will be applied to highlight hidden migration routes by removing elements that could interfere with detection accuracy.

Additionally, the terrain analysis will incorporate the OCOKA factors, a concept used in military studies, which include observation and fields of fire, cover and concealment, obstacles, key terrain features, and avenues of approach. These factors will be used to identify and map strategically relevant areas. The primary objective of this approach is to develop a predictive model of migration routes based on the analysis of these critical variables.

Conclusions: The integration of satellite imagery, digital terrain modeling, and geospatial data analysis provides a comprehensive approach to identifying risk areas and migration routes at Romania's external border. By leveraging advanced processing techniques, such as terrain classification, raster visibility analysis, and terrain masking, this study enhances the accuracy of migration route detection and highlights critical areas for border surveillance.

Acknowledgements: Conf. univ. dr. ing Jocea Andreea Florina.

Keywords: *Digital elevation model, migration, satellite images, geospatial data.*

References:

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- [2] İpek, E. b. (2018). *International Migration in the 21st Century: Problems and Solutions*. Cambridge Scholars Publishing;
- Răducanu, D. (2022). *Introducere în Analiza Militară a Terenului, factorii OCOKA*. București, România.



2) Optimising Emergency Response Management Using Open-Source Geospatial Technologies

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Introduction: Efficient emergency response management is crucial in reducing response time and optimizing resource allocation during crises such as accidents, fires, and natural disasters. This research focuses on developing a Geographic Information System (GIS)-based solution for emergency management using open-source tools such as QGIS, QField, PostGIS, and GeoServer. The proposed system enables real-time monitoring of emergency units, automated dispatch of the nearest available teams, and dynamic route optimization using geospatial data. By leveraging open-source technologies, the system ensures cost-effectiveness and adaptability for various emergency scenarios.

Methods and Results: The methodology integrates multiple open-source technologies to create a seamless emergency response platform. The core database is implemented in **PostGIS**, storing geospatial data on emergency units (police, fire, and ambulance stations), vehicle fleets, and response teams. Data collection and updates are facilitated using **QField**, enabling field units to modify their status in real-time. The **incident management module** allows operators to manually input emergency locations, triggering an automated selection of the closest available response units based on predefined intervention rules.

For route optimization, the system dynamically generates navigation links using **Waze Deep Links** or **Google Maps API**, guiding teams to the incident scene via the fastest possible route. Furthermore, **GeoServer** is used to publish and visualize real-time geospatial data, allowing coordination centers to monitor active emergencies and allocate resources effectively. Preliminary tests in Bucharest show significant improvements in response time, reducing delays by up to **30%** compared to traditional dispatch methods.

Conclusions: This study demonstrates the potential of open-source GIS technologies in modernizing emergency response management. The developed system provides real-time situational awareness, optimizes resource allocation, and enhances communication between field units and dispatch centers. Future improvements include integrating real-time traffic data from OpenStreetMap-based routing engines such as **pgRouting** and expanding the system to cover additional emergency scenarios.

Acknowledgements: Col.(r) lect. univ. dr. ing. Liviu PORUMB.

Keywords: *Emergency GIS, Open-Source, QGIS, Real-Time Monitoring, Route Optimization, GeoServer.*

3) Evaluation of the Effects of an Omnidirectional Explosive System on an IED Casing

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Introduction: The paper presents the results of a numerical analysis on how the casing of a IED reduces the velocity of omnidirectional water jets generated by the neutralization system. The study contributes to the improving of neutralization techniques.

Methods and Results: IED neutralization using water jet propulsion is based on transmitting a shock to the device, with the aim of separating or interrupting the elements of its firing chain. The firing chain represents the assembly of components that ensure the initiation and propagation of detonation within the improvised explosive device.



The presence of a casing made from different materials (e.g., wood, steel sheet, plexiglass, polystyrene, etc.) and varying thicknesses produces the attenuation of water jet velocity, thereby reducing the direct impact on the main explosive charge and detonator.

This study aims to determine, through numerical analysis, the extent to which a steel sheet casing with a thickness of 0.4 m attenuates water jet velocity. The research investigates different configurations of explosive charges and their placement distances relative to the water jet propulsion system.

The configuration used was a cylindrical omnidirectional type, with a volume of one liter of water. The numerical analysis was conducted using Autodyn code, and simulations were performed in a two-dimensional (2D planar) space. The analyzed explosive charge consisted of 2, 3, or 4 turns of detonating cord, each containing 20 g of PENT per meter, positioned at distances of 15 cm, 20 cm, and 25 cm from the casing.

Conclusions: The results suggest that various factors, such as casing material and thickness, play a role in the attenuation of water jet velocity and the overall effectiveness of neutralization strategies. The study provides insights that could be useful for optimizing the configuration of explosive neutralization systems. Future research could explore additional parameters and materials to further improve safety and efficiency in counter-IED applications.

Acknowledgements: Col.(r) Prof. Univ. Dr. Ing. Lupoae Marin, Col. Conf. Prof. Univ. Dr. Ing. Constantin Daniel, Cpt. PhD Student Ing. Casapu Alexandru, Lt. PhD Student. Ing. Berechet Costin.

Keywords: *IED, neutralization, omnidirectional water jet, sheet metal casing.*

4) Geospatial Database Creation and Web Visualization Using Open-Source GIS Technologies

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Introduction: My paper is about geospatial databases and how they can be used for data analysis and processing. The objectives of the paper are to create, populate, and visualize geospatial databases by publishing them on open-source platforms.

Methods and Results: The methodology of this study focuses on the creation, population, and visualization of a geospatial database using open-source technologies. The database is developed in PostgreSQL with PostGIS, which allows efficient storage and management of spatial data. The data model includes point features representing technical chambers and other features representing infrastructure elements in Bucharest, Sector 6.

The geospatial database is created and populated using QGIS, which provides an intuitive environment for editing and managing spatial data. To ensure interoperability and facilitate web-based visualization, the data is published on GeoServer, enabling dynamic interaction with the spatial features through a web map interface.

For mobile data collection, QField is integrated into the workflow, allowing real-time updates and field validation of geospatial objects. This approach enhances accuracy and efficiency by enabling users to capture new data, attach photographs, and modify attributes directly from the field.

The results demonstrate that open-source GIS technologies provide a cost-effective and scalable solution for managing spatial data. The implemented workflow facilitates data consistency, real-time updates, and easy access to geospatial information. The final web map enables users to explore and analyze geospatial data interactively, supporting applications in urban planning, infrastructure monitoring, and spatial analysis.



Conclusions: The study highlights the importance of open-source technologies in the development of geospatial databases. By leveraging PostGIS, QGIS, and GeoServer, it is possible to create a flexible and scalable system for managing spatial data. The use of QField enhances data collection by enabling real-time updates directly from mobile devices. **Acknowledgements:** At this section you can indicate the coordinator teacher.

Acknowledgements: My coordinator teacher is COL.(r) Asst.Prof. Eng. Liviu PORUMB, PhD.

Keywords: *Geospatial database, QGIS, PostGIS, GeoServer, QField, GIS applications.*

5) The Study of the Effects of the Explosion Resulting from the Clearance of Ammunition in the Urban Environment

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Introduction: The paper presents the results of numerical and analytical analysis regarding the effects of an unexploded ordnance detonation in an urban environment. Both the effects of the explosion in the urban environment and methods for limiting its impact to ensure urban integrity have been studied.

Methods and Results: Establishing safety distances for the disposal of unexploded ordnance in an urban environment is a priority, given the necessity of ensuring public safety. This paper determines safety distances for different types of structures and various protection levels based on the amount of explosive. Similarly, safety distances for personnel are established concerning the shock wave. Additionally, the paper presents the results of numerical analyses regarding the attenuation capacity of reinforced concrete panels against spherical fragments with diameters of 8, 10, and 12 millimeters. The initial propulsion velocity of the projectiles was determined for a cylindrical configuration corresponding to a 120 mm mortar bomb. The impact between the projectiles and the panel was modeled using 2D planar method from the Autodyn code.

This simulation is relevant as it illustrates the ability of the reinforced concrete panel to retain fragments, making it easier to study the limitation of explosion effects and correlate the results with what would happen in a real scenario.

Conclusions: The paper highlights the importance of establishing safety distances for the disposal of unexploded ordnance in urban environments to protect both the population and infrastructure. Numerical and analytical analyses have determined optimal distances for structures and personnel exposed to the shock wave.

The study on the attenuation capacity of reinforced concrete panels against fragment impacts demonstrates their effectiveness in reducing explosion effects. The conducted simulations provide a clear understanding of how these structures can contribute to urban protection in real scenarios.

Acknowledgements: Cpt. PhD Student Ing. Casapu Alexandru, Col.(r) Prof. Univ. Dr. Ing. Lupoae Marin, Col. Conf. Prof. Univ. Dr. Ing. Constantin Daniel, Lt. PhD Student. Ing. Berechet Costin.

Keywords: *Unexploded ordnance (UXO), explosion effects, urban environment, safety distances, shock wave, numerical and analytical analysis, blast mitigation, reinforced concrete panels, fragment impact, protective structures, urban safety.*



6) The Use of Tubulanes in Defense and Biomedicine

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Introduction: Tubulanes, inspired by theoretical crosslinked carbon nanotube structures, are a groundbreaking material with transformative potential in modern armies and armor applications. Another practical use for it could be its implementation in medical implants, aiding bone regeneration.

Methods and Results: The tubulane-structures exhibit futuristic mechanical properties, including high impact resistance and load-bearing capabilities, which have been experimentally validated through 3D-printed polymer analogs. In ballistic tests, tubulane-inspired grids demonstrated tenfold greater effectiveness in stopping projectiles compared to solid materials, reducing the weight and increasing the sturdiness of the armour by absorbing energy from the impact. In biomedicine, tubulane structures hold promise for creating biocompatible, high-strength implants and prosthetics. Their porous, flexible topology mimics natural biological materials, making it useful for bone scaffolds and tissue engineering.

Conclusions: The integration of tubulanes into industrial and biomedical sectors underscores their versatility. As a material that bridges theoretical innovation and practical utility, tubulanes represent a significant advancement in materials science, promising to revolutionize both defense and healthcare industries.

Acknowledgements: Ch. assistant Petar Stamatov Valchanov, Ph.D., MU-Varna.

Keywords: *tubulanes, biomedicine, armour, implants, 3D structures, prosthetics, defense.*

References:

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- [2] Mohammad Aftab Alam Ansari,abc Aleksandra A. Golebiowska, “Engineering biomaterials to 3D-print scaffolds for bone regeneration: practical and theoretical consideration” *PubMed*;
- [3] Mike Williams “Theoretical tubulanes inspire ultrahard polymers”, Rice University.

7) EOD Robot with a Dual Manipulation System

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Introduction: This paper presents a robotic system equipped with a dual-arm manipulator, developed to support Explosive Ordnance Disposal (EOD) operations. The system is designed to handle objects in potentially dangerous environments, reducing the need for direct human intervention. The dual-arm structure allows for coordinated or independent movement, enabling complex manipulation tasks that require precision and stability.

Methods and Results: The robot was modeled and simulated using MATLAB and the Robotics Toolbox developed by Peter Corke. This toolbox supports kinematic modeling, trajectory planning, and 3D simulation for robotic manipulators. Two EOD-related scenarios were developed to test the system’s manipulation capabilities:

1. **Opening a plastic bottle**, where one arm holds the bottle while the other unscrews the cap.
2. **Unzipping a backpack**, with one arm stabilizing the bag and the other pulling the zipper along its path.



These scenarios were chosen to replicate real-world operations where careful handling and fine control are essential. Simulation results showed smooth and coordinated movements of both arms, confirming the robot's potential for precise dual-arm tasks.

Conclusions: The proposed system demonstrates the advantages of dual-arm robotic manipulation in EOD applications, particularly for tasks that require fine motor skills. MATLAB and the Robotics Toolbox provided an effective environment for design, control, and simulation. Future developments will include integrating vision systems

Acknowledgements: Col. Assoc. Prof. Univ. Dr. Eng. Constantin Daniel.

Keywords: *EOD, dual-arm robot, MATLAB, robotics simulation, bottle opening, zipper manipulation.*

8) Evaluation of the Effects of Asymmetric Unidirectional Water Jet Propulsion on IEDs

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Introduction: This study presents a numerical analysis of the effects of a unidirectional water jet propulsion system on an improvised explosive device (IED). The primary objective is to assess whether the water jets can separate the components of the initiation system without causing accidental detonation, either through direct shock transmission or by unintentionally activating the triggering mechanism. The analysis was made using Autodyn software in 2D planar space.

Methods and Results: The unidirectional propulsion system consists of a parallelepiped plastic container containing a mass of 0.5 liters of water and a burden mass of 1.5 liters of water, with propulsion achieved through the initiation of a detonating cord containing PETN. The detonating cord of 20g PETN per meter is set up in four turns. The firing distance is set at 20 cm from the IED, ensuring an optimal range for impact and effectiveness.

The numerical simulations focus on two primary cases: assessing whether the water jets can be powerful enough to initiate a C4 plastic explosive and determining if the water jets can activate a pressure plate triggering system. To evaluate these scenarios, the simulations analyze the velocity and pressure distribution of the water jets upon impact, the ability of the jet to separate key initiation components without transmitting a shock that could cause detonation, and the effectiveness of the jet in activating a pressure plate mechanism.

Preliminary findings indicate that the velocity and momentum of the water jet experiences significant influence by the firing distance. There appears to be a critical pressure threshold where the water jet can disrupt the initiation chain without causing detonation. In certain configurations, the jet can unintentionally activate a pressure plate mechanism, which highlights the risk of inducing detonation rather than achieving a safe neutralization.

Conclusions: The study provides insights into the controlled application of unidirectional water jet propulsion for neutralizing IEDs. The results suggest that system parameters such as water mass, propulsion charge, and firing distance need careful optimization to achieve effective separation of initiation components while minimizing unintended detonations. Further experimental validation is required to refine these findings and improve counter-IED strategies.

Acknowledgements: Col.(r) Prof. Univ. Dr. Ing. Lupoae Marin, Col. Conf. Prof. Univ. Dr. Ing. Constantin Daniel, Cpt. PhD Student Ing. Casapu Alexandru, Lt. PhD Student. Ing. Berechet Costin.



Keywords: *IED, unidirectional water jet, neutralization, Autodyn simulation, triggering mechanism.*

9) Modular Multilayer Ballistic Panel for Urban IED Protection

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Introduction: This paper presents a modular multilayer ballistic panel designed to protect against Improvised Explosive Devices (IEDs) in urban environments. The increasing risk of IED attacks requires efficient and mobile protection systems to ensure the safety of personnel and civilians. The panel is built to mitigate both blast waves and shrapnel, offering modularity to adapt to different mission needs.

Methods and Results: The panel includes several layers, each with a specific role. The first layer is a V-shaped hardened steel plate, designed to deflect the blast wave and fragments. Behind it, a reinforced concrete layer slows down remaining shrapnel and absorbs part of the shock wave. To block fragments that could pass through weak points of the V-shape, a second flat steel plate is added for extra protection.

Next, a honeycomb structure filled with sand absorbs the remaining shock wave and fragments. Finally, a Kevlar mesh is placed at the back to stop any residual shrapnel. The modular design allows easy transport and quick assembly, and the panels can be fixed or mobile, depending on mission requirements.

The panel is estimated to withstand fragments traveling up to 1500 m/s and attenuate shock waves of up to 0.5 MPa, making it effective for typical urban IED threats.

Conclusions: The proposed modular multilayer panel offers effective protection against IED blast waves and fragments in urban areas. Its adaptable design allows fast deployment, improving safety for military and law enforcement teams. Further testing is needed to confirm its performance against multiple or repeated detonations.

Acknowledgements: Col.(r) Prof. Univ. Dr. Ing. Lupoae Marin, Col. Conf. Prof. Univ. Dr. Ing. Constantin Daniel, Cpt. PhD Student Ing. Casapu Alexandru, Lt. PhD Student. Ing. Berechet Costin.

Keywords: *IED, ballistic panel, modular protection, blast wave, fragments, urban defense.*

10) Studying the Influence of Light in Aerial Photography with a Digital Camera

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Introduction: This article explores the science of photogrammetry, focusing on aerial photography with drones and the acquisition of digital aerial photos. The primary emphasis is on the influence of light on the quality and accuracy of the imaging, which is essential for the applications of digital photogrammetry.

The study analyzes the impact of different light conditions on aerial photography. Factors such as cloudiness, inappropriate shooting time, reflections from water surfaces, instrument settings and the presence of snow cover are the subject of the study. For the purpose of the experiment, a DJI Phantom 3 Professional drone is used, equipped with a high-quality camera capable of providing detailed high-resolution images.



Methods and Results: The methodology involves conducting experimental flights under various weather and light conditions, with subsequent analysis of the resulting images. The data will be evaluated on several criteria, including pixel clarity, contrast, distortions, and overall image quality against digital photogrammetry standards.

Conclusions: The expected results predict that under adverse weather conditions, such as heavy clouds or strong reflections, pixel quality will deteriorate, leading to lower accuracy of the recording. At the same time, under clear weather and optimal equipment settings, the images will meet the requirements of digital photogrammetry and provide accurate and reliable data for analysis.

Acknowledgements: assoc.prof. Monika Bedzheva, assoc.prof. Dimitar Petrov.

Keywords: *unmanned aerial vehicles; aerial photography; digital photogrammetry; influence of light.*

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11) Geospatial Intelligence for Border Security

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Introduction: Border security is important for national safety and requires modern technology to monitor and prevent smuggling and unauthorized migration. This study explores the use of Geographic Information Systems (GIS), visual programming and automation methods to help border authorities identify high-risk areas along Romania and Hungary's western border.

Methods and Results: To create a detailed geospatial analysis, I utilized GIS software, including QGIS, along with Python scripting for data processing and automation, integrating both vector and raster data. Various geographical factors were considered to assess the difficulty of crossing specific areas, including:

- ***Terrain conditions*** (elevation, slopes)
- ***Vegetation density*** (forests, shrublands)
- ***Hydrography*** (rivers, lakes, wetlands)
- ***Transport networks*** (road accessibility)
- ***Urban infrastructure*** (built-up areas and settlements)

Using a 30 km buffer along the border within the country and a 10 km zone beyond it, I created a multi-layered map that classifies regions based on their ease of traversal. The dataset was enhanced with satellite imagery and topographical data to identify areas prone to unauthorized border crossings. Additionally, a ModelBuilder workflow was implemented to automate spatial analysis, reducing manual effort and increasing efficiency.

A key aspect of this research was the development of a custom GIS plugin, enabling real-time risk assessment and visualization of border vulnerabilities. This tool integrates various geospatial datasets, providing border police with actionable intelligence for patrol



planning and rapid response, while also equipping them with fast and accurate cartographic products to strengthen their presence in high-risk areas.

Conclusions: The study demonstrates the effectiveness of GIS-based methodologies in supporting border security operations. By integrating automated data processing and real-time visualization tools, authorities can optimize their monitoring strategies, focusing resources on high-risk zones. This approach not only strengthens border control efforts but also contributes to enhanced national security.

Acknowledgements: Prof.univ.dr.ing. Răducanu Dan-Gabriel.

Keywords: *Border Security, GIS Analysis, Smuggling Prevention, Migration Monitoring, Geospatial Intelligence.*

12) Integrated GIS Analysis of Urban Pollution

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Introduction: Rapid urbanization and intensified anthropogenic activities have led to multiple forms of pollution—air, water, soil, noise, and light pollution—which negatively impact public health and urban living quality. Geographic Information Systems (GIS) provide a powerful platform for monitoring and analyzing these complex environmental issues. This project investigates the application of GIS technology for evaluating urban pollution distribution and its correlation with human-induced impacts by comparing two leading GIS platforms: ArcGIS Pro and QGIS.

Methods and Results: Data were collected from multiple sources, including air quality monitoring stations (measuring PM10, PM2.5, NO2, SO2, CO, O3, and NH3), satellite imagery from Sentinel-5P, meteorological data (temperature, humidity, wind speed and direction) from ERA5 and local meteorological agencies, and urban infrastructure data from OpenStreetMap. The data underwent rigorous preprocessing (cleaning, georeferencing, and standardization) before being analyzed using spatial interpolation techniques such as Inverse Distance Weighting (IDW) and Kriging. Automation of the workflow was achieved through the development of a Python Toolbox in ArcGIS Pro (using ArcPy and ModelBuilder) and corresponding PyQGIS scripts in QGIS. The comparative analysis revealed a statistically significant correlation between traffic intensity and pollutant concentration, and highlighted differences in workflow efficiency and precision between the two platforms.

Conclusions: The integrated GIS approach demonstrated in this study confirms that advanced spatial analysis techniques can effectively monitor urban pollution and assess anthropic impacts. While both ArcGIS Pro and QGIS yield comparable results in terms of spatial interpolation, the choice between them may depend on resource availability, technical expertise, and specific user requirements. These findings provide a robust basis for urban managers and policymakers to develop targeted intervention strategies aimed at reducing harmful emissions.

Acknowledgements: I gratefully acknowledge the guidance of our project supervisor, Lect. univ. dr. ing. Necula Lucian, and the support provided by Academia Tehnică Militară "Ferdinand I" in the execution of this study..

Keywords: *GIS, urban pollution, spatial interpolation, ArcGIS Pro, QGIS, anthropic impact, environmental monitoring.*

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13) Methods for Creating a High-Precision Reference Surveying Network

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Introduction: The article explores the establishment of the process of creating high-accuracy reference geodetic networks employed as a permanent reference basis in geodetic, cartographic and engineering practices.

Methods and Results: In Bulgaria, their production began at the turn of the 19th century, since then evolving on the basis of new techniques and technologies.

The main features of these networks are high accuracy, point stability, international geodetic reference system compatibility and the capability of long-term observation of geodynamic processes.

Particular emphasis is placed on the methodology for designing a high-precision network, including optimal point selection, stabilization, measurements and data analysis. Simulation of this kind of network is carried out by applying mathematical algorithms for optimizing location and processing the measurements through specialized software.

The new technologies, especially GNSS systems, hold a pivotal place in building high-precision surveying networks. They provide efficiency and speed coupled with high accuracy of measurement.

Conclusions: The Bulgarian Military University has built a high-precision reference surveying network, and it is used as a tool for training, scientific research, and practical application.

Acknowledgements: prof. Y. Dachev.

Keywords: *geodetic; GNSS; high-precision; Bulgaria; network.*

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5. AEROSPACE AND MECHANICAL ENGINEERING

1) Takeoff and Landing based on LiDAR sensor for fixed wing UAVs

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Introduction: Traditional altitude measurement for fixed-wing Unmanned Aerial Vehicles (UAVs) typically relies on barometric sensors, ultrasonic devices, or radar systems. This research introduces a different approach that employs a single downward-facing 1D LiDAR sensor as a high-precision rangefinder method for takeoff and landing.

Methods and Results: The system is built around a single beam LiDAR rangefinder featuring a vertical downward orientation, with a high sampling rate up to 388 measures per second and a measurement range from 0.2 m to 50 m with an accuracy of ± 0.2 cm. A software implementation (SITL) with a real time 2D representation of the fixed wing UAV is done in python to mimic the realistic approach before the actual flight. Using UbuntuOS terminal the flight modes and any parameter can be changed during the flight if in case of an emergency. After ensuring precise vertical alignment in front of the UAV the LiDAR sensor has an unobstructed view of the ground surface, also the actual flight will take place in a closed environment, far away from high-traffic and obstructed areas. All the flight data is compared between the simulation and the actual flight.

Conclusions: The implementation of a downward-facing LiDAR offers a highly accurate solution for altitude measurement in fixed-wing UAVs as long as the takeoff and landing area is flat. It's more precise than barometric sensors and faster than ultrasonic devices, or radar systems, immune to changes in atmospheric pressure and easier to calibrate. The view to the ground has to be always clear, while on the software side, you'll need to apply Extended Kalman filter for rangefinder and low-pass filtering to reduce noise while using adaptive thresholds for dependable takeoff and landing detection, and include failsafe mechanisms to cover any interruptions in sensor data.

Acknowledgements: I gratefully thank the Department of Integrated Aviation and Mechanical Systems of Military Technical Academy Ferdinand I for their invaluable support and guidance throughout this project.

Keywords: *UAV Navigation, LiDAR, Rangefinder, Altitude Measurement, Autonomous Takeoff, Precision Landing.*

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2) Perspectives, Human Factor, and Forecasts in Unmanned Aviation

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Introduction: The rapid evolution of aviation in recent decades has been driven by technological advancements, leading to the emergence of unmanned aviation. This paper examines the development of Unmanned Aerial Vehicles (UAVs), their integration with artificial intelligence, and their impact on training and operational efficiency. As UAV applications expand in surveillance, research, and defense, they also present challenges related to the role of human operators. This study aims to explore how technological progress and AI implementation can enhance UAV capabilities while maintaining human involvement in decision-making and safety oversight.

Methods and Results: The research highlights the latest advancements in UAV technology, emphasizing the integration of aerodynamics, material science, and machine learning. AI-driven autonomous navigation systems are improving UAV efficiency and mission execution, enabling tasks such as object recognition, terrain scanning, and environmental monitoring. UAVs are increasingly used in disaster response, climate research, and military operations. Additionally, cybersecurity measures and anti-collision technologies are being developed to ensure safe and reliable UAV operations. A key focus of this study is the role of human operators in UAV systems. Despite growing automation, human expertise remains crucial for mission planning, decision-making in unforeseen circumstances, and ethical considerations. A comparison between traditional pilot training and UAV operator training highlights the distinct skill sets required. While pilots undergo intensive physical and cognitive preparation, UAV operators focus on remote control, AI interaction, and data analysis. The study also explores the ethical and legal aspects of UAV operations, particularly in military and surveillance contexts. The paper presents an analysis of societal acceptance trends regarding UAVs, drawing on studies from the past decade. Public perception of UAV applications for commercial, governmental, and military purposes has evolved, with increasing acceptance of UAVs in fields such as environmental monitoring and emergency response. Forecasts indicate that the UAV market will expand significantly in the coming years, driven by technological advancements and regulatory developments.

Conclusions: Unmanned aviation represents both a challenge and an opportunity for the future of aerospace technology. While AI-driven automation enhances UAV functionality, human oversight remains essential for ethical decision-making and operational safety. The growing societal acceptance of UAVs and their expanding applications highlight the importance of balanced integration between technology and human expertise. As UAV technology advances, continued research and responsible implementation will shape the future of aviation.

Acknowledgements: The authors acknowledge the support of the Georgi Benkovski Bulgarian Air Force Academy in the preparation of this research.

Keywords: *Unmanned aviation, UAV technology, artificial intelligence, human factors, risk assessment, societal acceptance.*



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3) Modelling and Analysis of Electric and Hybrid Propulsion Systems on Light Aircraft

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Introduction: The aviation industry has experienced significant advancements with the introduction of modern technologies and the recent development of battery and electrical motors. The evolution of hybrid and electric aircraft represents a remarkable innovation. The main objective of this research is to model and analyze the cruise and flight performance of a two-seat light aircraft intended for general aviation. The range of electric planes has been significantly studied since their early appearance. The study will focus on electric-hybrid and fully electric configurations of the aircraft, aiming to identify viable design options. In this context, the existing market model, Pipistrel Alpha Electro, will be used, and simulations will be conducted based on it.

Methods and Results: The development of a simulation for an existing hybrid and full electric aircraft will be carried out using the simulation tool developed by MathWorks, available as a Matlab/Simulink project called *"Electrical Component Analysis for Hybrid and*



Electric Aircraft". The Simulink models are structured to visualize the mission profile, aircraft configuration, and propulsion system, each with interconnected inputs and outputs, as shown in Fig. 1 and Fig. 2.

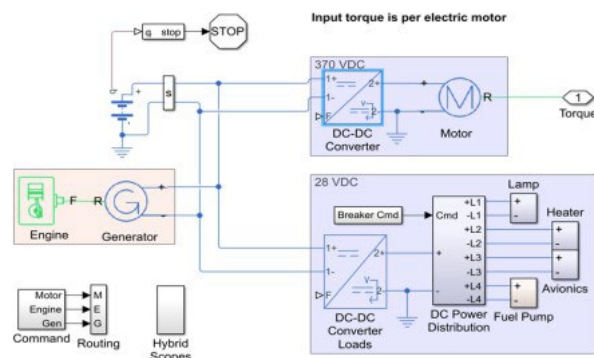


Fig. 1: MATLAB/Simulink Model for Hybrid Aircraft

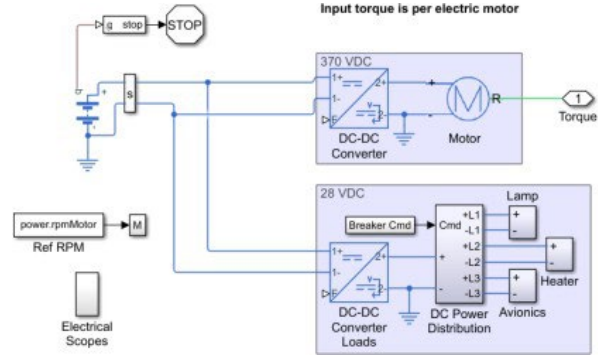


Fig. 2: MATLAB/Simulink Model for a Fully Electric Aircraft

The Simulink models of an electric or hybrid aircraft incorporate a battery, a converter, a DC-DC motor, and a connection port for consumers. In the case of the hybrid aircraft, an internal combustion engine and a generator are also included as a power source, supplementing and recharging the battery during flight. The generator and electric motors are modelled using permanent magnet synchronous motors. The battery is modelled with internal resistance, with its capacity being set accordingly. The project allows the "Environment" subsystem. The subsystem integrates altitude as the aircraft climbs, descends, or maintains level flight, continuously adjusting this parameter based on the flight conditions. The mission profile introduces a flight scenario with the input parameters required by the MATLAB code for simulation. The DC power distribution subsystem models the circuit breakers that open and close to connect and disconnect loads from the low-voltage DC power network. These loads include lights, avionics, fuel pump (for hybrid systems), and cabin heating.

Variable conditions influence the power extracted from the network, the aircraft's range, and the power requirements for the aircraft's electrical systems. These variable conditions include factors such as outside temperature, altitude, speed, and the operating requirements of each load, which directly affect the required power and the way energy is distributed to different components. An increase in power demand from auxiliary loads, such as the heating system or lighting, can reduce the overall range of the aircraft, as more energy is consumed by non-propulsion systems, leaving less available for flight.

Initially, a flight will be simulated without payload, and the pilot's mass will be neglected. However, the influence of additional mass on the system's range will be observed as example in Fig. 3. The payload is set initially to 0. The empty weight of the aircraft with the motor is set to 700 lbm (approximately 330 kg). The mission profile graph of the successfully completed flight will have the shape of a trapezoid.

Simulations and graphical analyses will demonstrate the superior performances of hybrid system for the same battery capacity compared to the fully electric system. In the case of the fully electric aircraft, flight duration increases proportionally with battery capacity, but remains inherently limited.

The hybrid aircraft benefits from greater efficiency in battery usage, thanks to the motor-generator system that enables in-flight recharging. This significant difference in range becomes even more apparent with larger battery capacities. It is concluded that as mass increases, range decreases dramatically, highlighting the direct impact of payload. Excess weight is critical to aircraft performance. Any exceedance of weight limits leads to a drastic reduction in both performance and flight safety. Additionally, an operating cost analysis will be conducted for both versions, considering the maximum price of electricity and fuel in Romania based on January 2025 prices. For the simulation, real aircraft parameters from Pipistrel Technical Manuals were used, or approximate estimates in cases where the required parameters could not be found in the Technical Manuals.

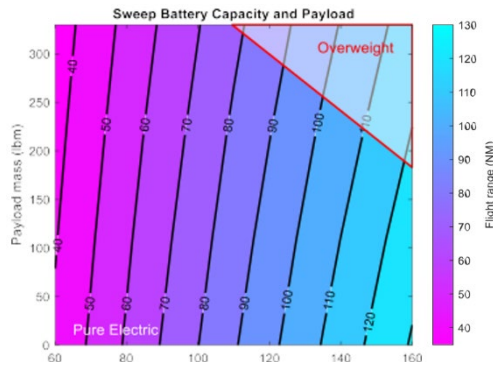


Fig. 3: Payload Impact on Range (full electric aircraft)

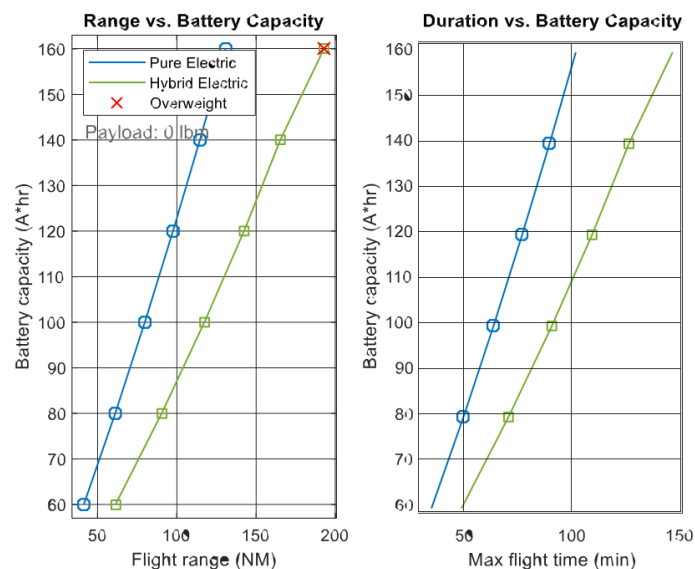


Fig. 4: Comparative graphs of autonomy/flight duration for electric aircraft/hybrid aircraft (full electric aircraft)

Conclusions: The hybrid system offers greater range for the same battery capacity. For the fully electric aircraft, flight duration increases linearly with battery capacity, but it remains limited. The hybrid aircraft has a much longer duration, using the batteries more efficiently and recovering energy through the motor-generator assembly, which recharges the battery. The significant difference in range becomes evident with larger battery capacities.

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Keywords: Range, Matlab/Simulink, Hybrid, Electric propulsion, Pipistrel ALPHA ELECTRO.

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Introduction: This paper presents a numerical simulation of a NACA 2412 airfoil using the ANSYS Student 2025 R1 software. The main objective of this study was to determine key aerodynamic characteristics—lift and drag coefficients—by investigating the impact of discretization on the results. The airfoil was modeled using different meshing techniques. Additionally, simulations were conducted for different angles of attack (AoA).

Methods and Results: The NACA 2412 airfoil was scaled as needed and defined using its characteristic parameters. The geometric settings and boundary conditions were adjusted to accurately reflect real operating conditions. Different meshing approaches were used, each with a different granularity, to study the solution's convergence and highlight numerical variations

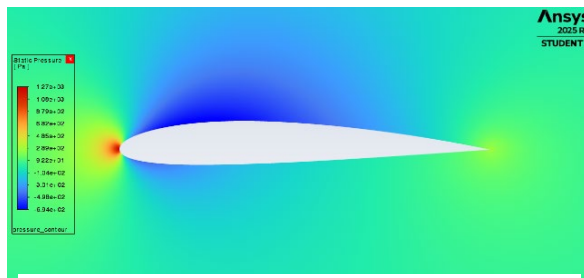


Fig. 2: Representation of the static pressure distribution

in the obtained results. Simulations were also performed at a 0° AoA—where low lift force values are expected—and at an 8° AoA to analyze the significant increase in aerodynamic effects. From simulations, values for lift and drag forces were obtained, which were then used to compute c_l and c_d . Analysis included the evaluation of the pressure distribution on the airfoil's surface and the identification of flow separation zones. The differences observed between meshing methods highlight the importance of selecting an appropriate numerical model. The results obtained for varying AoA provide a clear perspective on the aerodynamic behavior of the airfoil, demonstrating its sensitivity to both geometric parameters and operating conditions.

Conclusions: The study emphasized the importance of proper meshing for achieving reliable aerodynamic simulations. The results indicate that, in addition to the direct influence of the AoA on aerodynamic forces, the choice of discretization method plays a crucial role in the accuracy of computed values. These findings contribute to the optimization of numerical modeling techniques in aerospace engineering and can serve as a basis for future studies, including investigations of other airfoil profiles and different operating conditions.

Acknowledgements: Lt. Eng. Daniel Măriuța, PhD.

Keywords: Drag and Lift Coefficients, Discretization, Shear Stress, Static Pressure.

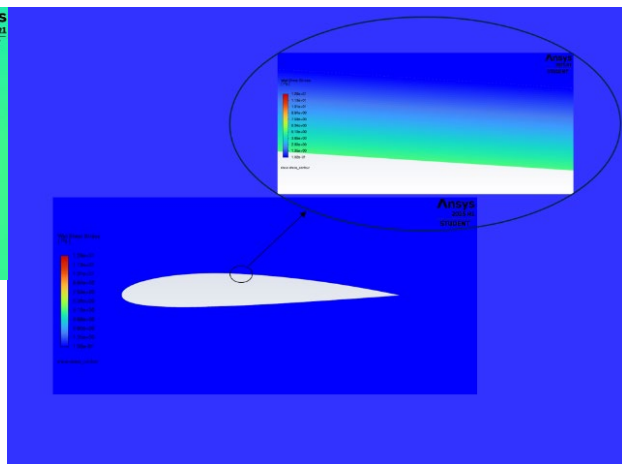


Fig. 1: Representation of the shear stress distribution



5) Shaping the Future of Flight: an Overview of More Electric Engines for Civil Aviation

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Introduction: The aviation industry is undergoing a major transformation driven by environmental concerns, including greenhouse gas emissions, noise pollution, and air quality degradation from traditional gas turbine engines. In response, the concept of More Electric Aircraft (MEA) is emerging, which integrates advanced electrical systems into aircraft design and operation to enhance energy efficiency and reduce emissions. Central to this approach are More Electric Engines (MEE), which employ hybrid or fully electric propulsion technologies to lower fuel consumption and noise levels while improving reliability and reducing maintenance costs. Supported by breakthroughs in energy storage, power electronics, and lightweight materials, MEA and MEE are poised to play a critical role in transitioning towards cleaner, more sustainable aviation in an era of increasing regulatory pressure.

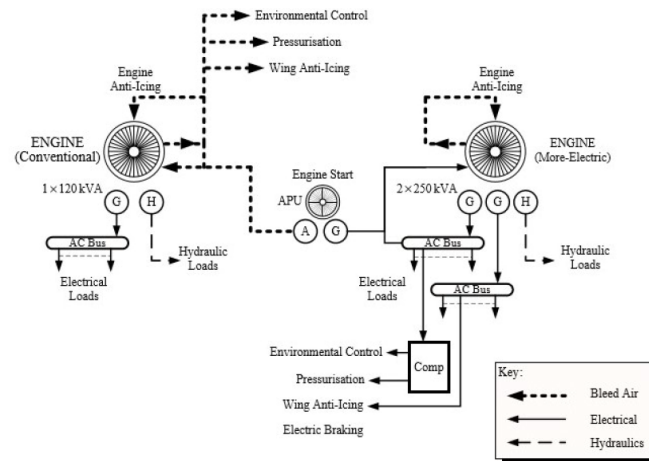


Fig. 1: Scheme comparison between MEA and conventional aircraft

Methods and Results: The study employed a comprehensive evaluation of More Electric Engines (MEEs) for civil aviation by analyzing and comparing traditional and more electric aircraft architectures.

The methods included: a **detailed review** of conventional aircraft power distribution and the integration of electrical systems (MEA) for propulsion, flight controls, and environmental management, **modelling and simulation** of three hybrid propulsion configurations—series, parallel, and series-parallel—using performance metrics such as **specific fuel consumption (SFC)**, **thrust specific power consumption (TSPC)**, and energy specific aircraft range (ESAR).

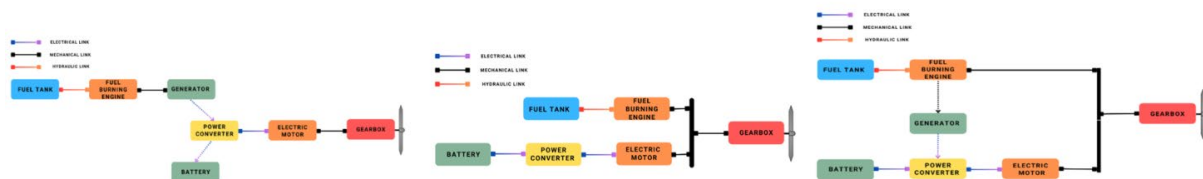


Fig. 2: Different propulsion configurations: series, parallel and series-parallel



Moreover, an application of a standard flight mission profile (including taxi, takeoff, climb, cruise, descent, and landing) was considered to assess engine sizing trade-offs, with a case study focusing on an A320-type aircraft.

The results indicated that while series hybrid systems are hindered by energy conversion losses, parallel hybrid configurations offer notable benefits. Specifically, the parallel hybrid electric propulsion system (PHEPS) achieved approximately a 12.55% reduction in fuel consumption over a flight range of around 600 nautical miles. Furthermore, the study identified that further improvements in efficiency are possible with advancements in battery technology, though current challenges such as battery weight penalties and the need for components that can endure high thermal conditions persist.

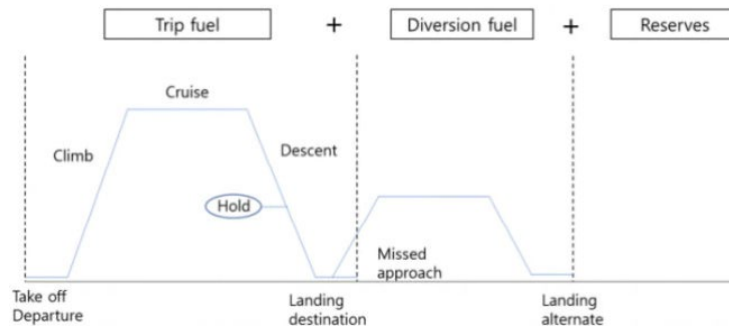


Fig. 3: Standard mission profile for civil aviation

Conclusions: The study concludes that More Electric Engines (MEEs) provide significant benefits, including improved efficiency, reduced emissions, and enhanced flexibility, particularly through hybrid electric propulsion systems. These systems optimize fuel consumption during critical flight phases. However, challenges such as battery weight penalties and the harsh thermal environments of gas turbines must be addressed. MEEs show promise for short-range applications, but further developments in battery technology and system optimization are necessary for long-range aviation.

In summary, MEEs replace traditional systems with electric ones, enhancing efficiency, cutting emissions, and increasing operational flexibility. Hybrid systems optimize fuel use by balancing power between gas turbines and electric motors during high-demand phases. However, current battery weight and thermal challenges still hinder long-range applications, necessitating further advancements in technology and system integration.

Acknowledgements: Coordinators: Conf. Dr. Ing. Jenica-Ileana CORCĂU, Conf. Dr. Ing. Liviu DINCĂ.

Keywords: *More Electric Engines, Hybrid Propulsion, Energy Efficiency, Mathematical modelling, Emissions reduction, Energy efficiency.*

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6) Aircraft Electrical Network Interface

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Introduction: This paper presents the development of an application designed to support the practical component of the bachelor's thesis titled "Design of the Electrical Power System for a Lightweight Twin-Engine Multirole Helicopter with a Maximum Gross Weight of 2835 kg." The purpose of the application is to enhance the understanding of the electrical system's operation, both in nominal and emergency modes, and to provide a useful educational tool for students, instructors, and aerospace specialists.

Methods and Results: The application is designed to provide an interactive interface for visualizing the onboard electrical system and examining the aircraft's electrical components. Operators can observe detailed electrical schematics under both nominal and emergency conditions. They can interact with components such as generators and batteries via various knobs and controls, enabling them to switch generators on or off, adjust other system settings, and visualize real-time changes in the electrical schematic. Additionally, messages from the aircraft's onboard systems are displayed, enhancing user awareness of operational states. Users can also view detailed information related to the electrical power system and analyze mission scenarios for various flight conditions. The software architecture integrates graphical representations and comparative analysis to improve user comprehension. The application is intended to be user-friendly and accessible, making it suitable for educational and research purposes.

Conclusions: The application has proven to be a valuable tool for understanding the electrical power distribution and management of the EC-135 helicopter [1], as an example. Its user-friendly interface and ability to model various operational scenarios make it particularly useful for educational purposes. Future improvements to the application could include integrating more advanced simulations and expanding the range of aircraft models available for analysis. The tool provides a solid foundation for further research and development in this area.

Acknowledgements: Cpt.dr.ing. Bogliș Carmen-Ioana, lect.dr.ing Adochiei Ioana.

Keywords: *Electrical Power, Power Distribution, Power Consumption, Electrical Network.*

References:

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7) Tandem Vertical Takeoff and Landing UAV System

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Introduction: In modern warfare, drones have shown their importance evolving from surveillance to combat missions. The *Australian Army Research Center* claims that "Drones have been used for various purposes, including surveillance, reconnaissance, and targeted strikes. Overall, uncrewed systems represent a transformative advance in military technology, reflecting significant investment and development worldwide". UAV systems are competitive against large and heavy manned military vehicles, with minimum human losses. However, their most significant benefit is cost efficiency. With only several hundred dollars, objectives costing



over \$1,000,000 can be destroyed: in November 2024, an FPV drone destroyed an Osa air defense system valued at \$10 million, according to *Defense Express*.

Methods and Results: It is currently of great interest to further develop new features for improved drone flight capabilities and manufacturing efficiency. Let us consider a jet engine drone, capable of higher speeds, bigger weapons on board, longer distances of operation and reusable, all compared to a well-known FPV drone. We will now refer to it as JET-D. One of this prototype's downsides would be its vulnerability on take-off and landing missions because it would require a runway. To compensate for this disadvantage, a second drone (a quadcopter) will be used to lift the JET-D. This quadcopter will ensure vertical take-off. After being lifted above all obstructions, the quadcopter will commute its propellers from a horizontal to a vertical position, moving horizontally while carrying the JET-D. This movement will ensure the necessary speed, needed for the JET-D to fly independently.

As for landing, a pre-established path will be assigned to the JET-D at the desired height. The quadcopter will stay in position waiting for the JET-D to secure its route. After that, the quadcopter will place itself above the JET-D and will carefully come closer. When ready, JET-D's motor will shut down and the quadcopter will immediately grab it around the fuselage, with two robotic arms, one in front and the other in the back of JET-D's wings. From this moment the deceleration of the newly formatted system begins. Finally, the quadcopter will execute a vertical landing, in this way completing the cycle.

Conclusions: Note that this system of vertical take-off and landing will enable operators to take cover in forests and urban areas, ensuring a physical barrier against enemy FPV drones that can be hardly maneuvered in these environments. Another advantage of this system is represented by reducing the costs of production, as the JET-D is a reusable alternative to an FPV drone. Compared to a VTOL drone, this system can execute faster flights, while the quadcopter can be used for landing other existing flying equipment. Finally, using the JET-D as a reconnaissance drone will allow the quadcopter to capture enemy drones for analysis and reverse engineering procedures.

Keywords: *Vertical take-off and landing, Jet engine drone, Dual system.*

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8) SNS and RTK Systems, Navigation for Civil And Military Applications

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Introduction: Navigation is the science of determining one's position and course of travel. Civilizations have developed diverse methods and tools to navigate by land, sea and sky which evolved through history. Nowadays, our navigation systems have lot of interesting applications in both civilian and military. Satellite Navigation Systems (SNS) is one of the most applied in this area.

Methods and Results: SNS, as the Global Positioning System (GPS), represent a cornerstone of modern navigation technology, offering precise positioning, timing, and navigation services across the globe. With an accuracy up to 20m to determine the position of an object, the SNS is based on the Global Navigation Satellite System (GNSS) receiver which collect signals from at least 4 satellites orbiting Earth to determine their location and navigate virtually anywhere on Earth. Thanks to the use of differential correction methods, an improvement of accuracy is possible, which in optimal conditions, where the receiver has a



clear view of multiple satellites in favorable geometry, reduce the errors and gives an accuracy of a few meters in a three-dimensional position, also including the velocity and time of the object. However, SNS are quite sensitive to external factors such as signal blockage (in the form of vegetation or civil buildings), multipath interference, ionospheric and tropospheric effect, receiver errors, ... leading to positional errors of several meters or more. Despite these challenges, SNS remain indispensable tools for a wide range of applications, offering continuous and reliable positioning, navigation, and timing services worldwide. Ongoing advancements in this technology conduct improvements in accuracy, as the Real-Time Kinematic (RTK).

RTK is a positioning technique used to enhance the precision of position data derived from Satellite Navigation Systems, originating back to the mid-1990s. The RTK method is carried out in two ways. Either by using a receiver fixed at a reference point with already known coordinates that transmits correction data to a mobile receiver in real-time, via a wireless link (conventional RTK), or using a network of reference stations (Network RTK) for broadcasting the same correction data. With the use of RTK, navigation has significantly enhanced accuracy in comparison to standalone GPS or GNSS positioning techniques, while this technology proves to be exceptionally suitable for simple, basic, or essential tasks, such as land surveying, agriculture, building construction and vehicle navigation, ensuring accuracy up to the centimeter level, in both horizontal and perpendicular axis, wherever such precision is demanded.

GNSS are the fundamental of both SNS and RTK systems. They are a constellation of satellites orbiting earth at specific level and with determined inclination. Those satellites are equipped with atomic clocks and onboard transmitters to broadcast the microwave signals (in continuity or by specific timelapse). The receiver needs to process these signals to extract detailed information about the time, meteorology, satellite positioning, message on the system health, ... allowed it to determine its position in a geocentric reference system everywhere on Earth. Each GNSS has a lot of similarity in their construction and technology used. In fact they work with 3 segments: the Space segment (satellites), the Control segment (Monitoring & Control Station), and User segment (receiver). These different GNSS programs lead to a vast advancement on the satellite navigation on Earth.

Conclusions: In this project, we have done in-depth research about SNS and RTK in different documents such as theses or official documents to get a deep understanding of both systems for civil or military application.

Acknowledgements: Lt. cdr. PhD. VIDAN Cristian.

Keywords: *SNS, RTK, GNSS, Navigation.*

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9) Harnessing and Applying Hydrogen Propulsion as Future Technology for Hypersonic Flight

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Introduction: Hypersonic flight represents the next chapter of the aerospace engineering field, where military and civilian aircraft can reach speeds of Mach 5. Hydrogen propulsion is a viable solution as the fuel source for defense capabilities and rapid global transportation because of its high specific energy and environmental and tactical advantages. The written essay shows the characteristics of liquid hydrogen as fuel, its benefits and downsides, past and present research, and future capabilities achievable for hypersonic flight.

Methods and Results:

Characteristics of Hydrogen Propulsion:

Hydrogen is the lightest and most abundant element in the universe. It has uncommon physical and chemical capabilities beneficial for air-breathing jet engines, such as a high energy-to-weight ratio (142MJ/kg), which is more than three times higher than conventional jet fuel (43MJ/kg). This results in higher flight performance and lower total mass of the aircraft, allowing it to have a more efficient propulsion system and extended flight ranges at hypersonic speeds (Mach 5+) [1].

However, to use it properly, hydrogen must be stored at cryogenic temperatures of -253°C to maintain its liquid state. This requires a special tank composed of certain kinds of materials to withstand the extreme temperature fluctuations and pressure variations during flight. This represents a considerable challenge that demands advanced engineering solutions involving multiple layers to isolate the fuel and vacuum-jacketed containers [2].

Furthermore, regarding hydrogen safety capabilities, it dissipates rapidly into the atmosphere in case of a leak, given its low molecular weight, leading to a reduced risk of explosion compared to traditional fuel for aircraft [2].

Usability and Tactical Military Advantages:

Because of its lightweight capabilities, the whole mass of the aircraft is lower than usual for an airframe that uses conventional fuel. So then, its compatibility with air-breathing engines, such as ramjets and scramjets, makes it suitable for hypersonic flight [3].

Hypersonic flights by hydrogen aircraft have significant defense applications due to their ability to reach target locations, evasive maneuvering against missiles, and reach global locations quickly. An aircraft of this type can be ideal for reconnaissance missions and can revolutionize military operations from a strategic point of view because of its low to no heat detection on the radar [4].

Storage and Handling:

The storage tanks in which the liquid hydrogen is stored must maintain low temperatures while minimizing weight to compensate for the low volumetric density of the fuel (compared to kerosene) by developing advanced materials such as carbon fiber composites, aluminum-lithium alloys, and aerogels to enhance fuel insulation and structural rigidity accordingly [5].

Furthermore, the injectors have to handle high-pressure and low-temperature fuel flow while ensuring the efficiency of the mix with oxidizers in the combustion chamber. Such injectors are manufactured in high-strength stainless steel and ceramic matrix composites to withstand intense mechanical stress and thermal variations in hypersonic conditions [6].



Research and Development:

During the Cold War, the U.S.A. and the Soviet Union started exploring this method of propulsion and created the Lockheed CL-400 "Suntan" and the Tu-155. These experimental aircraft faced problems such as storage incapacity and faulty fuel handling [7].

Modern advancements in such propulsion methods improved the overall efficiency and integration with the current technology, which resulted in new aircraft experiments:

For Scramjet Propulsion, NASA's X-34A project has demonstrated hydrogen's capability for sustained hypersonic flight, reaching a top speed of Mach 9.6. This type of engine relies on great fuel efficiency at great speed compared to traditional rocket engines [6].

Turbojet-Scramjet Hybrid Technology: This new propulsion design incorporates two types of engines into one propulsion system, varying from turbojet to scramjet as speed increases. This invention focuses on maximizing efficiency across a wide range of velocities and ensures a higher flexibility of aircraft possibilities, which can facilitate hypersonic transport more practically [8].

Future Developments:

To make hydrogen propulsion more feasible in the future, lightweight materials and insulation technologies are necessary to minimize fuel loss and improve aerodynamic integration [5]. Also, hypersonic flights need an advanced thermal protection material to prevent overheating of the fuel tanks to reduce the possibility of reaching extreme temperatures [6].

Conclusions: Hydrogen propulsion for hypersonic flight represents a powerful shift in the military and civilian aerospace engineering industry with multiple benefits, such as a low to no thermal footprint of the aircraft on the radar, the development of new types of materials, and high-performance capabilities.

Keywords: *Hydrogen, aviation, hypersonic flight, scramjet, stealth, cryogenic.*

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10) Experimental and Numerical Analysis of Vibration Absorption in Mechanical Systems

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Introduction: In the world of engineering and mechanical systems, the quest to minimize vibrations is a constant challenge. Whether it's the gentle hum of a perfectly balanced machine or the subtle resonance of a well-tuned musical instrument, controlling vibrations is essential for optimal performance, structural integrity, and even human comfort. Among the arsenal of tools engineers have at their disposal, one ingenious solution stands out: the tuned vibration absorber (TVA).

Methods and Results: Methods of studying tuned vibration absorbers encompass both experimental and analytical approaches, each offering unique insights into their behavior and effectiveness. Experimental studies involve real-world testing, where physical prototypes of

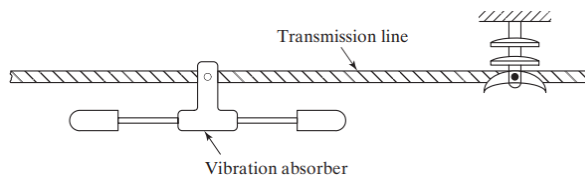


Fig. 3: Ex. of a system
with a vibration absorber[1]

tuned vibration absorbers are subjected to controlled vibrations to observe their performance. These experiments will employ measurement techniques such as inductive sensors and an acquisition data system to quantify vibration levels and assess the absorber's ability to attenuate them. On the other hand, analytical

methods involve mathematical modeling and simulation to predict the behavior of tuned vibration absorbers under various conditions. These models consider factors such as mass distribution, spring stiffness, damping coefficients, and the dynamic characteristics of the primary vibrating system. Both experimental and analytical approaches complement each other, providing valuable insights that inform the design and implementation of tuned vibration absorbers across a wide range of applications.

Conclusions: In summary, the tuned vibration absorber is a relatively simple yet efficient method for controlling vibrations in mechanical systems. Through a blend of experimental testing and analytical modeling, engineers can optimize their design to enhance performance and ensure the integrity of structures and machinery.

Acknowledgements: Lt. lect. dr. ing. Constantin Lucian.

Keywords: *Tuned vibration, absorber, damping, mass distribution, Matlab, Patran.*

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11) The study of Flow and Parametric Analysis in the Axial Compressor Stage

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Introduction: The efficiency and performance of axial compressors are significantly influenced by the flow characteristics within their stages. This paper aims to analyze the flow behavior in a specific axial compressor stage through numerical simulations. By varying key parameters, such as rotational speed and stator blade incidence angle, we examine their effects on the flow characteristics and overall performance, as presented in the reference [1]. The study



also explores methods to maintain or improve the stage's efficiency despite operational changes according to the reference [2].

Methods and Results: The analysis starts with modeling the axial compressor stage, extracting the mid-span blade profiles, and importing them into ANSYS CFD for flow simulation. Computational Fluid Dynamics (CFD) is employed to evaluate how variations in operational parameters, particularly the rotational speed, impact flow distribution, pressure fields, and velocity profiles.

By systematically adjusting these parameters, the study identifies correlations between the values which characterize them and changes in flow efficiency. The results highlight the influence of operational regimes on performance indicators such as pressure ratio and efficiency. Based on these findings, an optimization strategy is proposed to mitigate efficiency losses and enhance overall compressor performance, according to the reference [3].

Conclusions: The study demonstrates that variations in parameters significantly influence the aerodynamic performance of the axial compressor stage, according to the reference [4]. By analyzing the effects of parameter adjustments, we propose a solution to stabilize and enhance the stage's efficiency. The insights gained from this research contribute to a better understanding of compressor behavior and provide a basis for improving its performance in real-world applications.

Keywords: *Axial Compressor, Flow Analysis, Computational Fluid Dynamics, Efficiency Optimization, Parametric Analysis..*

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12) Analysis of a Fixed Wing to Equip an Unmanned Aerial Vehicle with VTOL Capabilities

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Introduction: Hybrid fixed-wing UAVs with Vertical Take-Off and Landing (VTOL) capabilities represent a modern solution that combines the endurance and efficiency of fixed-wing platforms with the operational flexibility of multirotor systems. These UAVs can take off and land vertically without the need for a runway, making them ideal for deployment in confined or remote environments. Their aerodynamic design enables extended flight times, higher altitudes, and improved endurance compared to traditional multirotor drones, supporting long-range missions and minimizing the risk of airframe damage during landing. This configuration is increasingly valuable in both military and civilian applications — from surveillance and data collection in inaccessible zones to precision agriculture, traffic monitoring, and remote infrastructure inspection. In this context, the present study aims to analyze a fixed-wing configuration suitable for integration into a fixed-wing UAV with VTOL functionality, focusing on aerodynamic performance and feasibility of implementation.



Methods and Results: The study began with the aerodynamic analysis of several airfoil profiles to identify the most suitable candidate for integration into a fixed-wing UAV with VTOL capabilities. Using the numerical method implemented in XFLR5 software, multiple profiles were evaluated based on their lift, moment and drag performance. Following the initial selection, the chosen airfoil was further analyzed using both analytical methods and Computational Fluid Dynamics (CFD) simulations to determine its aerodynamic coefficients with higher precision.

Subsequently, a statistical analysis of existing UAVs in the same class was conducted to establish the general dimensions of the platform. With these parameters defined, the final wing configuration was assessed using both analytical formulas and XFLR5 simulations to validate the aerodynamic performance in terms of lift and drag coefficients.

The next phase of the study focused on selecting a fuselage geometry compatible with the wing and suitable for VTOL integration, ensuring both aerodynamic stability and structural feasibility. Finally, various design solutions were investigated to enable modularity of the wing, aiming to facilitate transportation, maintenance, and operational flexibility.

Conclusions: The study resulted in the development of a wing design that meets both aerodynamic and practical requirements for integration into a VTOL-capable fixed-wing UAV. The selected airfoil and wing geometry demonstrated favorable lift and drag characteristics, while the proposed modular structure enhances ease of transport and maintenance. The analysis proceeded without technical issues, validating the adopted methodology. Future work will focus on structural strength and modal vibration analyses, with the long-term objective of completing the full UAV design.

Acknowledgements: The author would like to thank Lector Căpitan Dr. Ing. Tofan-Negru Andra for the valuable guidance and support throughout the development of this study..

Keywords: *UAV, VTOL, hybrid fixed-wing, aerodynamic analysis, XFLR5, Ansys CFD simulation.*

13) Design of an Electric UAV in a VTOL Configuration

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Introduction: In the past years there have been numerous studies on development of technology in the electric aircraft field [1]-[3]. The objectives of these studies were to exclusively use electrical energy with the help of electrochemical energy units (EEU) in order to ensure the power supply of the entire electrical system of an aircraft. In this paper there is presented a potential model of an electric UAV in a VTOL configuration.

Methods and Results: The aircraft model studied in this paper is derived from the canard UAV "Newsolar" [4], which was redesigned in SolidWork. These changes consists of a straight wing with a positive dihedral angle of one degree to increase lateral stability, a straight horizontal stabilizer and a "T" shape fuselage, with constant cross section, to further increase the lift. Additionally, two elevons located on the trailing edge of the wing play the role of control surfaces. Furthermore, four electric ducted fans were mounted on the extremities of both wing and horizontal stabilizer and can be used in a VTOL configuration. In order to accomplish the transition between the terminal and flight phases, the motors can be rotated through a chain of servomechanisms that engage a series of shafts. Thus, by controlling the angle and speed parameters, the motors can also play the role of command surfaces. A combination between the control of both elevons and motors achieves an improved maneuverability.

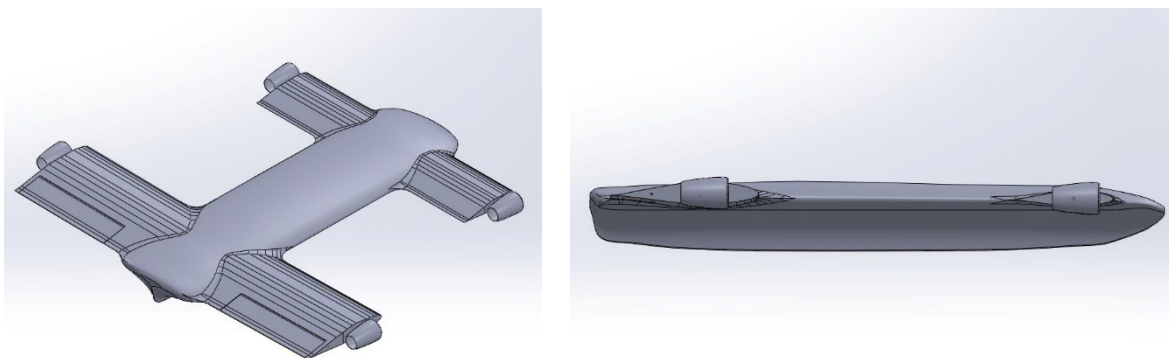


Fig. 1: SolidWork design of the UAV

The electrical system designed for this UAV is hybrid and consists of 70 solar cells and two Li-Po batteries. In the terminal phases of flight, the aircraft only uses the batteries and can supply an electrical power of 5.772 kW. However, in the flight phase, the electrical system switches from the batteries and uses solar cells instead. These cells are able to supply an electrical power of 260.4 W through an arrangement of two groups connected in parallel, each of them consisting of 35 cells in series.

In order to make the flight possible, there were used four electric ducted fans. Each motor can supply a traction force of 34 N at maximum thrust. At full thrust the motors drain an electrical power of 7.814 kW. This aspect cannot be achieved do to the lower power supplied from the batteries. In this regard, it was decided that in the terminal phases of flight the power load of the motors to be divided by half. This way the motors will only use 3.9 kW. Furthermore, in the flight phase, the electrical power supplied by the solar cells is sufficient to maintain the UAV airborne.

Conclusions: Although this paper serves as a preliminary study in order to outline a general view of such an aircraft, it is necessary to further study the methods in which the parameters of the motors can be processed to ensure both the transition between flight phases and the aircraft attitude control.

Acknowledgements: Dincă Liviu.

Keywords: UAV, VTOL, Electric, Hybrid.

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14) Selected Constraints of UAV Precision Landing

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Introduction: Unmanned Aerial Vehicles (UAVs) are utilized in both civilian and military sectors. On the modern battlefield, they are primarily used for reconnaissance [1] and

observation, delivering explosive materials [2] and providing supplies [3]. In the context of cargo transportation, one of the most critical research challenges in UAV applications is achieving precise positioning over a target and landing in difficult environmental conditions - even in situations where opponents deploy electronic warfare measures. The implementation of an autonomous landing algorithm increases the efficiency of the resupply process, relieving the operator of the demanding task of landing the UAV, which requires a high level of focus. The aim of this study is to present methods and solutions enabling precise, autonomous landing of a UAV (specifically a quadcopter) in terrains with diverse topography and dynamically changing environmental conditions.

Methods and Results:

Achieving precise autonomous UAV landing requires the implementation of several structural modifications. In the quadcopter's design, it is crucial to optimize the placement of additional components while maintaining balance and stability, and at the same time minimizing the impact of the extra load on flight performance. The drone modification plan includes adding a GPS module, an STM32F411 microcontroller, a Pixhawk 2.4.8 flight controller, infrared sensors, and a LIDAR sensor. The most significant challenges in quadcopter's operation include GPS signal interference and variable weather conditions. Implementing a

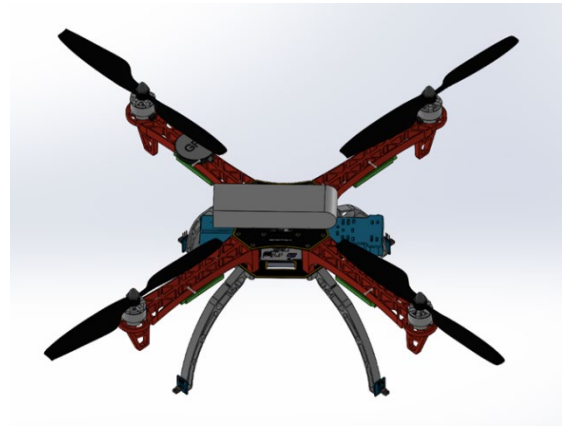


Fig. 1: 3D model of DJI F450 with new component placement

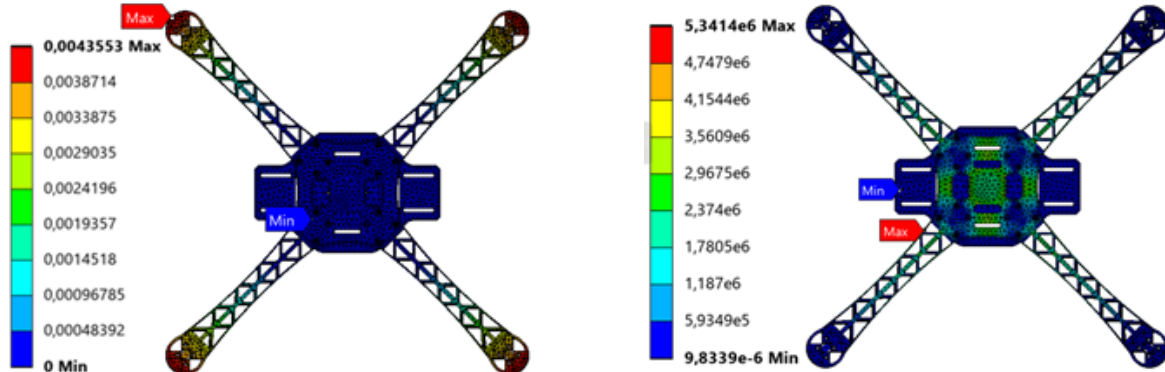


Fig. 2: a) Deformations [m] and b) stresses [Pa] of the UAV caused by the thrust of the four engines and the weight of the system

system based on the Pixhawk flight controller requires synchronization of multiple sensors and distance measurement devices for data fusion, which poses additional challenges due to differences in refresh rates and potential delays. This paper addresses the issues of motion simulation and drone design optimization while minimizing the impact of additional components on flight stability and performance [4]. For this purpose, an analysis of the drone's deformations was conducted, considering the weight of components, payload, and thrust generated by the motors using ANSYS software. A static structural analysis of the UAV frame conducted using the finite element method in ANSYS software showed that the maximum deformation occurs at the ends of the arms, where the highest thrust force generated by the motors acts. Maximum stress was recorded in the central parts of the arms and along the inner edge of the base plates, confirming the results' consistency with material predictions. The data



obtained demonstrated that a frame made of PA66 nylon and E-glass fiber can withstand the operational loads with a total system weight of 3130 g.

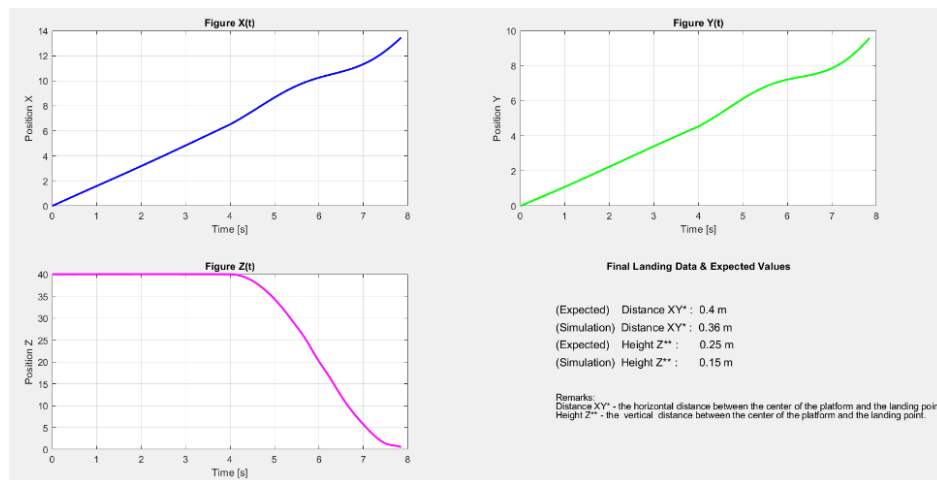


Fig. 3: The resulting graphs of the drone's position in each

Subsequently, a precise landing of the drone was analyzed in MATLAB, considering factors such as wind speed and temporary GPS and IR signal losses. A simulation of the quadcopter's flight in variable conditions in MATLAB (considering disturbances such as GPS and IR signal losses and variable wind direction) allowed for the replication of the dynamics of UAV landing on a moving platform. The autonomous control of the landing process proved effective in correcting the drone's position in real time under the aforementioned conditions. The final simulation results show landing errors ranging from several centimeters to several dozen centimeters, depending on the tested conditions.

Conclusions: The simulation of autonomous landing in MATLAB enabled the identification of key disruptive factors, such as wind forces, sensor errors, and aerodynamic resistance, and effectively replicated their impact on the flight trajectory. The UAV frame structure made of PA66 nylon and glass fiber exhibits sufficient strength and stiffness to withstand maximum operational loads. This work is part of a larger project focused on building an autonomous, precision UAV landing system. Further development of the project will include constructing a physical model that utilizes the developed algorithms and schematics to examine the system's behavior under real-world conditions.

Acknowledgements: Supervisor – Natalia DANIEL M. Sc. Eng..

Keywords: *Unmanned Aerial Vehicles, Precision Landing.*

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15) Airborne Risks: The Interplay of Compatibility and Risk Assessment in Avionics Components

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Introduction: Avionics components are fundamental to aircraft safety and efficiency, ensuring seamless functionality within complex aviation systems. This study explores the critical relationship between compatibility assessments and risk evaluation in avionics components, highlighting their impact on operational reliability and safety. Compatibility involves ensuring the seamless interaction of hardware and software elements to prevent malfunctions, while risk assessment identifies and mitigates potential failures that could compromise aviation safety. The interplay between these two processes strengthens aircraft reliability, minimizing risks associated with system integration, electromagnetic interference, and software anomalies.

Methods and Results: The study investigates avionics components by categorizing them into hardware and software, detailing their roles and importance in modern aviation. It outlines various dimensions of compatibility, including electrical, data, environmental, and software integration. Risk assessment methodologies such as Failure Mode and Effects Analysis (FMEA), Fault Tree Analysis (FTA), and Probabilistic Risk Assessment (PRA) are explored as essential tools in identifying vulnerabilities and mitigating risks. The findings emphasize the importance of compatibility assessments in streamlining risk evaluations. When avionics components are incompatible, the likelihood of operational failures and safety hazards increases. This research demonstrates how compatibility assessments act as a preliminary filter in risk management, enabling more precise and effective risk mitigation strategies. Key risk factors, including electromagnetic interference (EMI), human factors, environmental challenges, and software reliability, are analyzed alongside mitigation approaches such as redundancy, shielding, and proactive maintenance protocols.

Conclusions: This study underscores the necessity of integrating compatibility and risk assessments in avionics engineering. By proactively addressing compatibility concerns and utilizing structured risk assessment methodologies, aviation professionals can enhance safety, reduce operational risks, and maintain the reliability of avionics systems. The research highlights the importance of early-stage evaluations and mitigation strategies to uphold aviation's stringent safety standards.

Acknowledgements: The authors acknowledge the guidance and support of the “Georgi Benkovski” Bulgarian Air Force Academy in the preparation of this study..

Keywords: *Avionics, compatibility assessment, risk evaluation, safety, reliability, mitigation strategies.*

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6. AUTOMOTIVE ENGINEERING AND MATERIALS TECHNOLOGY

1) The Importance of Composite Armour in Military Vehicles. Advancing Protection and Endurance

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Introduction: In modern warfare, the protection and endurance of military vehicles are critical factors in ensuring operational success and troop safety. Traditional steel armor, while effective in the past, has proven to be heavy and less adaptable to evolving threats. This study explores the significance of composite armor, its key advantages, and its impact on the future of military design and warfare.

Methods and Results: To gain a comprehensive understanding of the importance of composite armor in military vehicles, a range of research methodologies can be employed. These methods not only help assess the material's effectiveness but also examine its advantages over traditional armor systems and its impact on vehicle performance, mobility, in combat. Key approaches include:

To gain a comprehensive understanding of the importance of composite armor in military vehicles, a range of research methodologies can be employed. These methods not only help assess the material's effectiveness but also examine its advantages over traditional armor systems and its impact on vehicle performance, mobility, in combat. Key approaches include:

Analyzing literature review is an essential starting point to understand the current state of knowledge on composite armor. By analyzing research papers, technical journals, and historical military reports, we can trace the evolution of armor technologies and their impact on military vehicle design.

Material testing is a cornerstone of understanding how composite armor performs under various conditions. Using techniques like ballistic testing, stress analysis, and fatigue testing to determine durability and protection levels. These rigorous tests offer a direct comparison of composite armor against other materials and help gauge its effectiveness in real-world combat scenarios.

Advancements in computational tools allow to simulate the behavior of composite armor under various conditions, making it possible to predict how different materials will respond to threats without conducting extensive physical testing. Comparing composite armor to traditional materials like steel, aluminum, and reactive armor is essential in evaluating the true advantages of composite technology and key factors such as weight reduction, fuel efficiency, and overall vehicle endurance.

Conclusions: As military vehicles face increasingly sophisticated threats, the continued evolution of composite armor will play a crucial role in ensuring the survivability of both the vehicles and their crews. Future research and innovation in composite materials will likely focus on enhancing their performance further while reducing costs and improving manufacturability.

Keywords: *Protection, Durability, Performance, Threats, Innovation.*



2) Developing an Efficient System for Managing Technical Resources and Vehicles

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Introduction: Effective logistics management plays a crucial role in reducing costs and enhancing operational efficiency in both logistics companies and military organizations. By integrating advanced tracking, predictive maintenance, and fleet management technologies, organizations can optimize resource allocation, prevent equipment failures, and ensure uninterrupted operations in critical situations.

Methods and Results:

Inventory and Management of Technical Equipment:

- Case Study: NATO's Logistics Management System (LOGFAS)
- NATO employs LOGFAS (Logistics Functional Area Services), an advanced logistics management system that monitors essential equipment and resources in operational theaters. It ensures strict control over weapons, ammunition, vehicles, and spare parts, preventing losses and unauthorized use.

Implementation:

- RFID system for tracking weapons, vehicles, and military equipment in real time.
- Secure warehouses with biometric access and electronic authorization to prevent theft and misuse.
- Centralized tracking system for stock levels and resource distribution to ensure logistical efficiency.

Preventive Maintenance Planning

- Case Study: U.S. Army and Predictive Maintenance Systems (CBM+ – Condition-Based Maintenance Plus)
- The U.S. Army utilizes CBM+, an advanced condition-based maintenance system that employs sensors and artificial intelligence to monitor armored vehicles and aircraft. This system detects potential failures early, preventing major breakdowns and reducing downtime.

Implementation:

- IoT sensors on military vehicles (e.g., armored personnel carriers, tanks) to monitor engine temperature, suspension wear, and fuel consumption.
- Data analysis software generating automated alerts for necessary technical inspections. Digital predictive maintenance program to minimize mission failures and ensure constant equipment availability.

Enhancing Fleet Management:

- Case Study: German Army and the MILIS Fleet Management System
- The Bundeswehr (German Army) uses MILIS (Military Logistic Information System), a digital system that tracks all military vehicles and logistical resources. It optimizes the use of tanks, transport vehicles, and aircraft, increasing efficiency and reducing operating costs.

Implementation:

- Digital fleet management system to monitor vehicle usage, fuel needs, and technical condition.
- Intelligent vehicle allocation platform to ensure rapid deployment of necessary equipment. Data analytics to reduce fuel consumption and improve logistical efficiency.

Conclusions: The integration of advanced logistics technologies, such as RFID tracking, predictive maintenance, and automated fleet management, plays a crucial role in optimizing military logistics. These systems not only enhance operational efficiency but also reduce costs, prevent equipment failures, and improve resource allocation. Case studies from NATO, the U.S. Army, and the German Bundeswehr demonstrate the effectiveness of these approaches in modern defense operations. By adopting similar strategies, the Romanian Armed



Forces can significantly enhance their logistical capabilities, ensuring better preparedness and operational readiness in both peacetime and conflict scenarios.

Acknowledgements: Associate Professor PhD Eng. STOICA Ramona.

Keywords: *RFID tracking, predictive maintenance, military fleet management, automation in logistics, defense logistics.*

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3) Dual-Axis Steering System

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Introduction: In our motorsport era, the teams are fighting for the fundamental hegemony. Even if it costs, the engineering innovations are inevitable appearing for the battle between the motorsport teams.

In Formula 1, these breakthroughs are constantly being hunted because the car is more important than the driver. In 2020, the Mercedes-AMG-Petronas F1 Team had developed a special steering system called Dual-Axis Steering (DAS). Don't confuse the DAS system from F1 with the DAS system from electronics(Distributed Antenna System) which involves the use of several antennas as opposed to one antenna to provide wireless coverage to the same area but with reduced total power and additional reliability. In 2021,the system was banned by FIA(International Automobile Federation),on Christian Horner`s complaint(the team principal of the main rival team:Red Bull Racing).

Methods and Results: This study is based on a qualitative analysis of existing literature, technical reports, and expert analyses from sources including Formula 1 technical documents, automotive engineering studies, and expert interviews. The research investigates:

- The mechanical function of DAS and how it influenced tire performance;
- The advantages it provided in straight-line speed, cornering, and tire temperature control;
- The regulatory challenges leading to its ban in 2021.

Data sources include race statistics, performance reports, and FIA technical regulations to evaluate how DAS contributed to Mercedes' competitive edge in the 2020 season.

Findings from this analysis reveal the following key insights:

- Improved Tire Management: DAS enabled dynamic toe adjustments, allowing drivers to optimize tire temperature, reducing wear and improving tire longevity over race distances;
- Enhanced Cornering and Straight-Line Stability: The ability to switch between zero-toe (for straights) and negative toe (for cornering) allowed better vehicle handling, increasing both speed and stability;
- Impact on Mercedes' Success: The W11 car, equipped with DAS, secured 13 victories, 15 pole positions, and dominated the 2020 season;
- Regulatory Implications: Despite its effectiveness, the system was banned for the 2021 season due to concerns over its legality and fairness. The FIA ruled that it was an active suspension-like system, which conflicted with existing regulations.

This case study emphasizes how engineering advancements often challenge regulatory boundaries, leading to debates over the fairness and legality of such innovations. The ban of



DAS raises important questions about the future of technological developments in Formula 1, particularly as the sport seeks to maintain both competitiveness and fairness.

Conclusions: As motorsport continues to evolve, the legacy of DAS serves as a reminder of how cutting-edge technology can redefine competition—until regulatory bodies step in to maintain a level playing field.

Keywords: *Dual-Axis Steering (DAS), Formula 1 engineering, Toe angle, Tire temperature management, Mercedes-AMG Petronas F1 Team, FIA regulations.*

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4) Application of Additive Manufacturing in Automotive Component Production

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Introduction: In recent years, Additive Manufacturing (AM) has become a revolutionary technology in the automotive industry, fundamentally changing the way vehicle components are designed and produced.

Methods and Results: Unlike traditional subtractive manufacturing methods, AM allows for the creation of parts layer by layer, reducing material waste and offering increased design flexibility. The application of additive manufacturing in the automotive field ranges from rapid prototyping to the production of functional components, providing significant advantages such as weight reduction, performance improvement, and cost optimization for low-volume production. Technologies such as Fused Deposition Modeling (FDM), Selective Laser Sintering (SLS), and Direct Metal Laser Sintering (DMLS) open up new possibilities for creating lightweight, durable, and customized automotive components. The goal of this research is to analyze the impact of additive manufacturing on the automotive component production process, highlighting the benefits, challenges, and future potential of this technology within the industry. Through practical projects and theoretical studies, we will explore how AM can contribute to increasing efficiency, sustainability, and innovation in automotive engineering.



Conclusions: Additive Manufacturing has the potential to significantly transform the automotive industry by offering innovative solutions for the production of lightweight, durable, and highly customized components. While the technology brings numerous benefits, including enhanced design flexibility, cost-efficiency, and improved performance, it also presents challenges that need to be addressed for its widespread adoption in mass production. As the industry embraces these advancements, AM will play a critical role in revolutionizing how automotive components are designed, produced, and optimized.

Acknowledgements: col. conf. univ. dr. ing. Radu VILAU.

Keywords: *additive manufacturing, rapid prototyping, fused deposition modeling, selective laser sintering, direct metal laser sintering, automotive components.*

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5) Tubular Heat Exchangers: Efficiency, Functionality, and Industrial Applications

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Introduction: Tubular heat exchangers play a key role in efficiently transferring thermal energy between two fluids at different temperatures without mixing. The objective of using such an exchanger is to optimize the cooling or heating of a fluid, maintaining thermal efficiency and protecting the equipment against overheating or excessive cooling. In the context of exploitation, tubular heat exchangers are used in industries such as automotive, chemical, energy and naval, where resistance to high pressures and thermal variations is essential. Thanks to their robust design, they are suitable for challenging environments such as high-power engine cooling systems, extreme temperature industrial processes or military applications where optimum reliability and performance are critical.

Methods and Results: Heat transfer takes place according to the second principle of thermodynamics: heat always moves from a warmer environment to a cooler one. The heat transfer in a tubular heat exchanger is carried out by three fundamental mechanisms: conduction, convection and radiation. In the case of tubular heat exchangers, the first two are the most important and are found in the following order. Convection – heat passes from the warm environment to the wall. Driving – heat moving through the wall. Convection – heat is transferred from the wall to the cold environment. Tubular heat exchangers operate on the principle of heat transfer by thermal conductivity between two fluids at different temperatures without mixing. The process is carried out in a system consisting of an assembly of tubes located in a cylindrical housing. Stages of the heat transfer process: Fluid input – A hot and cold fluid circulates through the exchanger. One of the fluids passes through the inside of the tubes, and the other through the space between the tubes and the outer shell. Heat transfer – Heat is transferred through the tube walls from the warmer fluid to the cooler fluid, either by convection (when the fluid flows and changes heat with the tube walls) or by conduction (through the tube material). Fluid output – After the heat exchange has taken place, the fluids come out of the exchanger with changed temperatures: the hot fluid cools, and the cold one heats up. The type of fluid flow specific to tubular heat exchangers is the counter-current flow, that is, the fluids move in opposite directions, maximizing the heat transfer efficiency.



Heat exchangers are found mounted horizontally or vertically, in the fusion of the constructive solution. In vertical heat exchangers occurs the effect of thermosiphon, where the differences in temperature and density of the fluid determine its natural circulation, without requiring a recirculation pump, while at horizontal heat exchangers this effect is not found. In vertical tubular heat exchangers: heated fluid becomes lighter and naturally climbs while the cold, denser fluid descends but also allows to save energy and reduce operating costs, being ideal for energy-efficient systems. In horizontal tubular heat exchangers: the natural circulation of the fluid is very limited, because there is no difference in height that favours the separation of fluids of different densities, and to ensure an effective heat transfer, it is necessary to use a pump that forces fluid circulation.

Advantages of tubular heat exchangers:

1. High thermal efficiency – Good heat transfer between fluids due to the large heat exchange surface.
2. High pressure and temperature resistance – Can operate under extreme conditions, being used in industrial processes.
3. Durability and reliability – Constructed from corrosion-resistant materials (stainless steel, special alloys).
4. Easy to maintain and clean – Tubes can be individually inspected and cleaned.

Disadvantages of tubular heat exchangers:

1. Large size – Requires considerable space for installation, especially in the long tube variant.
2. High initial cost – Manufacture and installation can be expensive compared to other types of exchangers.
3. Possibility of depositing and clogging – Dirty or viscous fluids can cause deposits on tubes, reducing efficiency.
4. Heat loss – Requires insulation to minimize thermal loss, especially in high temperature applications.

Conclusions: In conclusion, we can say that tubular heat exchangers are efficient heat transfer solutions, used in a wide range of industrial applications, including in areas such as TAB77. Their efficiency depends on factors such as the diameter of the tubes, which influence the heat transfer surface and pressure losses, as well as the cooling time, which is essential for processes requiring precise temperature control. By optimizing these parameters, it can improve system performance, reduce operational costs and increase energy efficiency, making them a versatile choice for various industries.

Acknowledgements: Associate Professor PhD Eng. VOICU Daniela.

Keywords: *thermosiphon effect, heat transfer, military, automotive..*

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6) Methods to Improve Visibility at Driver's Post for Romanian Armored Personnel Carriers

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Introduction: The modernizations and methods that the Romanian army can make to improve driver's visibility when driving armored personnel carriers.

Methods and Results: We will analyze the current constructive solutions and how we can improve visibility with or without major changes to the carrier and their effect on driving.

Conclusions: Through this research, we aim to identify the best modernization equipment and methods, to increase the visibility in Romanian armored personnel carriers, thus increasing the driver's reaction capacity in the battlefield and reducing fatigue caused by the low field of view.

Acknowledgements: I wish to express my sincere appreciation to *Lt.col. conf.univ.dr. ing. Marian TRUŢĂ*, for the guidance and support throughout the research process.

Keywords: *armored personnel carrier, visibility, modernization, field of view..*

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7) Last-Mile Supply in Military Operations

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Introduction: Efficient last-mile supply in military operations is crucial for sustaining combat effectiveness. Traditional supply chains, reliant on ground convoys and manned aircraft, are often hindered by terrain challenges, hostile threats, and delays. New technologies such as Unmanned Aerial Vehicles (UAVs) as well as a new tactical approach to logistics, has introduced new possibilities for secure and rapid supply deliveries. This presentation explores the role of UAVs in last-mile military delivery, examining past operations and technological advancements.

Methods and Results: Military logistics have historically depended on centralized distribution points, making last-mile delivery a significant operational vulnerability. Past conflicts, such as those in Iraq and Afghanistan, highlighted the dangers of ground-based convoys, which suffered from ambushes and improvised explosive devices (IEDs). In response, UAVs have been increasingly integrated into logistics frameworks, enhancing delivery efficiency while minimizing personnel risk.

UAV logistics provide decentralized supply distribution, reduce reliance on large transport assets, and improve resilience in contested environments. Systems like the Joint Tactical Aerial Resupply Vehicle (JTARV) and autonomous quadcopters have demonstrated their potential for delivering medical supplies, ammunition, and rations in battlefield conditions. Additionally, UAVs can provide rapid emergency resupply to isolated units, ensuring continuous operational effectiveness in dynamic combat scenarios. Their ability to operate autonomously or be remotely piloted allows for real-time adaptability, reducing dependency on pre-established supply routes that may be compromised due to enemy action or environmental challenges.



Advanced UAVs equipped with artificial intelligence (AI) and real-time data processing can optimize route planning, avoiding detection and hostile engagements. Furthermore, modular payload capabilities allow UAVs to transport various types of supplies depending on mission requirements, from humanitarian aid to critical combat resupply. Future developments may include AI-driven swarm logistics, where multiple UAVs collaborate to deliver supplies more efficiently and mitigate single-point failures.

Conclusions: The integration of UAVs in last-mile military supply chains presents both opportunities and challenges. While these systems enhance operational flexibility and security, challenges such as payload limitations, cybersecurity threats, and airspace coordination must be addressed. Ongoing technological advancements in UAV efficiency and reliability will continue to shape the future of military logistics. Future military supply chains will likely involve hybrid models, combining manned and unmanned delivery systems for greater adaptability and resilience.

Keywords: UAV, drone, supply, last-mile, military.

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8) The Revolution of Common Rail Injection Systems “i-ART CRS”

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Introduction: The i-ART CRS or Intelligent-Advanced Rail Tehnology is an advance fuel injection system. Unlike traditional systems, it uses individual pressure sensors on each injector, allowing for precise control of fuel delivery. This improves fuel efficiency, engine performance and lowers emissions, revolutionizing common rail technology in diesel engines.

Methods and Results: To better understand the impact and benefits of the i-ART Common Rail System, several analysis and testing methodologies were employed. These techniques enabled an in-depth evaluation of the system's efficiency, its superiority over traditional methodologies, and its overall impact on operational performance. The key methodologies implemented are as follows:

Literature Review: A detailed review of technical literature, including industry reports, academic research papers, and manufacturer specifications, was undertaken to understand the development of common rail injection technology. This investigation provided critical insights into the progression of fuel injection systems, the challenges addressed by i-ART CRS, and its role in enhancing fuel delivery precision, efficiency, and emissions control.

Performance Testing: The i-ART CRS was subjected to rigorous real-world testing under varying engine loads, speeds, and environmental conditions. Key performance parameters, such as injection timing accuracy, pressure stability, atomization quality, and response time, were meticulously analyzed. The system's ability to dynamically self-adjust injection timing and pressure in response to real-time engine demands was examined to determine its impact on fuel economy, power output, and emissions reduction.

Comparative Assessment: The performance of the i-ART CRS was benchmarked against conventional common rail systems. Metrics such as fuel efficiency, NOx and particulate emissions, and power output variations were analyzed. The results demonstrated that the i-ART CRS offers superior fuel metering precision and enhanced adaptability, reducing fuel consumption and emissions.



Conclusions: The findings confirm that the i-ART CRS enhances fuel injection accuracy, improves combustion stability, and reduces emissions while maintaining optimal engine performance. The adaptive injection control system allows for real-time adjustments, leading to increased efficiency and reduced wear on engine components. Computational simulations further validated the system's ability to optimize fuel delivery across various operational scenarios, reinforcing its advantages over traditional CRS technologies.

Acknowledgements: Col.conf.univ.dr.ing. VILĂU Radu.

Keywords: *Injection, Engine, Pressure, Emissions.*

9) The study of polymeric materials

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Introduction: In our current times polymer-based materials are found everywhere, ranging from food packaging all the way to gun parts.

Methods and Results: Every day we use objects made from these materials such as water bottles, toothbrushes, pens and many more, fact that shows us how dependant on them we are. The reasons why plastics are so widespread are ease of use, cost efficiency and high durability compared to their light weight. Despite all these qualities plastic has one major drawback that makes it far from a perfect material, it is one of the main factors that pollutes our environment.

Conclusions: In other words, we can understand that the use of plastic is a double-edged sword, being able to both make our lives easier and more affordable but also to make our lives a lot harder because of its toll on our environment.

Acknowledgements: Prof. Nedelcu Roxana.

Keywords: *polymer-based, plastics, affordable, environment.*

10) The Sonicity Theory

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Introduction: The Sonicity Theory, developed by the Romanian engineer and scientist George (Gogu) Constantinescu, remains one of the least publicized yet most groundbreaking scientific contributions of the 20th century. Despite his recognition among the greatest minds of his time—alongside figures such as Marie Curie, Einstein, Edison, and Marconi—Constantinescu's work was largely confined to the military domain under the British Admiralty, limiting its dissemination and practical application.

Methods and Results: Constantinescu's theory postulates that mechanical energy can be transmitted through sonic waves in fluids and solids, much like electrical energy travels through conductors. This concept laid the foundation for innovations such as the synchronized machine-gun firing mechanism used in World War I, which allowed pilots to fire through the rotating propeller blades without damage. This invention provided a crucial advantage in aerial combat, and many surviving pilots expressed their gratitude to Constantinescu for his life-saving technology. Despite this, his contributions have often been misattributed—many historical accounts credit Germany with pioneering synchronized firing systems, overlooking the Romanian scientist's pivotal role.



His work was not only recognized by peers like Lord Rayleigh, Sir J.J. Thompson, and Sir Charles Parsons but was also compared in scope to Einstein's Theory of Relativity. A 1966 obituary in the Journal of the Society of Engineers in England acknowledged that, even half a century after its publication in 1918, the Sonicity Theory was still not fully understood. This raises a fundamental question: why has such an innovative theory remained in obscurity?

Several factors contribute to this. Some barriers were self-imposed by Constantinescu, who introduced certain intentional "keys" or complexities in his formulations, making his work difficult to interpret. Other obstacles stemmed from economic and industrial interests—widespread adoption of his couple convertor and other sonic-based transmission systems would have disrupted established industries relying on conventional mechanical gear systems. There is also speculation that some of his innovations, such as the sonic silent cannon developed in 1919, were secretly adapted for use in military applications, such as torpedo and missile launches from nuclear submarines.

The fate of Constantinescu's work bears similarities to that of Nikola Tesla—both were visionary scientists whose revolutionary ideas faced suppression or appropriation due to financial and political interests. While Tesla envisioned free, unlimited energy for humanity, his projects were deliberately underfunded and suppressed. Similarly, Constantinescu's contributions in energy transmission and mechanics were marginalized, though many of his principles remain relevant today.

As modern physics revisits concepts such as quantum vacuum energy and resonance-based energy conversion, the Sonicity Theory may yet prove to be a cornerstone for future technological breakthroughs. Constantinescu's work offers a legacy that extends beyond his time, providing fundamental insights that could shape new advancements in mechanical and energy transmission technologies.

Conclusions: The Sonicity Theory, developed by Gogu Constantinescu, revolutionized the understanding of mechanical energy transmission by applying wave principles similar to electromagnetism. It proposed that energy could be transferred efficiently through fluids and solids using sonic waves, eliminating the need for traditional gears and mechanical linkages. One of its most notable applications was in aviation, where Constantinescu's synchronization mechanism allowed machine guns to fire through a rotating propeller without damage. Despite its potential, the theory remained largely overlooked due to military secrecy and resistance from industrial interests. Although recognized by prominent scientists of the time, its full implications are still not widely explored. As modern physics advances in wave-based energy transmission, the Sonicity Theory may hold untapped potential for future technological innovations in mechanics, fluid dynamics, and energy systems.

Acknowledgements: Associate Prof. Col. Radu VILAU, PhD.

Keywords: : *Sonicity Theory, mechanical energy, sonic waves.*

11) Study on the Influence of Heat Transfer at the Brake Disc Level on System Performance

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Introduction: Heat transfer plays a crucial role in the performance of braking systems, influencing both deceleration efficiency and component durability. The heat dissipation capacity of the disc directly affects the braking system's behavior and can lead to phenomena such as thermal fading, accelerated material wear, and loss of braking performance.

Different automobile manufacturers employ various design solutions for braking systems, with the most commonly used being disc brake systems and drum brake systems. In this study, we will focus on the disc brake system, which, from a structural perspective, consists of the following components, observable in Fig.1: the brake disc, caliper, brake pads, mounting system, and actuation mechanism.

Methods and Results: During vehicle braking – especially under conditions approaching the tire-road adhesion limit – the brake disc undergoes intense heat transfer through conduction, convection, and radiation. Conduction occurs at the interface between the brake pads and the disc, where frictional heat moves inward into the cooler disc material. This helps distribute temperature but may also cause structural deformation or cracking. Convection transfers heat to the atmosphere and is strongly influenced by vehicle speed and airflow velocity across the disc. Ventilated discs, equipped with internal channels, enhance cooling by inducing turbulent airflow, making convection the most efficient transfer mechanism. Radiation becomes relevant at high disc temperatures (200–300 °C), as energy is emitted as electromagnetic waves—mainly in the infrared spectrum—toward the environment. While less dominant than convection, radiation plays a key role at peak temperatures. Together, these mechanisms ensure effective heat dissipation and maintain braking system performance under demanding conditions.

The brake disc material directly influences heat dissipation and thermal performance. Cast iron, commonly used in production vehicles, offers good thermal conductivity but is heavy and prone to cracking under extreme stress. Alloy steel ensures mechanical strength but may overheat without proper ventilation. Advanced materials like carbon-ceramic perform well at high temperatures yet are costly and impact-sensitive. Material selection requires balancing thermal efficiency, durability, and cost.



Fig. 1: View of a disc brake system

Braking systems function as energy conversion mechanisms. When a vehicle is in motion, it carries kinetic energy proportional to its mass and velocity. Upon application of the brakes, friction is generated between the brake components. This frictional interaction converts the vehicle's kinetic energy into thermal energy. This energy transformation process exemplifies the First Law of Thermodynamics, which asserts that energy cannot be created or destroyed, but only converted from one form to another. It is nevertheless essential to acknowledge that this study disregards energy losses occurring in components with relative motion, such as the transmission. The analysis is based on the assumption that the entire kinetic energy is converted into heat at the level of the braking system.

$$E_c = 0.15Mv^2$$

Kinetic energy of the vehicle, referenced to a single front brake disc, with m representing the dynamic load transferred to the front axle during braking – approximated as 60% of the total vehicle mass. Vehicle velocity can be determined using the following formula:

$$v = v_0 \left(1 - \frac{t}{t_f}\right), \quad \text{where} \quad t_f = \frac{1}{\delta \phi g} \left[v_1 - v_2 + \frac{kA}{3M_{ag}\phi} (v_1^3 - v_2^3) \right] - \text{braking time.}$$

Rate of generated heat due to friction is equal to the friction power, with the resulting thermal energy being partially absorbed by the disc and partially by the pads. This distribution is attributed to the imperfect thermal contact at the pads–disc interface, an assumption adopted in this study, considering the thermal resistance caused by a third-body layer formed from detached particles:

$$\sigma = \frac{\xi_d S_d}{\xi_d S_d + \xi_p S_p} - \text{heat partition coefficient.}$$

The study focuses on constant deceleration, as previously mentioned, while also accounting for the pressure distribution at the sliding surfaces by considering an uniform wear, which is a more realistic assumption after several braking.

The heat generation for the disc:

$$d\dot{E} = dP = v dF_f \Rightarrow d\dot{E}_d = \sigma dP = \sigma \omega \mu p \phi_0 r^2 dr$$

The heat flux: we divide rate of thermal energy by the surface contact area:

$$q_d(r, t) = \frac{d\dot{E}_d}{ds_d} = \sigma \frac{\phi_0}{2\pi} \mu p r w(t) \text{ and } p = p_{max} \frac{r_2}{r} - \text{pressure distribution for uniform wear.}$$

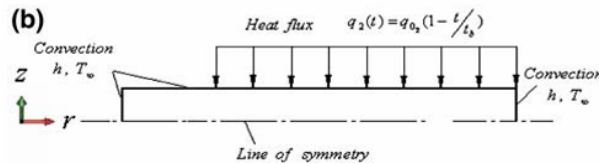
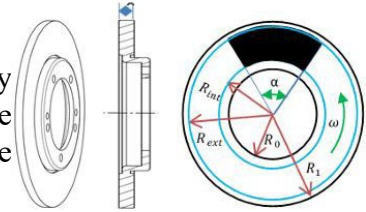


Fig. 3: Boundary conditions

The temperature distribution within the brake disc is determined using Fourier's heat conduction equation. The analysis assumes an transient state thermal regime with no internal heat generation, where the temperature laplacian is expressed in cylindrical coordinates, appropriate for the disc geometry. The boundary conditions are defined at the disc's outer surface, incorporating energy losses through convective heat transfer. Due to the continuous rotation of the disc and the assumption that the brake pad engages the entire circumferential angle, the temperature gradient in the circumferential direction is considered negligible and the generated heat is uniformly distributed in that direction.

Fig. 2: Disc-pad dimension

$$\frac{\partial^2 T}{\partial r^2} + \frac{1}{r} \frac{\partial T}{\partial r} + \frac{\partial^2 T}{\partial z^2} = \frac{1}{\alpha_p} \frac{\partial T}{\partial t}$$

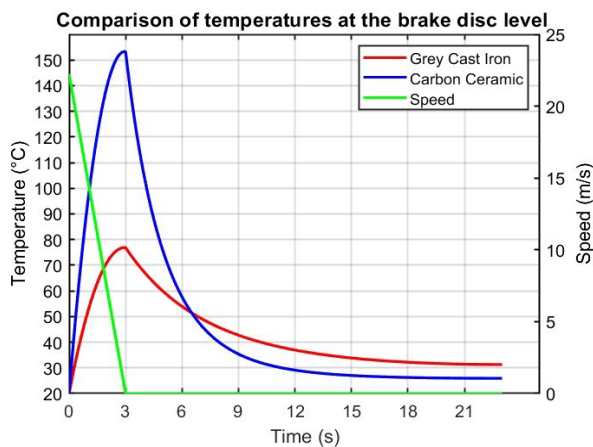


Fig. 4: Temperatures variation

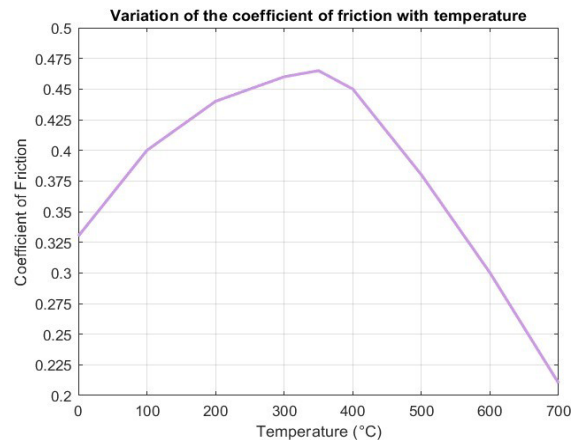


Fig. 5: Friction coefficient



After performing braking at the adhesion limit from an initial speed of 80 km/h, the variation in temperature within the brake disc cooling area was analyzed. The underlying assumption was that, under these conditions, heat dissipation occurs predominantly through natural convection to the surrounding atmosphere. This convection regime is considered appropriate since the vehicle is stationary and the brake disc is not exposed to a forced, turbulent airflow that could otherwise enhance heat transfer. To estimate the cooling behavior of the brake disc under these conditions, Newton's law of cooling was applied.

$$T_r = T_a + (T_{r-1} - T_a) * e^{-\frac{A*U}{m_d*c_p}\Delta t}$$

Conclusions: The study emphasizes the importance of effective heat transfer in braking systems, showing that temperature distribution and cooling behavior are strongly influenced by disc material properties and thermal mechanisms like conduction, convection, and radiation. Under stationary conditions, natural convection governs cooling, with peak temperatures occurring shortly after braking begins. A realistic model assuming uniform wear enabled accurate estimation of heat flux and temperature variation. The findings underline the need for careful material selection and disc design to prevent thermal degradation and ensure reliable braking performance.

Acknowledgements: mr. conf. univ. dr. ing. STOICA Ramona.

Keywords: *Heat transfer, braking system, thermal dissipation/ thermal stress, materials, braking performance.*

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12) Design and Kinematic Analysis of a Front Hood Lock for an Automobile

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Introduction: This paper presents the design process and motion analysis of a front hood lock for an automobile, focusing on the functionality of the locking and unlocking mechanism. The study aims to enhance the security and reliability of automotive hood locks by optimizing their mechanical performance. The lock was modeled and assembled in CATIA V5, incorporating key components such as the base plate, locking mechanism, and springs.

Methods and Results: The kinematic analysis identified the system's degrees of freedom and examined the movement of components during operation. Simulations were conducted to determine the minimum stroke required for unlocking, ensuring smooth operation without mechanical interference. The results demonstrated that the redesigned mechanism



improves both security and ease of use, making it a reliable solution for modern automotive applications.

Conclusions: The study confirms that an optimized hood lock design significantly enhances safety and efficiency in automobiles. The detailed technical documentation provides valuable insights into the assembly's functionality, supporting further advancements in automotive locking systems.

Acknowledgements: The authors would like to thank prof. Voicu Daniela for guidance and support throughout this research.

Keywords: *kinematic analysis, motion study, mechanical design, simulation.*

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13) Laser Systems in Engineering and Automotive Industries

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Introduction: In this article, we explore the impact of laser systems in engineering, with a special focus on the automotive industry. Laser technology has revolutionized industrial processes, bringing greater precision, speed, and efficiency..

Methods and Results:

1. Applications of Laser Systems in Engineering and the Automotive Industry

1.1 Material Processing

- Laser cutting and welding – used in manufacturing metal parts with high precision.
- Engraving and marking – inscription of barcodes, serial numbers, and other technical information.

1.2 Metrology and Quality Control

- Laser sensors for measurements – enable verification of manufactured parts' dimensions.

- Material analysis through laser spectroscopy – identification of chemical composition.

1.3 Laser Systems in Automobiles and Autonomous Vehicles

- Lidar (Light Detection and Ranging) – used for autonomous vehicle navigation and obstacle avoidance.

- Material and safety testing – determining the strength of automotive components.

2. Advantages of Using Laser Technology

- High precision – essential in manufacturing high-quality components.
- Speed and efficiency – reduces production time and optimizes costs.
- Automation and easy integration – compatible with industrial robots and automated production lines.

- Durability and minimal wear – reduced contact with processed materials.

3. Challenges and Limitations of Laser Systems

- High costs – initial investment and maintenance can be significant.
- Energy consumption – some laser systems require a high power supply.
- Difficulties in processing reflective materials – aluminum and copper can reduce efficiency.

- Strict safety measures – protecting operators from laser radiation is essential.

Conclusions: Laser systems represent cutting-edge technology with vast applications in engineering and the automotive industry. While costs and safety measures remain challenges, the benefits of precision, speed, and efficiency outweigh these obstacles. As



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technology advances, laser applications are expected to become even more accessible and diverse.

Keywords: *Laser technology, automotive industry, material processing, autonomous vehicles (Lidar), quality control.*



7. LOGISTICS FOR DEFENCE AND SECURITY

1) Blockchain Technology in Logistics – A Supply Chain Revolution

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Abstract: The thesis analyzes and optimizes the distribution process in Company X. The theoretical section outlines the fundamentals of distribution and their importance in supply chains, along with modeling techniques for process improvement. The case study examines the existing distribution system, a simulation model developed in FlexSim, and results after implementing enhancements. The study emphasizes the role of modeling in improving logistics efficiency.

Keywords: *distribution, modeling, logistics, optimization, FlexSim, logistic processes, distribution channels, mathematical modeling, data analysis, logistic efficiency, simulation tools, supply chain management.*

2) Logistics for Defence and Security: Challenges and Strategic Implications

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Introduction: Logistics plays a pivotal role in the defence and security sectors, serving as the backbone of military operations and national security strategies. In an era of increasing geopolitical tensions and hybrid threats, the efficiency and resilience of logistical systems are critical to ensuring the readiness and effectiveness of defence forces. This study explores the challenges and strategic implications of logistics in the context of defence and security, with a focus on modern warfare, supply chain vulnerabilities, and the integration of emerging technologies.

As Sun Tzu once stated, "*Order involves organizational structure, chain of command, and logistics.*" This timeless insight underscores the importance of logistical planning in maintaining operational effectiveness, particularly in defence and security contexts where delays or failures can have catastrophic consequences. The authors will examine how logistical systems are adapting to the demands of modern warfare, including the need for rapid deployment, sustainability, and resilience in the face of asymmetric threats.

Methods and Results: This study employs a mixed-methods approach, combining qualitative analysis of case studies with quantitative data on logistical operations in defence and security. The research identifies key challenges, including supply chain disruptions, the vulnerability of critical infrastructure, and the increasing complexity of global logistics networks. Additionally, the study highlights the role of emerging technologies such as artificial intelligence (AI), blockchain, and autonomous systems in transforming defence logistics.

The findings reveal that while technological advancements offer significant opportunities for improving efficiency and reducing costs, they also introduce new risks, particularly in terms of cybersecurity and dependency on digital systems. The study also examines the strategic implications of logistical challenges for national security, including the need for robust contingency planning, international cooperation, and investment in resilient infrastructure.



Case studies from recent conflicts and military operations illustrate the critical role of logistics in determining the success or failure of missions. For example, the rapid deployment of resources during the Ukraine conflict demonstrated the importance of agile and adaptable logistical systems. Conversely, logistical failures in other contexts have highlighted the consequences of poor planning and coordination.

Conclusions: This study concludes that logistics is a cornerstone of defence and security, with significant implications for operational effectiveness and national resilience. The challenges posed by modern warfare, supply chain vulnerabilities, and technological dependencies require a proactive and strategic approach to logistical planning. Key recommendations include:

1. **Investment in Technology:** Leveraging AI, blockchain, and autonomous systems to enhance the efficiency and security of logistical operations.
2. **Resilience Planning:** Developing robust contingency plans to address supply chain disruptions and infrastructure vulnerabilities.
3. **International Cooperation:** Strengthening partnerships with allied nations to ensure interoperability and shared logistical resources.
4. **Cybersecurity Measures:** Protecting digital logistical systems from cyber threats to prevent disruptions and ensure continuity of operations.

The study emphasizes that the integration of advanced technologies and international collaboration will be essential for addressing the logistical challenges of the 21st century. By adopting a forward-looking approach, defence and security organizations can enhance their logistical capabilities and maintain a strategic advantage in an increasingly complex security environment.

Acknowledgements: Cpt.cdor Conf.univ.dr.ing. Cotorcea Alexandru.

Keywords: *Logistics, defence, security, supply chain, emerging technologies, resilience.*

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3) Industry 5.0 Concept - Another Step into the Future or an Unattable Goal?

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Introduction: Industry 5.0 is a term that is increasingly on the lips of not only scientists, but also entrepreneurs. Unlike previous industrial revolutions, which focused all attention on automation and eliminating humans from the production line, the concept of Industry 5.0 sets itself the priority of restoring the balance between production and social values. In today's world filled with the desire to achieve the highest results and optimize every process in the enterprise, is there room for the symbiosis of man and machine?

Methods and Results: Industry 5.0 represents the next phase of industrial evolution, integrating advanced automation with human collaboration to enhance efficiency, sustainability, and resilience. Unlike Industry 4.0, which prioritizes full automation, Industry



5.0 emphasizes human-centric production, where intelligent systems and workers cooperate to optimize processes. Key enabling technologies include artificial intelligence, digital twins, cobots, and real-time data analytics, all designed to augment rather than replace human labor.

The transition to Industry 5.0 promotes greater flexibility in production, reduced environmental impact, and improved working conditions through personalized and adaptive manufacturing systems. Sustainability plays a crucial role, focusing on circular economy principles, resource efficiency, and integration of renewable energy sources into industrial operations.

Despite its potential, significant challenges exist, including workforce adaptation, cybersecurity risks, regulatory frameworks, and the need for cross-sector collaboration. Companies must invest in upskilling employees to bridge the gap between traditional expertise and emerging digital competencies. The shift from Industry 4.0 to Industry 5.0 requires a fundamental rethinking of industrial strategies, moving beyond automation toward a holistic, human-centered manufacturing paradigm.

Future industrial ecosystems must integrate smart supply chains, AI-driven decision-making, and ethical considerations to ensure technological advancements align with societal needs. This transformation demands strong cooperation between industry, academia, and policymakers to establish global standards and best practices. Industry 5.0 is not merely an extension of current trends but a necessary evolution toward more adaptive, responsible, and intelligent manufacturing systems.

Conclusions: In the study authors presented the latest scientific achievements in the field of new technologies. The aim of the article is to define the meaning of the Industry 5.0 concept and the possibilities of its development and impact on society. Attention was also paid to the factors that caused the need to create a new industrial concept.

Keywords: *industry, efficiency, concept, impact.*

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4) Maintenance of Electrical Equipment on Board the Ship

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Introduction: This paper addresses the maintenance activities that must be implemented on maritime vessels, proposing new methods and approaches compared to traditional ones. In the context of energy generation for propulsion and powering the installations and equipment in the machinery and navigation systems (integrated system of the vessel), it is essential to consider the complexity and diversity of the systems involved, including thermal, electrical, and hydromechanical systems, which are interconnected and critical for the proper functioning of the vessel.

Methods and Results: The paper details a maintenance program adapted to the requirements of the manufacturer, the operating conditions of the vessel, and the type of equipment, aiming to ensure long-term operational efficiency. Maintaining the vessel's fundamental qualities, such as buoyancy, unsinkability, and stability, largely depends on a rigorous maintenance program that addresses these challenges. In this regard, the paper analyzes the importance of preventive and predictive maintenance, as well as proactive



maintenance, conducting a detailed SWOT analysis to assess the strengths, weaknesses, opportunities, and threats associated with these strategies.

Conclusions: Efficient maintenance of maritime vessels is an essential component in ensuring their long-term operability. Adopting advanced maintenance strategies, combined with proper crew training and the implementation of cutting-edge technologies, is key to achieving optimal results in the maritime industry.

Acknowledgements: University Professor, Doctor of Engineering Samoilescu Gheorghe.

Keywords: *maintenance, predictive, proactive, SWOT, analysis, opportunities.*

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5) Securing the Army's Logistic Needs Through Public Procurement in Poland

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Introduction: Spending public money to pay for key state institutions is a complex issue that requires a rational approach and responsibility. It is not without reason that, since Poland regained independence, for over a century, a public procurement system has been created and continually improved, the priority of which is the effective and efficient spending of public funds to meet the state's needs. This article will discuss the characteristics of the Polish public procurement system in the context of securing the logistics needs of the Polish army.

Methods and Results: The article addresses two main issues. First, through the analysis of individual (both historical and currently applicable) acts relating to the issue of public procurement, the genesis and development of the Polish public procurement system was developed. It is worth noting that the need for the discussed law arose, among other things, from the needs of responsible and rational financing of the army from taxpayers' money. The analysis of the applicable act allows us to identify who, when and on what terms can become a contractor or supplier for the Polish Army. The second issue addressed in the article is the analysis of proceedings conducted in a given period by the body responsible for purchases for the army. The collected data can be used to examine the proceedings and assess them in terms of effectiveness and efficiency. Generally, dealing with the issue of securing logistical needs through public procurement can bring the following two benefits. First, learning about the specifics of the public procurement system allows us to adapt to it and (as an enterprise) become more competitive on this market. Second, it allows us to find imperfections in the law or its application and propose improvements in order to optimize the spending of public funds.

Conclusions: Without a doubt, public procurement law is one of the most important factors determining how the army's logistical needs are met. The Polish public procurement system has undergone a long path of changes and improvements, so that it can now serve the rational financing of the needs of state institutions, operating within the framework of a free market economy and European Union integration.

Keywords: *logistics, public procurement, Polish Army.*



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6) Strategies for Efficient Supply Management in High-Risk Zones

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Introduction: Efficient supply management is critical in high-risk zones, where operational success and personnel survival depend on the timely delivery of essential resources. These zones include active conflict areas, regions affected by natural disasters, and politically unstable locations. Traditional supply chains struggle with challenges such as enemy interference, destroyed infrastructure, and unpredictable conditions. This presentation explores innovative strategies to enhance supply efficiency, leveraging modern technology, decentralized logistics, and adaptive planning.

Methods and Results: Managing supplies in high-risk areas requires advanced logistics strategies and resilient infrastructure. Key challenges include hostile interference, where enemy forces disrupt supply routes through ambushes, attacks on convoys, or cyber warfare. Infrastructure damage further complicates logistics, as roads, bridges, and storage facilities may be destroyed, requiring alternative transport methods. Additionally, unpredictable conditions such as weather fluctuations, shifting frontlines, or sudden policy changes can impact supply chains, making flexibility and adaptability essential.

To address these issues, several innovative solutions are being implemented. The use of autonomous systems and UAVs enhances supply security by enabling real-time reconnaissance, reducing human exposure, and supporting small-scale deliveries in contested areas. AI-powered autonomous vehicles can navigate dangerous terrain without endangering personnel. Another crucial approach is the implementation of a decentralized distribution flow system (DFS).

Instead of relying on a single vulnerable supply line, DFS establishes multiple smaller hubs that improve adaptability and response times. These hubs minimize the impact of a single disruption, ensuring continuous supply availability. By integrating these technologies and methods, military and humanitarian operations can maintain a resilient supply chain despite adverse conditions.

Conclusions: In recent decades, rapid advancements in technology have led to increased precision-strike capabilities, with militaries worldwide deploying cost-effective attack drones and guided missiles. Modern battlefields have become increasingly contested, allowing adversaries to strike deeper behind the frontlines with unprecedented accuracy. Supply chains are particularly vulnerable due to the predictability of their movements, making them prime targets for disruption. To mitigate losses in personnel and equipment, logistics strategies must evolve, integrating decentralized distribution models, autonomous delivery systems, and adaptive planning to enhance supply resilience in high-risk zones.

Keywords: *distribution flow system, military, supply management, high-risk area.*

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7) Optimisation of Spare Parts Inventory in the Naval Sector

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Introduction: The paper analyzes methods for optimizing spare parts inventory management in the naval sector, with a focus on electrical components. By combining classical inventory management theory (the Economic Order Quantity model – EOQ), with modern prediction and analysis methods, the study proposes a theoretical framework adapted to the specificities of naval operations. Forecasting algorithms, adapted mathematical models, and specific risk factors are presented, demonstrating the potential for cost reduction by 18-25% and service level improvement by 15%. The paper also proposes an inventory optimization system Naval Spare Parts Optimization System (NSOS), integrated with technologies such as artificial intelligence, providing a practical approach to improving operational efficiency and supply chain resilience in the naval sector.

Methods and Results: Our research methodology combined theoretical analysis with mathematical modeling to create an optimized inventory management system for naval spare parts. Studies indicate that vessels experience an average of 20% downtime due to spare parts unavailability, resulting in considerable financial losses. To address this, we developed a modified Economic Order Quantity (EOQ) model specifically adapted for naval operations:

$$EOQ_{naval} = \sqrt{\frac{2DS(1 + \alpha)}{H}}$$

where D represents annual demand, S is ordering cost, H is holding cost, and α is the maritime risk factor. For effective demand forecasting in the maritime environment, we implemented the Exponential Smoothing method with Trend and Seasonality (Holt-Winters):

$$Y_{(t+h)} = (l_t + hb_t)s_{(t+h-m)}$$

where l_t represents the level, b_t the trend, and s_t the seasonal component. The system incorporates Safety Stock calculations adapted for the extended lead times common in naval operations:

$$SS = Z \times \sigma_d \times (\sqrt{LT + RT})$$

where Z is the service level factor, σ_d is demand standard deviation, LT is lead time, and RT is review time. Our theoretical validation utilized mathematical simulations across three key scenarios: normal operations, high-demand periods, and supply chain disruptions. The results demonstrated potential inventory cost reductions of 18-25%, a 22% reduction in average inventory levels, 15% improvement in service levels, and 28% reduction in emergency orders.

Conclusions: The research successfully integrates classical inventory principles with modern optimization techniques adapted for maritime conditions. Our Naval Spare Parts Optimization System (NSOS) provides a robust foundation for practical implementation, demonstrating significant potential for improving operational efficiency while maintaining high reliability standards. Future research will focus on real-time sensor integration, maritime-specific machine learning algorithms, and blockchain implementation for enhanced supply chain transparency.

Acknowledgements: University Professor, Doctor of Engineering Samoilescu Gheorghe.

Keywords: *inventory, optimization, maritime, logistics, algorithms, supply.*

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8) The Use of Artificial Intelligence in the Defence Automotive Industry

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Introduction: The defence automotive industry is undergoing continuous transformation, and the integration of artificial intelligence (AI) into logistics plays a crucial role in improving operational efficiency. By automating processes, optimizing delivery times, and reducing costs, AI contributes to a smarter and more efficient supply chain. This article explores AI applications in warehouse inquiring, optimal decision-making, and associated challenges, emphasizing the necessity of human intervention to ensure flexibility and adaptability.

Methods and Results: As the defence industry moves toward increasingly automated solutions, the use of AI in logistics has become a key priority. Advanced machine learning algorithms and data analytics enable better inventory management, reduced delays, and optimized transport routes. However, integrating AI also presents challenges related to costs, implementation complexity, and limitations in decision-making within dynamic environments.



Querying Warehouses, Hangars and Garages.

One of AI's main advantages in defence automotive logistics is its ability to query complex databases and provide accurate real-time responses. AI-driven systems utilize advanced technologies such as: Internet of Things (IoT) – for real-time inventory monitoring, Machine Learning (ML) – for anomaly detection and demand forecasting, Big Data Analytics – for analyzing large volumes of data and optimizing logistics decisions.

By integrating these technologies, AI can determine the availability of spare parts, optimize resource allocation, and reduce the risk of supply chain disruptions [1].

Decision-Making for Optimal Responses.

Artificial intelligence is not limited to data collection and processing; it also plays an active role in decision-making. AI algorithms can evaluate factors such as: Distance and delivery time – to select the optimal route, Market demand and seasonality – to adjust inventory levels, Supplier availability – to minimize supply risks, Operational costs – to optimize logistics expenditures.

Through optimization techniques, AI can provide precise recommendations for inventory management and transportation planning, thereby reducing delays and financial losses [3][4].

Disadvantages of AI and the Necessity of Human Intuition.

While AI offers numerous advantages, it also has significant limitations that necessitate a balance between automation and human intervention: Lack of adaptability in exceptional situations – AI may struggle to handle unforeseen events such as sudden changes in demand or supply chain disruptions, High implementation costs – developing and integrating AI-based systems require significant investments in infrastructure, software, and employee training, Dependence on high-quality data – AI efficiency is directly proportional to the accuracy and volume of collected data, requiring a rigorous data management strategy [5].

Conclusions: AI is revolutionizing defence automotive industry logistics by providing efficient solutions for supply chain optimization. However, to maximize the benefits of this technology, close collaboration between automated systems and human expertise is essential. By combining AI capabilities with the experience and intuition of logistics professionals, an optimal balance between operational efficiency and strategic adaptability can be achieved.

Acknowledgements: mr.lect.univ.dr.ing. Ramona-Monica STOICA.

Keywords: *AI, transport, logistics, industry, automotive, defence.*

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9) Drones – The Future Is Already Here

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Abstract: The engineering thesis aimed to analyze the impact of modern technologies on warehouse operations. To achieve this objective, a review of literature on warehouses and modern technologies was conducted at the outset. The definition of a warehouse, its various types, and the processes occurring within it were discussed, with particular emphasis on the picking process. In the second chapter, modern warehouse-related technologies were presented, such as warehouse robots, transportation devices, and warehouse management systems. Particular attention was given to AGV vehicles, picking robots, the Internet of Things (IoT), and the FlexSim computer simulation software. The third chapter provides a description of enterprise X, including its structure and scope of activity. An analysis of the company's problems was conducted using tools such as SWOT analysis and the Ishikawa diagram. Additionally, the company's warehouse and process maps occurring within it were presented. Based on this information, a computer simulation of the warehouse at enterprise X was developed, incorporating innovative technologies such as AGV vehicles, picking robots, and the Internet of Things. The fourth chapter details the analysis of the computer simulation. Both models – the baseline and the modernized – were described and their results compared. The conducted analysis allowed for an evaluation of the impact of modern technologies on the warehouse's functioning and efficiency.

Keywords: *logistics, warehouse, modern technologies, warehouse robots, AGV (Automated Guided Vehicles), order picking, Internet of Things (IoT), warehouse management system (WMS), FlexSim, computer simulation, modeling, efficiency, SWOT analysis, Ishikawa diagram, optimization, warehouse processes, picking robots, indicators.*



8. COMMUNICATIONS AND SIGNAL PROCESSING

1) Automatic System for Digital Modulation Classification

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Introduction: Digital modulation classification is a component in modern communication systems, with applications in signal intelligence, cognitive radio and interference detection. The ability to automatically classify modulation schemes enhances spectrum monitoring and modern communication systems. This thesis focuses on developing an automated system for digital modulation classification using machine learning techniques, aiming to improve classification accuracy.

Methods and Results: The proposed system extracts features from modulated signals using signal processing techniques such as Short-Time Fourier Transform (STFT), Wavelet Transform, and statistical feature analysis. A dataset of modulated signals, including MFSK, MPSK, MASK, and QAM, is generated and used for training classification models. Four machine learning algorithms, K-Nearest Neighbors (KNN), Support Vector Machine (SVM), Decision Tree and Naive Bayes, are implemented and evaluated. The classification performance is analyzed using a confusion matrix and accuracy metrics. Additionally, a MATLAB-based graphical user interface (GUI) is developed to facilitate signal visualization and classification selection.

Conclusions: Machine learning techniques effectively classify digital modulation schemes with high accuracy. The system provides an intuitive interface for signal analysis and classifier comparison, benefiting researchers and engineers. Future work may explore deep learning integration and real-time classification for improved performance in dynamic environments.

Acknowledgements: Coordinator teacher: Stănescu Denis.

Keywords: *Spectrogram, Wavelet Transform, Statistical Features, Confusion Matrix, Accuracy.*

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2) Wide Spectrum Communications: Ultra-Wideband (UWB) Transmitters and Receivers

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Introduction: Ultra-Wideband (UWB) technology represents a significant advancement in wireless communications, utilizing an exceptionally wide frequency spectrum (typically over 500 MHz) to transmit short, high-power pulses. Unlike traditional systems that employ narrow channels, UWB offers high data transfer capacity and exceptional precision in localization.

Methods and Results: UWB transmitters generate extremely short pulses (<1 ns) spread over a broad frequency range, while receivers detect these pulses and correlate them to



extract the transmitted information. Modulation techniques such as Pulse Position Modulation (PPM) or Binary Phase Shift Keying (BPSK) are employed to ensure transmission efficiency. Applications of UWB include precise localization, enabling indoor positioning with accuracy up to 10 cm; high-speed communications for IoT networks, ensuring secure communication with low energy consumption; and military and security applications, such as UWB radar for through-wall object detection and secure communications due to transmission below noise levels.

Advantages of UWB technology encompass high spectral efficiency, low energy consumption, and resistance to interference. However, major challenges include regulatory limitations on emitted power, reduced coverage distance (typically <100 m), and the hardware complexity required for implementation.

Conclusions: This is the section where you should include the main conclusions of the paper. Please adhere to the style guidelines presented here to allow us to maintain uniformity in the final form of the Book of Abstracts. Please not insert the page number.

Keywords: *Ultra-Wideband, wireless communications, precise localization, IoT, radar, spectral efficiency.*

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3) Electronic Device for Measuring, Recording, Storing, and Transmitting Environmental Parameters

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Introduction: In the context of environmental monitoring and remote sensing, the integration of in-situ measurements with satellite imagery analysis provides valuable insights into various environmental parameters. This paper presents the development of an electronic device capable of measuring, recording, and transmitting environmental parameters in real time. The project involves both hardware and software components, ensuring data acquisition from physical sensors and subsequent analysis through satellite image processing techniques. The target use-case of the project is the monitoring of water quality in the Black Sea, with a focus on key parameters such as temperature, TDS and turbidity. The main goal is to correlate the real time measurements with remote sensing data to enhance accuracy in environmental assessments.

Methods and Results: The system consists of a hardware platform incorporating Arduino and Raspberry Pi devices, which interact with various environmental sensors to collect data such as temperature, turbidity, and total dissolved solids (TDS). The collected data is transmitted to a central processing unit, where it is analyzed and stored.

In the software component, satellite imagery from Sentinel-1 and Sentinel-2 is processed to extract relevant environmental parameters. The images undergo preprocessing steps such as georeferencing, resampling, and noise reduction before extracting information regarding water quality indicators like chlorophyll concentration and turbidity levels.



According to Lock et al. [1], Sentinel-2 imagery provides reliable insights for coastal water body health. A REST API facilitates communication between the hardware module and the analytical software, ensuring seamless data integration.

The system is currently under development, and experimental testing will be conducted in the next stages of the project to validate its functionality and correlation capabilities.

Conclusions: The proposed system provides an efficient solution for environmental monitoring, leveraging both physical sensor data and satellite imagery analysis. The integration of real-time measurements with remote sensing techniques enhances data reliability and applicability in various environmental studies. At the current stage, the project is ongoing and final experimental validations are yet to be completed.

Acknowledgements: Lt. col. conf. univ. dr. ing. Stefan-Adrian TOMA.

Keywords: *Environmental Monitoring, Remote Sensing, IoT, Sentinel-2, Data Integration, Water Quality.*

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4) Integrated Military Communications System

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Introduction: This paper presents the design and implementation of an Integrated Military Communications System, focusing on IPsec VPN tunnel and radio communications to establish secure and scalable data transmission. The objective is to develop a communications infrastructure that fulfills the interoperability, security, and reliability requirements of modern military operations, ensuring protected communications channels between units in both fixed and mobile configurations.

Methods and Results: The implemented system establishes an IPsec VPN site-to-site tunnel, using digital certificates for authentication, enhancing security over wired networks. Unlike traditional pre-shared key (PSK) authentication, digital certificates provide stronger encryption and prevent key compromise risks [1].

For radio communications, the system integrates RF-7800W HCLOS and RF-7800M-MP radio stations, ensuring secure and reliable data transmission in environments where wired infrastructure is unavailable or unfeasible. These radios provide long-range connectivity and high-capacity communications, extending network coverage in challenging operational scenarios.

Conclusions: The developed system successfully integrates secure wired and radio communications, ensuring encrypted data and voice transmission. The IPsec VPN with digital certificates reduce vulnerabilities associated with PSK authentication, while radio communications with RF-7800W and RF-7800M-MP stations extend the connectivity range beyond the capability of wired infrastructures.

Acknowledgements: Cpt. lect. univ. dr. ing. Alexandru FRUNZĂ.

Keywords: *Military communication, IPsec, digital certificates, radio transmission.*

References:



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5) Technical Design and Simulation of Mobile Communications Systems

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Introduction: Mobile communications represent a fundamental pillar of modern society, enabling rapid and efficient interconnection between people, devices, and services. These systems rely on radio waves for transmitting information between mobile devices and cellular network infrastructure, ensuring access to voice, messaging, and internet services wherever coverage is available. The evolution of this field has been marked by a constant increase in data transfer speeds, network capacity, and spectrum efficiency, all contributing to the emergence of increasingly advanced technologies. Initially, mobile communications were primarily used for voice calls. However, with technological advancements, they have become essential for mobile internet, multimedia streaming, and next-generation applications. Cellular networks are structured based on the principle of radio cells, each covering a specific area and connected to a base station. As users move, the connection is automatically transferred from one cell to another, ensuring uninterrupted communication. [1]

Methods and Results: This project aims to design and simulate mobile communication networks (2G, 4G, 5G) to analyze base station coverage for the mentioned technologies. The simulation involves documenting base stations, designing a base station for each technology (BTS, e-NodeB, g-NodeB) with omnidirectional and sectorial antennas using ICS Telecom software, and comparing propagation models from the ITU standard, which are documented and applied in this project. [2] The final part consists of comparing base station coverage for each technology. A crucial step in this process is assigning base station parameters, configuring their antennas, and selecting appropriate propagation models. To achieve this, it was studied outdoor propagation models suitable for the scenarios and requirements imposed throughout the study.

Conclusions: The simulations in ICS Telecom confirm that omnidirectional antennas are more efficient for wide-area coverage in low-density user regions, such as rural environments with fewer obstacles (tall buildings, dense vegetation). Meanwhile, sectorial antennas provide better coverage in urban areas, where signal concentration in a specific direction is necessary. In the performed simulations, the starting reference point was the coverage obtained using a theoretical, ideal propagation model, where the signal is not obstructed by buildings, vegetation, varying terrain, or other obstacles. Based on the results from this model, it was possible to compare coverage obtained with realistic propagation models against the ideal propagation model, which naturally yields the best results, though unrealistic. [3] The goal was to approximate these ideal results as closely as achievable using models that provide real-world accuracy, taking into account factors such as building density, terrain elevation, and other obstacles.

Acknowledgements: Assoc. Prof. Dr. Eng. Digulescu Angela.

Keywords: *Mobile Communications, Base Stations, Propagation Models, 2G, 4G, 5G.*

References:

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6) Network Intrusion Detection, Alerting, and Monitoring System

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Introduction: In the context of the ever-evolving landscape of cyber threats, efficient network monitoring and intrusion detection have become essential components in securing IT infrastructures. The increasing complexity and sophistication of cyber-attacks necessitate the development of advanced security solutions to mitigate risks effectively. This paper presents the design and implementation of a Network Intrusion Detection, Monitoring, and Alerting System (NIDS) utilizing open-source tools such as Suricata, Zeek, Arkime, and the ELK Stack (Elasticsearch, Logstash, Kibana). The main objective of this study is to develop an integrated and efficient intrusion detection framework capable of identifying various attack vectors and providing real-time alerts for security administrators.

Methods and Results: To evaluate the effectiveness of the proposed system, a controlled experimental environment was established using virtual machines. The setup consists of an attacker machine running Kali Linux, two target machines using Ubuntu, and a security monitoring system deployed on a separate Ubuntu machine.

A practical scenario was implemented to simulate a full cyber-attack chain.[1] The process begins with initial reconnaissance and vulnerability scanning to identify potential security weaknesses, followed by phishing attacks that lead to system compromise. Once inside the network, the attacker engages in lateral movement and privilege escalation using brute-force techniques to gain deeper access. Finally, data exfiltration is conducted through advanced methods such as DNS and ICMP tunneling, ensuring the covert extraction of sensitive information.[2]

Suricata and Zeek were employed to analyze network traffic and detect malicious activities, while Arkime facilitated deep packet inspection. The ELK Stack was used to aggregate, visualize, and analyze security events, providing insightful visual analytics through Kibana dashboards.[3]

The experimental results demonstrate the efficiency of the system in detecting and alerting administrators at each stage of the simulated attack. The system successfully identified reconnaissance activities, intrusion attempts, lateral movement, and data exfiltration. Kibana's visual dashboards provided clear, real-time insights, enhancing threat response capabilities.

Conclusions: The proposed intrusion detection and monitoring system effectively identifies various cyber-attack techniques in real time. The integration of open-source security tools offers a cost-effective and flexible solution for improving network security posture. The study highlights the importance of comprehensive monitoring in detecting and mitigating sophisticated cyber threats. Future work aims to incorporate machine learning techniques to enhance anomaly detection capabilities.

Acknowledgements: Colonel, Associate Professor, PhD, Eng. Iulian RÎNCU.

Keywords: *NIDS, Suricata, Zeek, Arkime, ELK Stack, Phishing, Brute-force, DNS Tunneling, ICMP Tunneling.*

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7) 5G Technology-Based Video Streaming Transmission System

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Abstract: This study explores the development and evaluation of a 5G-based video streaming system designed for real-time transmission from a drone to a remote server. The research focuses on the practical implementation of a private 5G network using the OAIBOX platform, with an emphasis on performance testing under various network conditions. The system architecture integrates a DJI drone for video capture, a Jetson Nano for edge processing, and a server accessible via mobile devices, ensuring seamless data retrieval and visualization. The study covers key theoretical aspects of mobile communications, including the principles of 5G technology as defined by 3GPP and IMT-2020, alongside the system's operational mechanisms. Performance tests assess the impact of parameters such as bandwidth, frequency band, TDD slot configuration, modulation schemes, and antenna setup on transmission quality. Evaluations are conducted in both line-of-sight and non-line-of-sight conditions, comparing results with theoretical expectations. Experimental scenarios are designed to identify system limitations and optimize transmission quality, with iterative testing to refine configurations. The findings provide insights into the feasibility of deploying 5G-based video streaming solutions for real-time applications, highlighting key performance metrics such as latency, throughput, and video quality. Additionally, the research outlines potential improvements and practical use cases for integrating private 5G networks into surveillance, monitoring, and remote communication systems.

Keywords: *5G networking, drone video streaming, real-time transmission, network performance, edge computing.*

8) Multitenant secure VoIP PBX

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Introduction: Voice over Internet Protocol (VoIP) systems have become an essential tool in professional voice services, offering increased quality of services (QOS), higher versatility and scalability. For military environment enhanced security mechanisms can be implemented using already existing IP infrastructure. Government special departments can make use of VoIP systems provided through local secure cloud infrastructures, eliminating the need for traditional Private Branch Exchange (PBX) systems which are less secure now, avoiding costly subscription plans on the market.

Methods and Results: This project has the intention of the development of a multi-tenant VoIP PBX solution well suited for small to medium entities which is capable of multi-tenancy for better distinction between the departments using complex security measures. The system is capable of both internal voice calls, within the local networks and external calls that establish connections between networks through a "trunk" based on the Session Initiation Protocol (SIP). This solution relies on open-source or free software which offers good flexibility and has an adequate amount of available documentation.

At the heart of the VoIP solution described previously is the FreeSWITCH software. FreeSWITCH is a free and open-source telephony software for real-time communication and one of the leading open-source communication frameworks that powers some of the world's largest telecom infrastructures. FreeSWITCH solution can be used for software-defined



telecom network in the cloud. It provides to the administrator options to design and implement their network, tailored to their needs.

Free softphone applications will be used for extensions on the terminals.

The final result is a unitary solution, all virtualized and encapsulated in one box, offering complex hardware resources management and optimal use of space, while adhering to the cloud computing concept and keeping the costs down as much as possible.

Conclusions: This project demonstrates that an open-source, cloud-based VoIP PBX system using FreeSWITCH can be a smart communication solution for small to medium-sized institutions. Using this free software and virtualization solutions, the system ensures flexibility, scalability, and efficient resource management without compromising on functionality or security. With support for internal and external calls via SIP trunking and multi-tenancy capabilities, the solution proves to be a practical alternative to traditional analog PBX systems or other proprietary services, making telecommunication infrastructures accessible and customizable many users.

Acknowledgements: Coordinator teacher: Assoc. Prof. Petrică CIOTÎRNAE Ph.D.

Keywords: *VoIP, FreeSWITCH, network, PBX, cloud.*

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9) Automated Modulation Classification of Signal Spectrum Images Using Deep Learning

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Introduction: This tool was developed to automate the monitoring of electromagnetic spectrum in the context of rapid evolution of SIGINT tools. It can be easily modified and used for many applications, such as : determining the position of a transmitter using goniometry, supervising, and tracking wireless communication links,etc.It takes as input the image of an FFT from the interest signal and distinguish between AM or FM classes.

Methods and Results: To resolve the problem of classifying modulation types (AM vs. FM) from oscilloscope images, the process involves several key steps. First, the program extracts frequency axis limits using OCR (Tesseract), ensuring numerical values are correctly identified from the image. Then, the grayscale image is processed using OpenCV, applying thresholding to create a binary representation and summing pixel intensities

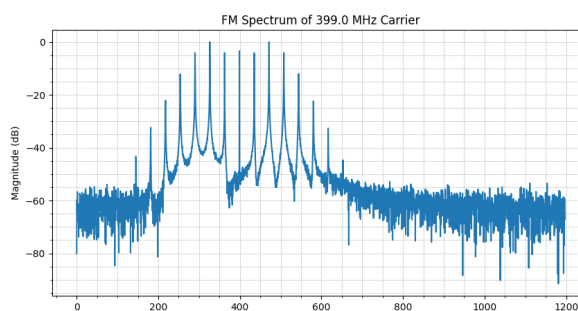


Fig. 1: Example of Input Image

along the vertical axis to generate an amplitude profile. This profile undergoes autocorrelation analysis to highlight periodic components, followed by feature extraction using curve fitting (SciPy), FFT analysis, and peak detection. The extracted features, including decay rate, oscillation strength, periodicity score, variance of peaks, and local minima count, are used as input for training an XGBoost classifier. The model is trained with data from a directory of labeled images, with feature standardization applied using Scikit-learn's StandardScaler. The trained model and scaler are then saved using Joblib for future predictions. These tools—



OpenCV, Tesseract OCR, NumPy, SciPy, Matplotlib, Scikit-learn, and XGBoost—enable efficient image processing, feature extraction, and classification in an automated workflow.

XGBoost (Extreme Gradient Boosting) is a powerful and efficient machine learning algorithm

based on gradient boosting decision trees. It is designed to provide high performance, scalability, and flexibility for both classification and regression tasks. XGBoost improves upon traditional gradient boosting methods by implementing optimizations such as tree pruning,

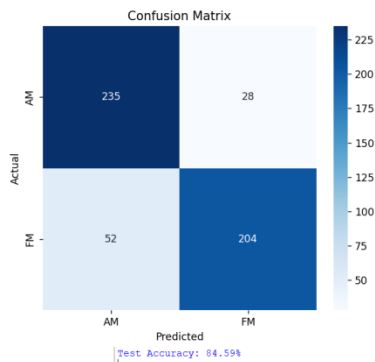


Fig. 2: Confusion Matrix used to assess the quality of the resulted model

parallel processing, and handling missing values automatically. It also includes regularization techniques (L1 and L2) to prevent overfitting, making it more robust for complex datasets. In the context of the modulation classification problem, XGBoost is used to train a model that distinguishes between AM and FM signals based on extracted features from oscilloscope images. By leveraging multiple decision trees in an ensemble, XGBoost assigns weights to misclassified samples iteratively, improving the model's accuracy with each boosting round. Its hyperparameters, such as learning rate, maximum tree depth, and number of estimators, can be fine-tuned for better performance. Additionally, XGBoost integrates seamlessly with Scikit-learn, allowing easy implementation and training. Due to its

efficiency and predictive power.

The dataset used to train and test the model was generated using synthetically generated signals (using Numpy), but the model can be used on other images.

Conclusions: The resulted accuracy is satisfying (84 %) ,and the confusion matrix shows that the model better predicts the AM class better than FM class. It is a useful tool, that has room to be improved, and allows the end user to make better decisions.

Keywords: Signal Processing, Classification Model, Image Processing, Ensemble Learning.

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10) Python Platform for Switch Security

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Introduction: In the global context, switches have an important role in the IT infrastructure, so their security becomes one of the main interests. Switches are equipments that manage data traffic between other network devices. Current types of attacks on switches include: MAC flooding attacks, ARP poisoning, DDoS.

To counter these attacks, there are a series of security measures that can be implemented, such as: forcing authentication on the switch, traffic analysis for anomaly detection, using ACLs, port security, and so on. There are vulnerabilities to these solutions; one example is MAC address cloning, where an equipment uses the same MAC address as an authorized device to gain access to the switch.



Methods and Results: The present paper introduces a Flask platform that monitors traffic in a network composed of one switch and two IP cameras. A baseline will be created and used to detect anomalies in the network traffic. Upon detection of an anomaly, the interface where the alarm was triggered will be switch to an isolation VLAN.

VLANs are logical groupings created within a switch to minimize the broadcast in the entire network. By isolating the breached interface, the attacker cannot access sensitive information from the switch or take control of the equipment.

There will be multiple tests that, if failed, the VLAN of the interface will be changed. These tests include: if a port changes state - from up to down or from down to up - suddenly, if an unknown MAC address connects to the device and if there is a spike in the traffic registered from an interface.

The platform has two types of users: the generic user and the administrator. The user only has viewing access to the statistics status, interfaces status and the alerts that appear. The administrator can also add equipments, known MAC addresses and users that have access to the application. Grafana was used to create graphics for an easy visualization of the status and the statistics of the interfaces. The statistics, the status and the alerts from the ports are saved in three different tables in a QuestDB database, which is time-series based.

Conclusions: As the number of attacks on networks increases, equipment security needs to be implemented to protect data from breaches. Lower level equipments do not need to be overlooked as they are normally the easiest way to infiltrate a network. As following, it is imperative to implement security on switches. Traffic analysis is a good way of detecting anomalies, since the traffic from a camera is different from a laptop.

Acknowledgements: Col. Assoc. Prof. Eng. Cristian-Iulian RÎNCU, PhD.

Keywords: *network traffic, traffic analysis, switch, anomaly detection.*

References:

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11) Data Management in IoT Networks

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Introduction: In today's context of continuous technological advancements, extensive networks of electrical devices and electronics are an unavoidable fact. Thus arises the need for evermore effective means of centralizing and managing the data produced by such networks, especially in those that compose Internet of Things (IoT) conglomerates [1]. But to manage data of any given number of different devices in an automated and flexible fashion, one must know precisely what devices are present in the area of interest. One category of data that has become of importance for identifying electrical devices is the way devices consume power, and through the means of Non-Intrusive Load Monitoring (NILM) systems and with automation improvements enabled by Machine Learning models, this task has become more feasible than ever.

The main purpose of this paper is to create a comprehensive study of how power consumption data that is produced by a series of electrical devices and electronics can be registered, stored and analyzed, with the end goal of creating a viable automated classification system of the devices present in the network.



Methods and Results: To achieve a working classifier, an extensive database of independent power consumption readings has been acquired, on which an analysis needs to be conducted to highlight what the best ways of characterizing these signals are. For this purpose, a series of statistical and signal processing methods have been applied to the readings, the outputs of which have been fed to multiple Machine Learnings algorithms. In this way, the most efficient and accurate system of electrical device classification can be described.

Conclusions: Compact and effective data management systems are an emerging need [2] that can be fulfilled through the development of signal processing protocols that can efficiently characterize and classify devices of any kind, using a most trivial but essential and constitutive building part of any stationary electrical device: its connection to the power line.

Acknowledgements: 1LT. Eng.Asst.Prof. Denis-Grigore STĂNESCU, PhD.

Keywords: *Communication Systems, Internet of Things, Signal, Data Management, Machine Learning, Classification.*

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12) Interference Monitoring System Using SDR Technology and GNU Radio

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Introduction: In the ever-evolving landscape of wireless communication, ensuring interference-free transmission has become a pressing challenge. As radio spectrum usage continues to grow, the need for intelligent and adaptable interference detection mechanisms has never been more critical. Software Defined Radio (SDR) technology offers unparalleled flexibility in signal processing, enabling real-time spectrum analysis and anomaly detection. This paper explores the development of an automated interference monitoring system, leveraging the power of SDR, GNU Radio, and Machine Learning to identify and mitigate disruptive signals in dynamic environments.

Methods and Results: The proposed methodology involves acquiring radio signals using a SDR-compatible receiver (e.g. Adalm-Pluto, HackRF) in a controlled environment, followed by generating test scenarios in GNU Radio that include both clean signals and those with simulated interference. Extracted features from the signals are preprocessed using filtering techniques and Fourier transformation before being fed into a machine learning model (e.g., Random Forest, SVM, CNN) trained for spectrum classification and automatic interference detection. The system is then validated and tested by evaluating model performance based on accuracy, precision, and response time. Expected outcomes include real-time automatic interference detection, reduced human errors in spectrum analysis, and improved efficiency in radio communication monitoring.

Conclusions: This paper proposes an innovative interference monitoring system using SDR and GNU Radio, integrated with Machine Learning techniques for automatic spectrum analysis. The system can be applied in various fields such as communication security, telecommunications networks, and radio signal analysis. Implementing such a solution contributes to the development of efficient methods for managing the electromagnetic spectrum.



Acknowledgements: I would like to express my gratitude to my coordinating professor, Sârbu Anamaria, for her invaluable guidance and support throughout this research..

Keywords: *SDR, GNU Radio, Machine Learning, Interference, Radio Spectrum Analysis.*

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13) Communication Protocols for Specific MPSoC Applications

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Introduction: MPSoC (Multiprocessor System-on-Chip) systems represent a major evolution in the architecture of modern embedded systems, offering a platform that combines multiple processing cores with programmable logic of the FPGA (Field Programmable Gate Array) type. These architectures allow parallel execution of multiple tasks, optimizing performance and energy efficiency in critical applications such as video processing, communications, artificial intelligence, or industrial automation.

Methods and Results: This project involves creating a hardware architecture that includes the processing area and the following communication protocols: UART (Universal Asynchronous Receiver-Transmitter), SPI (Serial Peripheral Interface), I2C (Inter-Integrated Circuit), and Ethernet. The functionality of the application will be achieved by sending data to a display via SPI, reading data from memory via I2C, and connecting to a PC up to level 3 of the ISO-OSI stack, while the UART protocol will be used only for debugging.

The first step is create a block design in Vivado that includes the listed components, based on which a virtual platform will be created in Vitis. Next, an application will be developed in Vitis where the processor will be programmed to initialize the modules based on hardware parameters and manage the data flows between the processor and peripherals. Efficient communication through these protocols will demonstrate the full functionality of the MPSoC platform in the context of an embedded application with multiple peripheral interactions.

Conclusions: By combining processing on ARM cores and FPGA programmable logic, it was possible to build a flexible embedded system, capable of efficiently communicating with a variety of peripheral devices. The development process, carried out in the Vivado and Vitis environments, highlighted the advantages offered by the Xilinx ecosystem for designing integrated hardware- software systems.

Acknowledgements: Mr. Dr. Ing. Leontin Tuță.

Keywords: *MPSoC, UART, SPI, I2C, Ethernet, embedded system.*

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14) Network Automation Using Ryu Controller Over the OpenFlow Protocol Architecture

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Introduction: Software-Defined Networking (SDN) is a transformative network architecture that separates the network control logic from the underlying data forwarding functions, enabling direct programmability of network behavior. According to the Open Networking Foundation (ONF), SDN introduces a centralized control plane that provides an abstracted, global view of the network, allowing administrators to dynamically manage network policies and optimize traffic flow.

Methods and Results: This research focuses on leveraging SDN principles to improve network control, real-time topology discovery, and traffic prioritization. By integrating a programmable SDN controller with a RESTful interface, the study explores how SDN can enhance dynamic network reconfiguration and ensure optimal Quality of Service (QoS) across different network environments. The implementation utilizes OpenFlow, a widely adopted SDN protocol, to establish communication between the controller and network elements. Initial testing is conducted in Mininet, a network emulation tool that enables flexible SDN prototyping, before transitioning to a hardware-based environment using Zodiac switches. A RESTful API facilitates real-time interaction with network components.

Conclusions: This research highlights the potential of SDN in creating more flexible, scalable, and programmable networks. The findings indicate that integrating automation and policy-based control significantly enhances network management efficiency.

Acknowledgements: Lt. dr. ing. Alexandru Frunza.

Keywords: *Software Defined Networking, Network Automation, RESTful APIs, Monitoring.*

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15) 5G Networks for Military Communications

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Introduction: The rapid evolution of 5G technology has opened new frontiers in military communications, offering enhanced reliability, low latency, and high data rates. This paper presents a study on the implementation and performance evaluation of 5G networks for military applications deployed in two scenarios, analyzing signal quality and network efficiency through simulated models.



Methods and Results: This research is based on a MATLAB simulation performed in two scenarios involving urban and rural deployment of communication services. The simulation was performed in two 5G frequency bands (3.5 GHz and 28 GHz) enabling an optimized configuration of base stations positioning, an initial evaluation of 5G network performance by computing SINR (Signal-to-Interference-plus-Noise Ratio) mapping, and an analysis of essential network parameters, including transmission power, propagation models, and coverage efficiency. The results illustrate clear distinctions between urban and open-field deployments, with highlighted particularities for each scenario and frequency band. We have presented two scenarios for which we have demonstrated the superiority of 5G networks in providing reliable, high-speed, resilient communication services for military communications.



Fig. 1: SINR Map in urban deployment

Conclusions: The research confirms that 5G networks provide significant advantages in military communications, particularly in environments where secure and efficient data transmission is critical. The SINR analysis demonstrated that optimized antenna placement and power control are essential for maximizing coverage and minimizing interference.

Acknowledgements: I would like to thank my coordinating professor Sârbu Annamaria, for her valuable guidance.

Keywords: 5G, military communications, SINR analysis, MATLAB simulation.

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16) An Implementation of a Radio Channel Using a M-PSK Modulation on the LabVIEW Platform Using SDR Devices

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Introduction: Nowadays, a sustainable method for transmitting a lot of information containing data is using a reprogrammable hardware device like SDR, who can submit a large amount of tasks over a digital signal for an optimization conveying via a perturbation communications channel without a dedicated infrastructure. A SDR device can be affiliated with a long range of specific situations where the hardcoded platform is programmable for transmitting, receiving and processing signals.

Methods and Results: The paper consists of making a pseudorandom sequence with a Geffe generator sequence which is subjected to over five basic statistical tests that measure the dissimilarity for a higher level of security for the quantification of the channel characteristics. This sequence is encoded with a Hamming code, in the correction form, in order to add redundancy in the bit stream to resist the noise impact in the transmission channel. For a higher ratio of transmission a modulation technique like M-array PSK is often used. This technique



can handle the lowest modulation order for maintaining an intelligible and unmodified message in the reception section and high modulation order when the perturbation density does not have much impact, known as adaptive modulation.

There are two scenarios for this transmission, one subjected to a simulation case where an AWG noise is injected in order to ensure the stability and the correcting performance of the Hamming code and the other is used on the USRP device which is soft compatible with the graphical language in LabVIEW. In both scenarios, the constellation diagram, where the phase shift of the consecutive symbols is plotted via a modulation pattern, was represented.

To maintain stability between the emitting and receiving parts, we need to integrate some training bits in the informational sequence which will be subjected to modulation afterwards. This bits are placed in front of the bit stream for signaling its presence and for obtaining an easy take out in the reception scheme. By using the correction mode of the code, the matrix multiplication in GF(2) between the coded word and Hamming control matrix is thoroughly calculated in the reception section. The result is the syndrome, which reflects the exact position in binary base where the bit error occurs. The essential parameter in choosing a code that quantifies the difference between two successive coded words is Hamming distance for correcting or detecting a specific number of isolated errors.

Conclusions: It is worth having a random sequence, which has a maximum entropy equivalent with a peak loading of information. For higher modulation order, the error probability, which is dependent of SNR, starts growing, limiting the channel capacity. The one shot transmission using USRP does not have a high range to transmit, making it limited for user applicability. All in all, for a better transmission without ISI, it is necessary to have a filter shape for the complex envelope like Root Raised Cosine or Raised Cosine, instead of using a rectangular or Gaussian shape.

Acknowledgements: Lt. Assoc. Prof. Eng. Denis STĂNESCU, PhD.

Keywords: SDR, M-PSK, Hamming code, AWG.

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17) Mission Critical Services over cellular networks

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Introduction: Most countries currently use dedicated land mobile radio (LMR) networks for communications between first responders. Although these technologies have proven robust and reliable, they exhibit certain limitations in terms of latency and data transfer rates. Many of these inconveniences, among other issues, could be overcome with the development of 5G technology[1]. The adoption of 5G mobile broadband technologies in the mission-critical public safety systems provides fast interoperable , real-time video, data , and voice services that enable all parties to communicate quickly and efficiently[2].

Methods and Results: This project aims to develop a mobile application for Android designed for first responder agencies, in order to assess the capabilities of 5G cellular networks in the context of mission-critical services. This application offers free access to specific services, such as PushToTalk, PushToVideo, PushToText, and emergency alerts. All mobile terminals



were connected to a test 5G base station (OaiBox Max)[3], which allowed a thorough analysis of cellular network parameters.

Conclusions: The study demonstrates that integrating 5G mobile broadband technology into mission-critical communications can effectively overcome the limitations inherent in traditional LMR networks. The developed Android application has proven to be a useful tool for public safety agencies when tested with the OaiBox Max 5G base station. The analysis of cellular network parameters indicates notable improvements in latency and data transfer rates, showing the potential of 5G to improve real-time communications during emergencies. These promising results advocate for further development and scaling of 5G-enabled solutions to facilitate public safety operations in increasingly demanding scenarios.

Acknowledgements: The project has been developed under the guidance of Asoc. Prof. Dr. Ing. Digulescu Angela.

Keywords: *mission-critical, 5G, PushToTalk, android application.*

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18) Audio Event Detection and Extraction Application

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Introduction: In recent years, audio recognition has started to play an important role in smart city applications such as safety, surveillance, traffic monitoring, and environmental noise reduction. This project focuses on developing an application that can detect and classify everyday sound events from audio signals, such as sirens, horns, dog barks, or alarms. The goal is to turn raw audio into useful information.

Methods and Results: This thesis explores the design and analysis of a system for detecting acoustic events in urban environments, with a primary focus on extracting relevant audio features from real-world sound recordings. The objective is to evaluate the system in terms of feature effectiveness, data structuring, and its potential integration into machine learning workflows.

Using MATLAB's Diagnostic Feature Designer, a wide range of temporal and spectral features are extracted from the UrbanSound8K dataset, which includes diverse urban sound categories. The dataset is organized so that each folder represents a distinct sound class, and the extracted features are compiled into a structured table, including corresponding labels for each audio sample.

After feature extraction, several classical machine learning algorithms were applied to evaluate the classification potential of the dataset. Support Vector Machines (SVM), k-Nearest Neighbors (k-NN), and Decision Trees were trained and tested using stratified cross-validation.

The evaluation centers on the ability of the selected features and models to capture distinctive characteristics of various acoustic events. Through statistical analysis and visual exploration, the separability and distribution of features across classes are investigated, providing insight into their suitability for future classification tasks.

By focusing on the feature extraction process, dataset organization, and classification performance, this work lays the groundwork for developing robust audio event recognition systems. The results aim to support applications in environmental monitoring, smart city infrastructure, and real-time acoustic analysis.



Conclusions: In conclusion, the project demonstrates the importance of well-structured audio data and carefully selected features in building reliable foundations for acoustic event detection systems. The insights gained from the feature and model analysis contribute to a better understanding of how urban sound events can be represented and differentiated, offering a solid basis for future work involving more complex classification models or real-time deployment scenarios.

Acknowledgements: Mr. Dr. Ing. Leontin TUȚĂ.

Keywords: *SVM, sound, features, urban, audio.*

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19) Analysis And Implementation of an Automated Virtual Machines Infrastructure Deployment Solution

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Introduction: In recent years, we have witnessed a period in which technology is no longer just a facilitator, but an essential driver that redefines every aspect of our lives and activities. This dynamic technological ecosystem profoundly influences the way we manage resources and optimize processes in the IT environment. In a context where the efficiency and scalability of digital infrastructure have become essential, implementing automated deployment solutions for virtual machines is gaining strategic importance.

Methods and Results: This project aims to address this challenge by developing a solution that simplifies the process of analyzing, implementing, monitoring and automatically scaling the components of a virtual infrastructure. Such a solution increases the efficiency of IT system management by reducing the time required for virtual infrastructure deployment and minimizing human intervention in the event of a disaster.

The first step in implementing the solution involves creating the virtual infrastructure using the open-source tool Terraform for provisioning and managing infrastructure resources. The second step employs Ansible, an open-source tool used for the automatic configuration of virtual machines. The host environment for the virtual infrastructure is the VMware vSphere virtualization platform.

The deployment monitoring process relies on collecting system metrics such as CPU usage, RAM status, and storage disk availability using Prometheus and Node Exporter. For a user-friendly and centralized visualization of the collected data, Grafana serves as an essential solution for creating interactive dashboards.

Conclusions: In conclusion, this solution ensures both the automation of the deployment process and efficient management and a quick response in case of failures or disruptions.

Acknowledgements: Col. Assoc. Prof. Eng. Iulian Rîncu, PhD.

Keywords: *virtualization, cloud, infrastructure, deployment, automation, monitoring.*

References:

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20) Mobile Target Detection and Localization System Based on UWB Technology

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Introduction: Ultra-Wideband (UWB) technology is an innovative advancement in communications and precise localization, providing advanced solutions for detecting and tracking mobile targets. Unlike other localization technologies, UWB utilizes ultra-wideband radio signals, enabling it to achieve a high level of accuracy in distance measurement and position determination within a three-dimensional space.

Methods and Results: Using the Time Domain sensors, I measured the distances between a tag and four anchors. After that I set the distances, along with the anchors' coordinates, as input in two Matlab functions. The two functions would give me the tag coordinates related to the anchors and I would compare the results with the real coordinates.

Codes used:

Code 1:

```
function P = trilateration_3d(known_points, distances)
    fun = @(P) [
        sqrt((P(1)-known_points(1,1))^2 + (P(2)-known_points(1,2))^2 + (P(3)-
        known_points(1,3))^2) - sqrt((P(1)-known_points(2,1))^2 + (P(2)-known_points(2,2))^2 +
        (P(3)-known_points(2,3))^2) + distances(2) - distances(1);
        sqrt((P(1)-known_points(1,1))^2 + (P(2)-known_points(1,2))^2 + (P(3)-
        known_points(1,3))^2) - sqrt((P(1)-known_points(3,1))^2 + (P(2)-known_points(3,2))^2 +
        (P(3)-known_points(3,3))^2) + distances(3) - distances(1);
        sqrt((P(1)-known_points(1,1))^2 + (P(2)-known_points(1,2))^2 + (P(3)-
        known_points(1,3))^2) - sqrt((P(1)-known_points(4,1))^2 + (P(2)-known_points(4,2))^2 +
        (P(3)-known_points(4,3))^2) + distances(4) - distances(1)
    ];
    P0 = mean(known_points, 1);
    options = optimoptions('lsqnonlin', 'Display', 'off');
    P = fsolve(fun, P0, options);
End
```

Code 2:

```
function P = Trilateration(known_points, distances)
    fun = @(P) [
        (P(1)-known_points(1,1))^2 + (P(2)-known_points(1,2))^2 + (P(3)-
        known_points(1,3))^2 - distances(1)^2;
        (P(1)-known_points(2,1))^2 + (P(2)-known_points(2,2))^2 + (P(3)-
        known_points(2,3))^2 - distances(2)^2;
        (P(1)-known_points(3,1))^2 + (P(2)-known_points(3,2))^2 + (P(3)-
        known_points(3,3))^2 - distances(3)^2;
        (P(1)-known_points(4,1))^2 + (P(2)-known_points(4,2))^2 + (P(3)-
        known_points(4,3))^2 - distances(4)^2
    ];
    P0 = mean(known_points, 1);
    options = optimoptions('lsqnonlin', 'Display', 'off');
    P = lsqnonlin(fun, P0, [], [], options);
End
```



	1.	2.	3.	General errors on each coordinate (mm)
Errors in the X coordinate	60	395	-160	98
Errors in the Y coordinate	290	410	110	270
Errors in the Z coordinate	70	75	-140	2
General errors (mm)				123

	1.	2.	3.	General errors on each coordinate (mm)
Errors in the X coordinate	-110	190	0	27
Errors in the Y coordinate	-100	-15	110	-2
Errors in the Z coordinate	90	220	-360	-17
General errors (mm)				15

Conclusions: The errors are small with indicates the potency of the technology. Depending on how I formulate the code the results are different.

Acknowledgements: Conf.dr.ing. Angela Manuela Digulescu-Popescu.

Keywords: *UWB (Ultra-Wideband), sensors, distances, errors.*

21) Stream Ciphers used in Mobile Communications

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Introduction: As wireless communication systems evolve towards 5G and future networks, concerns about data security become increasingly relevant. While ZUC-256, a stream cipher proposed by 3GPP, is widely adopted in China's 5G infrastructure, Europe and the United States continue to rely on well-established ciphers such as AES and SNOW 3G, due to transparency and geopolitical concerns. At the same time, SNOW-V is not officially supported by any standardization organization or state but it remains a promising candidate for future 6G networks, due to its excellent performance in software-based and virtualized environments.

Methods and Results: This project focuses on the implementation and comparison of the ZUC-256 and SNOW-V stream ciphers using Verilog on a Nexys 4 DDR development board equipped with the Xilinx Artix-7 FPGA. The goal is to evaluate these two stream ciphers from three key perspectives: encryption quality, hardware efficiency, and data throughput performance.

The encryption strength and quality of both ciphers will be evaluated through statistical randomness tests implemented in MATLAB, aiming to verify the strength and unpredictability of the generated keystreams. The efficiency of the FPGA implementation will be measured in terms of resource utilization such as logic slices, LUTs, flip-flops, and memory blocks providing insight into the hardware cost of each cipher.

Finally, I will evaluate the throughput performance of both implementations to determine how fast each algorithm can encrypt a continuous stream of data in real-time conditions. This comparative analysis is intended to provide practical insights into how these stream ciphers perform under realistic constraints, offering a valuable perspective on their potential role in next-generation, high-performance communication environments.



Conclusions: The implementations of the two ciphers were performed according to the specifications of their original standard versions at the time of their release, without including any later modifications proposed by various institutions or researchers. This approach to comparing the two stream ciphers can create an overview of the way in which SNOW-V may or may not rise to the performance level of a hardware implementation, for its integration as a core cipher in the encryption algorithms used in wireless communication systems spread across regions where the ZUC-256 algorithm is not considered a viable option.

Acknowledgements: Mr. Dr. Ing. Leontin TUȚĂ.

Keywords: *Stream Ciphers, SNOW-V, ZUC-256, Verilog, FPGA.*

References:

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22) Command and Control System for Unmanned Aerial Vehicles

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Introduction: A command and control system for unmanned aerial vehicles (UAV) is a combination between the hardware component and the computer-based application, with the main purposes of monitoring the flight parameters and pre-planning its flight course. This project presents the main requirements of such system, ranging from the devices needed for a drone to execute various missions to the script which offers the operator the ability to control the drone. This system is useful in many scenarios, such as: remote surveillance or search and rescue operations.

Methods and Results: The command and control application in this project presents a graphical interface which allows the operator to manually program the waypoints for a drone's mission and also monitor its parameters midflight. The system acquires the data offered by the UAV's sensors via a RF link in the ISM band using two identical radios, one mounted on the drone's frame, and the second one on the ground control station(GCS). After obtaining the information, it is processed with the help of Pymavlink module in Python, deconstructing the MAVLink format packets in more clear data, such as speed, altitude or location. In a similar manner, the operator might send certain commands back to the UAV, which can be considered the feedback of the acquired data. With the help of the Folium module, the drone pilot could elaborate a flight plan by using a real world map before taking off, giving the drone a certain level of autonomy. Furthermore, by using the Pandas module, it is possible to create flight logs, crucial in analyzing the development of the flight (for example, in case of a crash, we could possibly locate the downed aircraft more easily and search for an explanation of the failure).

Conclusions: The system is responsive to the data acquired by its sensors, crucial in carrying out the mission. Furthermore, the software part can successfully command the drone, offering a large variety of possibilities of tasks.

Acknowledgements: COL. Assoc. Prof. Eng. Florin POPESCU, PhD.

Keywords: *Drone, Command, Control, Autonomous.*



23) Design, Simulation and Analysis of a Satellite Constellation

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Introduction: In an era marked by rapid advancements in satellite communications, the design and simulation of satellite constellations are critical for ensuring robust global connectivity and bolstering defense security. This project introduces a comprehensive MATLAB-based application that simulates satellite trajectories using Two-Line Element (TLE) data and supports manual satellite data entry. The primary objectives are to analyze orbital parameters, optimize inter-satellite communication paths, and provide a user-friendly interface for managing extensive satellite networks.

Methods and Results: The application leverages MATLAB's powerful environment to develop an intuitive graphical user interface (GUI). Users can add satellites either by importing TLE files—sourced, for example, from CelesTrak[4] or by manually entering ephemeris data in a dedicated secondary window. Ground station integration is accomplished through interactive dynamic maps that allow for precise location selection, complemented by an option for manual coordinate input.

To enhance computational efficiency, satellite constellations are organized into structured groups, reducing application latency even when handling networks ranging from a few satellites to over a thousand. Users can easily toggle the display of various constellation groups through dropdown menus, ensuring seamless interaction without performance disruptions. In preliminary tests, the application demonstrated a noticeable reduction in processing time—approximately 15% compared to a less structured approach—enabling near real-time scenario analysis.

A key feature of the application is its analytical module for radio parameter evaluation, which assesses the viability of satellite links over extended periods. Recognizing that low Earth orbit (LEO) satellites can complete up to 15 orbits per day, the design addresses the need for multi-satellite configurations to maintain continuous connectivity. To this end, the application incorporates multi-hop propagation analysis that examines signal paths, transmission delays, and interference, and implements advanced routing algorithms to determine optimal connectivity routes.

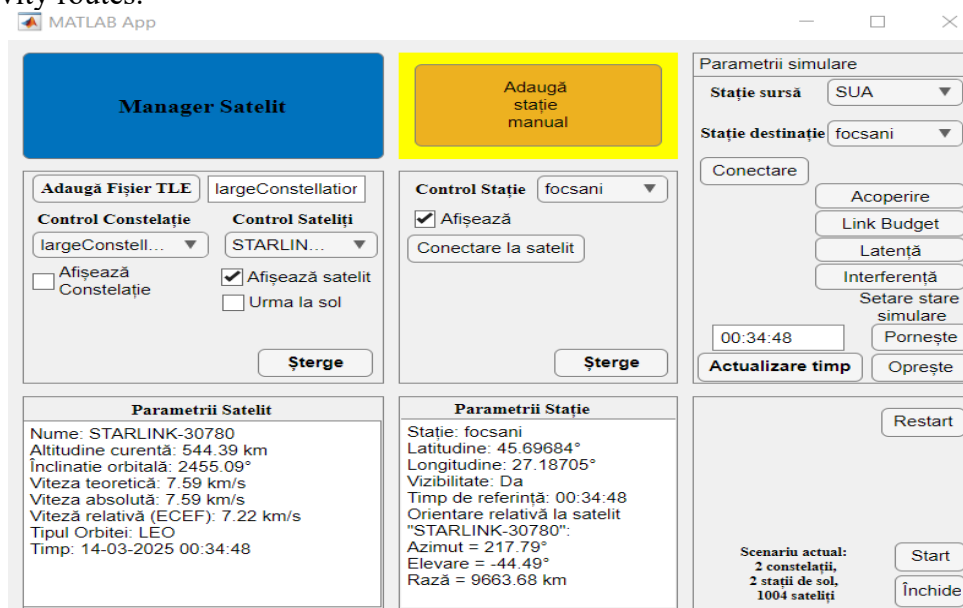


Fig. 1: Matlab interface



Moreover, the system supports establishing connections between ground stations and satellites, as well as among ground stations themselves. Operational control is provided through intuitive start and stop buttons, and a dedicated simulation window offers functionalities such as pause, time navigation, and adjustable simulation speed. Basic information about satellites, constellations, and ground stations is readily displayed within the interface, while additional parameters are presented in separate, clearly labeled panels. The simulation status, including the number of constellations, ground stations, and satellites, is continuously updated in real time, with all data refreshable by the user and adjustable according to the desired time frame.

Conclusions: In summary, the MATLAB-based application developed in this project is a robust and versatile tool for the simulation and analysis of satellite constellations. Its interactive GUI supports both automated and manual data entry, enhanced by advanced functionalities such as multi-hop propagation analysis and optimal routing for radio parameters. Furthermore, the system is designed with scalability in mind; by integrating a reliable database, the application can be expanded to support concurrent multi-user access. Future work may involve incorporating real-time data feeds, exploring more complex orbital mechanics, or even extending the framework to interplanetary missions. This scalability and potential for further development, along with its advanced analytical capabilities, make the application a valuable asset for both detailed satellite scenario analysis and educational purposes, while paving the way for continued research and innovation.

Acknowledgements: Lt. lect.univ.dr.ing. Denis Stănescu.

Keywords: *Satellite Constellations, Multi-hop Propagation, Ground Stations, MATLAB Interface.*

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9. ROBOTICS, AUTOMATION AND ELECTRONIC SYSTEMS

1) Autonomous Robot with An Intelligent Optic Camera-Based Control System

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Introduction: The automatization process has made autonomous vehicles be of great interest when it comes to technological innovation. They are able to move safely with minimum or no human intervention [1]. This project aims to develop a control system for an autonomous robot capable of following a pre-determined route using the data transmitted by an intelligent camera, equipped with a line-detecting algorithm. At the same time, the project aims to demonstrate the benefits of using simulations in the process of calibrating the control algorithms, contributing to saving time and costs associated with experiments before testing in a real environment.

Methods and Results: The above-mentioned system combines a simulation environment with real hardware to test and develop an autonomous robot based on computer vision. It integrates the simulation in Gazebo, ROS2 (Robot Operating System), a RDDRONE-FMUK66 [2] control board and a Pixy2 camera [3]. To mimic the camera's real behavior, a virtual sensor was configured in Gazebo, which generates images similar to those taken by Pixy2. An ROS2 node processes these images, extracting the coordinates from a white route's black margins. This data is then sent to an UART (Universal Asynchronous Receiver-Transmitter) communications node that sends them further to an MCU (Microcontroller Unit). Here, the control algorithm analyses the robot's position relative to the route's center and generates the necessary commands for acceleration and direction. The board sends these commands back to the simulator, allowing observation of the robot's behavior both in the virtual space and in the real one. This approach allows adjusting the control before real life tests.

To control the movement of the robot, two main algorithms were tested: PID (Proportional-Integral-Derivative) and LQR (Linear Quadratic Regulator) [4]. Both PID and LQR are mathematical models of control that adjust a system's commands based on calculated errors. PID adjusts direction and acceleration through a combination of proportional terms, integral and derivative, being easy to empirically implement and adjust. On the other hand, LQR optimizes commands using a mathematical model of the system and a cost function, offering a more precise and stable control as long as the system is well designed. Comparing the performances of both algorithms in simulation and real hardware allows the identification of the most efficient solution for autonomous navigation.

Conclusions: The testing and calibration of the control algorithms in a hybrid environment. That combines Gazebo simulations with real hardware, proved to be an efficient method to develop an autonomous robot with a control system based on an intelligent optic camera. The implemented system allows adjusting direction and acceleration commands before the tests on a real route, reducing errors and optimizing performance in real conditions.

Acknowledgements: Cpt. Conf. Univ. Dr. Ing. Mihai COCA.

Keywords: *Autonomous robot, Computer vision, ROS2, Gazebo simulation, Pixy2 camera, Control algorithms (PID, LQR).*

References:

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2) Active Learning Methods for Satellite Image Classification

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Introduction: In this paper we propose a novel framework by using active learning techniques for classifying satellite images. Through this modern approach we combine a relearning model with an enhanced uncertainty criterion, prioritizing the most uncertain samples. The goal of this approach is to reduce the number of labeled samples required while improving the classification accuracy.

Methods and Results: This study uses the active learning framework for classification of satellite images based on an ensemble of Convolutional Neural Networks (CNN). Rather than using a fully labeled dataset, the methodology begins with a smaller labeled subset, with the remainder of the data being unlabeled. The model is trained iteratively by selecting the most uncertain samples from the unlabeled pool for annotation, hence lowering the overall labeling effort.

To determine which samples to label, four uncertainty estimation methods were tested. Bayesian Active Learning by Disagreement (BALD) measures the disagreement among multiple network predictions, ensuring that the most ambiguous samples are selected for labeling. Entropy-Based Sampling selects images with the highest uncertainty by computing the entropy of the predicted class probabilities, prioritizing samples where the model is most unsure. Least Confidence Sampling identifies images where the highest probability prediction remains low, indicating uncertainty in classification. Margin Sampling selects instances where the difference between the two highest class probabilities is smallest, focusing on cases where the model struggles to distinguish between similar classes.

The CNN architecture used in this study is an ensemble of multiple networks and each is built with a multichain of convolutive layers, batch normalization, and fully connected layers. The networks are trained using stochastic gradient descent with momentum, an optimization method that improves learning stability and convergence. At every iteration, the model performance is recorded while increasing the labeled dataset until the accuracy of the classification stabilizes.

The results demonstrate that active learning highly reduces the required amount of labeled data while performing nearly as good as a fully supervised approach in classification tasks. Among the different uncertainty estimation methods, some were indeed more effective in selecting informative samples, leading to faster performance improvements with fewer labeled instances.

Conclusions: In remote sensing applications, the use of ensemble-based active learning enhances classification performance by leveraging multiple models to estimate uncertainty more reliably. Prior research has demonstrated that ensemble learning techniques, such as Bagging and Boosting, improve model robustness and reduce variance in predictions [1], [2]. This is particularly valuable in satellite image classification, where variations in land cover can introduce significant uncertainty, leading to potential misclassification errors [3].

Keywords: *Active learning, Remote sensing, Uncertainty Estimation, CNN.*

References:

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3) Designing a FM Radio Receiver and Channel Indexing

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Introduction: The FM radio is still used as a communication medium, providing information to people. Traditional radio receivers rely on hardware circuits for demodulation and tuning of the signal, in contrast of SDR technology that allows the signal processing to be done in a software environment. This approach is introducing flexibility and the possibility of later upgrading. This research presents the development of a FM radio channels detector and indexing system using SDR and GNU Radio software.

Methods and Results: In this paper I present the implementation of an FM Radio Receiver using a SDR and the indexation of the channels in an interactive interface using GNU Radio software platform, designed to have a dynamic detection of the channels. The electromagnetic spectrum is used for various forms of communication, including radio broadcasting.

SDR makes the transition from analog to digital technology using dynamic reconfiguration. The HackRF platform can transmit and receive signals within the 1Mhz - 6Ghz range.

Raspberry Pi 400 is used for signal processing and serves as a interface for the SDR and the user. This also gives enough computing strength to make sure that the results are analyzed in real time.

The software implementation is done in GNU Radio, a common signal processing platform , using the predefined Python blocks and some custom blocks.

In Romania, the FM band available for the large public is between 88 MHz -108 MHz, making it an ideal match for the HackRF SDR's 20 MHz bandwidth. This makes the process of detecting and indexing radio channels easier.

The indexing of the channels is done dynamically saving the data to a external file for later use.

Conclusions: This paper showcased the implementation of an FM receiver using HackRF SDR and GNU Radio, along with an interactive platform for channel detection and automatic frequency selection. The project can be further enhanced by adding additional features, requiring only software modifications.

Keywords: *FM Radio, Signal Processing, Indexing, Software-Defined Radio (SDR).*

References:

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4) Ensuring Image Integrity Using Steganography and Blockchain Technology

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Introduction: The technological advancements of the last decade raise a concerning issue regarding the authenticity of images, such as manipulation, falsification, modification, or AI-generated images that can lead to serious consequences in fields such as: Mass media, by manipulating public opinion (fake news); National security, by altering images obtained through military technology (satellites, radars, etc).

This work aims to address these issues by ensuring the immutability of images through steganography and Blockchain technology. Every entity—whether a public institution, university, authority, legal entity, or individual—can verify and/or sign the media content corresponding to the images they possess. Thus, images later displayed, for example, on official websites, can be verified on the web platform provided by this solution to ensure their validity.

The signing/validation process is secure, being protected by Blockchain technology, preserving the confidentiality of the user's media content. Protecting image integrity refers to ensuring their authenticity. To address these issues, we used a combined approach of two key technologies: steganography and blockchain. Steganography was used to hide the digital signature within the media content that needs to be secured, while an Ethereum Blockchain network was utilized to ensure the security of the application.

Methods and Results: For the development of this project, the following software was used: Ganache for generating a local Ethereum blockchain network with 20 users; Metamask digital wallet to enable interaction with the blockchain; React framework to create an interactive environment serving as the interface between the user and the network; Flask server to process and handle the images uploaded to the platform; Smart contracts specific to the Ethereum blockchain.

For network management, there are three types of users: Admin users, who have the right to add new members to the network, sign, and verify images; Users with signing and verification rights; Users with verification rights only. User rights can be modified at any time without requiring the platform to stop its activity.

The signing process from the user's perspective is intuitive. The user uploads the image to the platform and signs it with the private key associated with the account connected to the Metamask digital wallet. The processed image, resulting from the signing and steganography process, is then returned to the user.

The verification process is almost identical from the user's perspective. The user uploads the image to the platform and receives one of three possible outputs: The image is valid, displaying who signed it; The image is invalid, indicating that it has been modified and showing the original signer; The image is uncertain, meaning the image has never been signed. If a user's signing rights are revoked after signing an image, the platform will still return whether the image is valid or not but will mention that the signer no longer has signing rights.

The results confirm that, following the tests conducted, the platform is fully functional. No confusion or errors were encountered during the signing or verification processes.

Conclusions: The results demonstrate that the platform operates efficiently and securely, successfully integrating steganography and blockchain technology for image integrity protection. Testing confirmed that the signing and verification processes function as intended, without errors or inconsistencies. Users can seamlessly sign and validate images while maintaining confidentiality and authenticity. Additionally, the flexibility of modifying user permissions in real-time without interrupting platform activity ensures robust and dynamic access



control. These findings validate the reliability and effectiveness of the proposed approach in securing digital media content.

Acknowledgements: I would like to thank Professor Gorgoteanu Damian for help and support.

Keywords: *Metamask, Ethereum Blockchain, React, Flask server, Smartcontract, Steganography.*

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5) Device that Initiates an Explosive Charge Airborne on a Drone

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Introduction: UAVs have become essential in military, industrial and humanitarian applications due to their rapid evolution. This paper presents an innovative device that initiates an explosive charge in the air, mounted on a drone, for controlled demolitions, rescue missions and defense operations. The aim is to develop a lightweight, reliable and safe mechanism to ensure accurate charge activation without affecting flight stability or safety.

Methods and Results: The development of a drone-mounted explosive payload initiator involved the design of an integrated electronic system capable of ensuring precise and safe control of the activation process. For this purpose, I used the PIC16F18313 microcontroller, programmed in the MPLAB X IDE environment through MPLAB PICKit 4 in-circuit debugger, to manage the control logic and signal processing. The control signal is transmitted from a Futaba T6K remote control and received by the R3006SB receiver, which communicates with the microcontroller through a PWM (Pulse Width Modulation) signal protocol. To ensure a stable power supply to the microcontroller, I have integrated a voltage stabilizer that supplies 3.3 V, thus protecting the component from in-flight voltage variations.

Switching of the explosive charge is accomplished by an AOD4286 MOSFET, powered at 12 V per drain, which functions as an electronic switch. The output of the microcontroller, configured as a digital signal, is connected directly to the gate of the MOSFET transistor, allowing it to be activated only when the control signal is correctly received. This configuration ensures fast and efficient control, minimizing the risk of accidental activation.

To verify the functionality of the system, I performed tests on the breadboard, simulating the operating conditions of the device. Following these tests, I obtained suitable results, confirming that the signal from the remote control is correctly processed by the microcontroller and that the MOSFET switches efficiently on its command.

Conclusions: Tests on the breadboard have demonstrated that the PIC16F18313 microcontroller, together with the AOD4286 MOSFET, can reliably activate a switch to initiate an explosive charge using the signal from the Futaba T6K remote control via the R3006SB receiver.



The current system configuration, based on a voltage stabilizer at 3.3 V, has proven effective in protecting the microcontroller against voltage variations, contributing to operational stability under laboratory conditions.

Acknowledgements: I would like to express my special thanks to Professor Molder Cristian, who guided me throughout the realization of this work. I also appreciate his willingness to provide constructive feedback, which contributed significantly to improving the quality of the study.

Keywords: *Drone, Explosive Charge, Microcontroller, Debugger, Mosfet.*

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6) Target Tracking Using Radar Systems

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Introduction: Target tracking represents a fundamental capability in modern radar systems, allowing accurate estimation of an object's motion over time, ensuring operational effectiveness in surveillance and threat detection. Reliable estimation of a target's path in dynamic and noisy conditions is essential to the functionality of radar tracking systems. This study assesses the performance of modern tracking algorithms, tested under various real-world conditions.

Methods and Results: Object tracking relies on recursive estimation techniques to handle measurement noise and varying motion dynamics. One of the most widely used for such tasks is the Kalman Filter, which offers an efficient solution for linear system by predicting an object's future state and correcting it based on new observations. The present study is centered on the application of Kalman filtering to the problem of vehicle tracking in road traffic video. The video data is analyzed sequentially, frame by frame, to extract dynamic elements from the scene. A background model is first estimated by averaging multiple frames over time, providing a reference to compare with for identifying motion. Foreground objects are detected by comparing each incoming frame to this reference, highlighting regions with significant changes and likely associated with moving vehicles. The detected object in each frame, assumed to be a vehicle, is analyzed to extract its centroid and bounding box. A standard Kalman Filter is implemented, modeling the state vector as a combination of position and velocity. The filter is initialized using the first detected position and operates in a predict cycle throughout the sequence. The visual analysis presents a comparison between the raw detections and the Kalman filtered estimations, illustrating the filter's capability to smooth object trajectory and reduce the noise impact.

Conclusions: This study confirms the effectiveness and reliability of Kalman filtering for object tracking in video sequences. The approach ensures smooth trajectory prediction and robustness to noise and partial occlusions. Filter response under dynamic conditions confirms the method's versatility and its relevance to tracking systems.

Acknowledgements: COL. (ret) Assoc.Prof. Lucian ANTON, PhD.

Keywords: *Filtering Algorithms, Estimation, Tracking, Radar System.*

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7) Designing a Microcontroller Programmer

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Introduction: Microcontrollers are at the bottom of modern embedded systems, powering everything from household appliances to industrial automation. The aim of this project is to develop a circuit that facilitates code transfer to a microcontroller to ensure the best performance of its intended functions.

Methods and Results: The microcontroller programmer circuit is based on a classic architecture used by "Microchip Technology", designed for programming PIC microcontrollers. The core of the circuit consists of the PIC24FJ256GB106 microcontroller unit (MCU) that is responsible with handling of the communication between the PC and the target microcontroller. Around it, the design features several key functional blocks such as a USB interface, a voltage regulation module, level shifters to ensure compatibility with the different microcontroller voltage levels, an ICSP (In-Circuit Serial Programming) connector, firmware storage, target power control and status indicators.

In addition to these modules, there is a power path controller used to manage power switching between two voltage sources (a 9V battery and the 5V voltage coming through the USB).

To create this circuit, the Proteus software was used combined with other multiple software that made analyzing and testing each module easier.

Conclusions: In this project, the programmer was designed to ensure reliable, efficient and flexible programming of microcontrollers across a range of applications. The chosen architecture provides a solid foundation for effective use, successfully integrating key functional components and modules.

Keywords: *microcontroller, programmer.*

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8) Signal Generator with Microcontroller

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Introduction: In this paper, I present the implementation of a signal generator using a microcontroller, designed to produce accurate and stable waveforms for various applications. The project utilizes a PIC18F46K42 microcontroller in conjunction with an AD9833 waveform generator, capable of producing sine, square, and triangular signals. Additionally, an SSD1306 OLED display is integrated for user interaction and visualization. The goal of this project is to create a cost-effective and adaptable alternative to commercial signal generators, tailored for educational and research environment.



Methods and Results: The hardware setup includes a PIC18F46K42 microcontroller, an AD9833 programmable waveform generator, an SSD1306 OLED display, and essential peripheral components like power regulation circuits and user input controls. The system is developed using MPLAB X IDE with MCC to facilitate communication between the microcontroller and the AD9833. Also, the SSD1306 display is controlled via I2C to provide real-time monitoring and illustrate waveform parameters.

The circuit is powered by a 5V supply from a battery. Results confirm that the system reliably generates stable square, triangular, and sinusoidal waveforms. A keyboard is incorporated to allow users to conveniently adjust the frequency and waveform type in real time.

Conclusions: This project successfully shows capacity of using a microcontroller-based approach for signal generation. The implemented system offers flexibility, low cost, and ease of use, making it an excellent tool for laboratory experiments and educational purposes. Future improvements may include additional waveform customization options and integration with a graphical user interface for enhanced control.

Acknowledgements: I would like to thank Professor Gorgoteanu Damian for help.

Keywords: *Signal Generator, Microcontroller, Frequency Generation.*

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9) Platform for Automated Log Processing using Artificial Intelligence

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Introduction: In recent years, the growing complexity of information systems, combined with the rapid digitalization of processes, has led to an exponential increase in the volume of data generated by IT infrastructures. Among these data, system logs — automated records of events occurring within software and hardware environments — play a vital role in application monitoring, error detection, and security incident prevention. However, the manual analysis of such logs has become increasingly difficult due to both their sheer volume and their unstructured, often ambiguous nature.

This challenge highlights the need for intelligent solutions that can automate the process of log analysis, particularly for the early detection of anomalous behavior. The application of artificial intelligence — especially machine learning and natural language processing techniques — has proven to be highly effective in this regard, enabling the detection of subtle deviations from normal patterns without relying on predefined rules or continuous human oversight.

The project presented here aims to develop a modern platform for the automatic classification of system logs into two categories: *normal* and *anomalous*. The goal is to support the rapid identification of potential system failures or security threats. The platform leverages advanced AI techniques and is designed to offer both high accuracy and ease of integration within real-world system monitoring environments.



Methods and Results: To achieve the proposed objective, the platform was implemented starting with the training of a deep learning model, followed by its integration into a complete analysis system accessible through a web interface.

The model used is DistilBERT, a distilled and optimized version of the BERT architecture, specifically designed for efficient text processing in classification tasks. It was trained on a labeled dataset of system logs, enabling it to learn how to distinguish between normal and anomalous behavior. The preprocessing phase included data cleaning, tokenization, and preparing the input in a format compatible with the NLP model.

After training, the model was integrated into a REST API developed using the Flask framework, which handles communication between the back-end and the client application. The API allows for sending individual or batch log entries and returns a classification result for each instance.

The web interface was built using React, providing users with an interactive and intuitive experience. It is structured into three main functional modules:

- Historical analysis: displays statistical information and visualizations based on previously stored logs;
- File upload: allows users to submit log files for batch analysis;
- Real-time analysis: monitors continuous log streams and dynamically updates the results on the screen.

Communication between the React interface and the Flask API is carried out through standard HTTP request-response protocols, and the entire system was designed to be modular, scalable, and easy to extend.

Conclusions: The proposed platform demonstrates the effectiveness of using artificial intelligence in the automated analysis of system logs, offering a modern, scalable, and user-friendly solution for anomaly detection. The integration of the DistilBERT model has enabled an optimal balance between performance and inference speed, making real-time event analysis feasible.

By combining an advanced NLP model with a Flask-based API and an interactive React web interface, the platform provides a complete framework for log analysis — from processing historical log files to live system monitoring. This solution can be further extended in the future with advanced functionalities such as multi-class classification, model explainability, automatic alerting mechanisms, or root cause analysis of detected anomalies.

Acknowledgements: I would like to thank Professor Popescu Florin for help and support.

Keywords: *Anomaly detection, system logs, NLP, DistilBERT, binary classification, API, Flask, React.*

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10) The Role of Sensor Systems in Enhancing the Performance of Military Drones in GNSS-Jammed Hostile Environments

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Introduction: The deployment of drones in contemporary military contexts has profoundly transformed the planning and execution of war operations. Drones provide critical advantages through their capabilities in surveillance, reconnaissance, targeted strikes, and tactical support, including diminished human danger, operational flexibility, and access to challenging locations. Nonetheless, as drone technology has progressed, so too have the techniques for neutralizing them, with one of the most effective being the jamming of GNSS (Global Navigation Satellite System) signals.

Weapons employing GNSS jamming technologies provide a significant danger to the operational efficacy of drones, impairing their navigation and mission execution capabilities. Drones can be disoriented and lose control of their designated trajectory by emitting false signals or entirely obstructing positional signals, rendering them susceptible to adversarial countermeasures. In the present military landscape, marked by a complex and intensely electronically contested operational environment, the advancement of alternative navigation systems utilizing complementary sensors is crucial to sustain the operational efficacy of drones amid GNSS jamming.

This study examines the essential function of complementary sensor systems in mitigating the vulnerabilities posed by GNSS jamming, evaluating the approaches and procedures that can substantially enhance the performance and dependability of military drones in adversarial settings.

Methods and Results: This paper discusses strategies for multisensor data fusion utilizing inertial systems, optical sensors, and magnetic sensors. Data fusion algorithms, such as Kalman filters, were employed to provide reliable and precise navigation during GNSS signal loss scenarios. Simulations and empirical tests were conducted in scenarios that replicate actual hostile circumstances, emphasizing the efficacy of the proposed approach.

The data collected from the sensors is affected by noise, which is why we applied an Alpha filter to reduce it. Inertial navigation has cumulative errors, which leads to a significant drift of the position over time. To compensate for this cumulative error, we integrated a FIFO sensor system into an EKF and correct the deviations using the integrated distance measured between successive frames captured by the camera on board the UAV, using the Optical Flow method.

The results indicate a substantial enhancement in drones' capacity to sustain trajectory and function efficiently amid GNSS jamming. Multisensor fusion systems have demonstrated enhanced resilience, guaranteeing operational continuity and markedly diminishing operational hazards.

Conclusions: The incorporation of alternative navigation systems and the application of multisensor fusion constitute practical and efficient strategies for mitigating GNSS jamming. These methodologies enable military drones to sustain operational efficacy and effectively execute their missions against significant electronic interference, hence offering a crucial tactical edge in the modern combat landscape.

Keywords: *UAV, UAS, GNSS, EKF, Jamming, Spoofing.*

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11) AI-Based Text-to-Speech System

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Introduction: The rapid advancements in Artificial Intelligence (AI) have revolutionized many areas of technology, including natural language processing and speech synthesis. One of the most notable developments is the AI-based text-to-speech (TTS) system, which has the potential to transform how humans interact with machines. By converting written text into natural, intelligible speech, TTS systems enhance accessibility, enabling individuals with visual impairments or reading difficulties to access written content audibly. Modern AI-powered TTS systems use deep learning techniques, such as neural networks and generative models, to produce high-quality, expressive, and context-aware speech that closely mimics human intonation and emotion. This paper explores the underlying technologies behind AI-based TTS systems, their applications, and the significant improvements they bring to fields such as education, customer service, and assistive technologies.

The objective of this project is to present the underlying mechanisms and methodologies used in the development of an AI-based text-to-speech (TTS) system, as well as to demonstrate its significant usefulness across a variety of domains like voice-controlled devices, virtual assistants, and smart home technologies. The system is split in two main components: NLP and voice synthesis, the AI intervenes in the second component. To demonstrate the generated voice interactively, I have created a web application that allows users to generate human-like speech.

The generated speech is in Romanian, but it can be translated into other languages using a model specialized in multilingual translation. This way, it can be used by anyone, regardless of their region, for implementation in various fields.

Methods and Results: The implementation of the AI-based text-to-speech model and the creation of the web application rely on a combination of powerful programming languages that facilitate both the development of advanced machine learning models and the creation of intuitive user interfaces. For the AI model itself, Python is the primary language, chosen for its extensive support in the field of machine learning and deep learning. Libraries such as PyTorch, TensorFlow, and NumPy provide the essential tools for building, training, and fine-tuning the TTS system. Python's flexibility and rich ecosystem of frameworks make it the perfect choice for such complex tasks. On the other hand, the web application is developed using a blend of technologies, with JavaScript being the core language for frontend development. Frameworks like React help create a responsive and dynamic user interface, while backend development is powered by Python-based frameworks like Flask. These languages and frameworks work harmoniously to provide a seamless integration between the AI model and the web platform, ensuring an efficient, user-friendly experience.

The model after the training is done returns a file with all the weights which then can be used for inference, which is the process of generating outputs based on new, unseen data.





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The process of generating audio using the platform is fairly simple. The first step is placing the text in the box titled with an intuitive phrase. After that, you click the button designed for inference, wait a few seconds depending on the length of the audio, and finally, you receive an audio recording.

The application also includes a feature called web scraping. This is a technique that takes the text part of a web site and uses it in other ways. In my case, I am taking the text and use it as my input for the text-to-speech voice synthesis. This way, you can see the true versatility of the model and how well it is trained to respond to different types of words.

The results confirm that no errors occurred during audio generation and that the platform is fully functional.

Conclusions: The results demonstrate that by integrating advanced natural language processing (NLP) techniques with high-quality speech synthesis, the system can convert written text into natural-sounding speech, making information more accessible to a wider audience and providing opportunities for integration into various fields such as automation, improved human-machine interaction, and accessibility.

Acknowledgements: I would like to thank Professor Popescu Florin for help and support.

Keywords: *Python, TTS, AI, React, Flask server, NLP.*

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10. COMPUTER ENGINEERING AND AI

1) Recommendation System Using Machine Learning Techniques

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Introduction: In today's digital world, recommendation systems play a crucial role in enhancing user experience by providing personalized content suggestions. Movie recommendation systems, in particular, have gained significant attention in the field of artificial intelligence. These systems analyze user behavior and preferences to suggest films that align with individual interests. The objective of this study is to implement a movie recommendation system using machine learning techniques, focusing on collaborative filtering and deep learning methods.

Methods and Results: The proposed recommendation system utilizes collaborative filtering techniques, including user-based and item-based approaches, to predict user preferences. The dataset used for training consists of movie ratings from platforms such as IMDb or MovieLens. The implementation follows these key steps:

- **Data Preprocessing:** Handling missing values, normalizing ratings, and encoding categorical data.
- **Collaborative Filtering:** Employing matrix factorization methods such as Singular Value Decomposition (SVD) to generate latent user and item factors.
- **Deep Learning Approach:** Using neural networks to enhance the prediction accuracy by capturing non-linear relationships in user preferences.
- **Evaluation Metrics:** The performance of the model is assessed using RMSE (Root Mean Square Error) and precision-recall metrics.

Preliminary results indicate that deep learning models outperform traditional collaborative filtering methods by capturing more complex patterns in user interactions. The integration of content-based filtering further improves recommendations by considering movie genres and metadata.

Conclusions: The developed movie recommendation system demonstrates the effectiveness of machine learning techniques in improving personalized content delivery. The combination of collaborative filtering and deep learning provides a robust framework for predicting user preferences. Future work includes integrating reinforcement learning to enhance real-time recommendations and exploring hybrid approaches for better scalability and accuracy.

Acknowledgements: I am grateful to the faculty members at the Military Technical Academy "Ferdinand I" for their support and to Lecturer Stelian Spinu for his valuable mentorship.

Keywords: *Movie Recommendation, Collaborative Filtering, Machine Learning, Deep Learning, Personalized Recommendations, Hybrid Systems.*

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2) Methods of Face Manipulation Using Deepfake Techniques

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Introduction: Artificial intelligence is a powerful tool for generating and manipulating visual content. Among the most advanced and controversial technologies are deepfake methods, which allow for the alteration of human faces in images and videos with impressive realism. These techniques use deep neural networks to create impersonations, which opens both significant opportunities and risks.

Methods and Results: The developed architecture consists of three convolutional neural networks: an encoder, a decoder, and VGG19. The encoder and decoder form a variational autoencoder (VAE), responsible for compressing image information into a latent space, where facial attributes or other visual aspects can be modified. The decoder then reconstructs the image at its original resolution. The networks were implemented using Keras and TensorFlow.

To improve the training process, the pre-trained VGG19 neural network is used for perceptual comparison between the original and reconstructed images. At each convolutional layer of VGG19, the Mean Squared Error (MSE) is computed between the elements of the two images, capturing differences from low-level features like edges and contours to higher-level facial attributes. Additionally, Kullback-Leibler (KL) is used in order to guide the latent distribution toward a normal distribution, contributing to the organization of the latent space.

The training dataset, CelebA, consists of over 200,000 images of celebrities, annotated with various facial attributes (e.g., smile, beard, hair color) and key landmark coordinates (such as the corners of the eyes and mouth). These landmarks are crucial for image preprocessing. Before feeding images into the VAE-VGG network, preprocessing steps include resizing them to 128×128 pixels and aligning the key landmarks to specific coordinates. The OpenCV library is used for these preprocessing tasks.

Facial attribute modification is performed using vector arithmetic in the latent space. First, the latent representations of all images in the dataset are extracted. Then, representative vectors for each modifiable attribute (e.g., adding/removing a beard or changing hair color) are computed. These vectors can be added or subtracted with different coefficients to alter facial features in a controlled manner, allowing for realistic and precise modifications.

Conclusions: The proposed architecture successfully enables facial attribute modification through a variational autoencoder combined with a perceptual comparison approach using VGG19. By leveraging vector arithmetic in the latent space, this model allows for controlled and realistic alterations of facial features. The integration of deep learning techniques such as convolutional neural networks and pre-trained models significantly enhances the quality of the generated images. This approach demonstrates the potential of AI in image processing while also raising ethical considerations regarding deepfake technology.

Acknowledgements: Lect. Dr. Eng. Stelian SPÎNU.

Keywords: Variational Autoencoder (VAE), Convolutional Neural Networks, deepfake, Latent Space, KL Divergence.



3) Satellite Image Classification using Hardware-Accelerated AI on Zynq MPSoC

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Introduction: Recent advances in technology have allowed Artificial Intelligence to be integrated on satellites. One example is the Phi-Sat-1 mission [1] powered by the *Intel® Movidius™ Myriad™ 2* Video Processing Unit. This paper's aim is to explore an alternative hardware-accelerated Artificial Intelligence solution for a Convolutional Neural Network (CNN) on a hybrid FPGA – CPU architecture. The solution is suitable for satellite on-board operation, due to the low power consumption of the FPGA, allowing results to be computed on edge before sending them to the ground station, thus reducing communication traffic, removing overhead from the ground station and providing scalability.

Methods and Results: The initial challenge involved finding a fitting Artificial Intelligence model. To accomplish this, ConvNextKAN was selected [2], which substitutes the last, regular dense layers in the original ConvNext architecture, for more compact and memory efficient novel Kolmogorov-Arnold Network (KAN) layers. For example, the experiment conducted in the respective paper achieved a 96% accuracy on the EuroSAT [3] dataset using only 32 spline points. This is particularly relevant for the goal of this paper, because having less trainable parameters could potentially reduce FPGA resource usage. For the KAN layers, the efficient-kan [4] implementation from GitHub was used. After replicating the experiment on the RGB version of the dataset, the results were significantly lower compared to the original paper, with an average accuracy of 85%, instead of the 96% accuracy claimed by the authors. Further experimenting is needed for finding the source of error. The present project leverages the Xilinx's FINN [8] framework to synthesize a regular PyTorch Convolutional Neural Network into RTL implementation. Since FINN doesn't fully support off-the-shelf, complex models yet, the paper proposes a custom design, inspired by the VGG16 architecture, as seen in Figure 1.

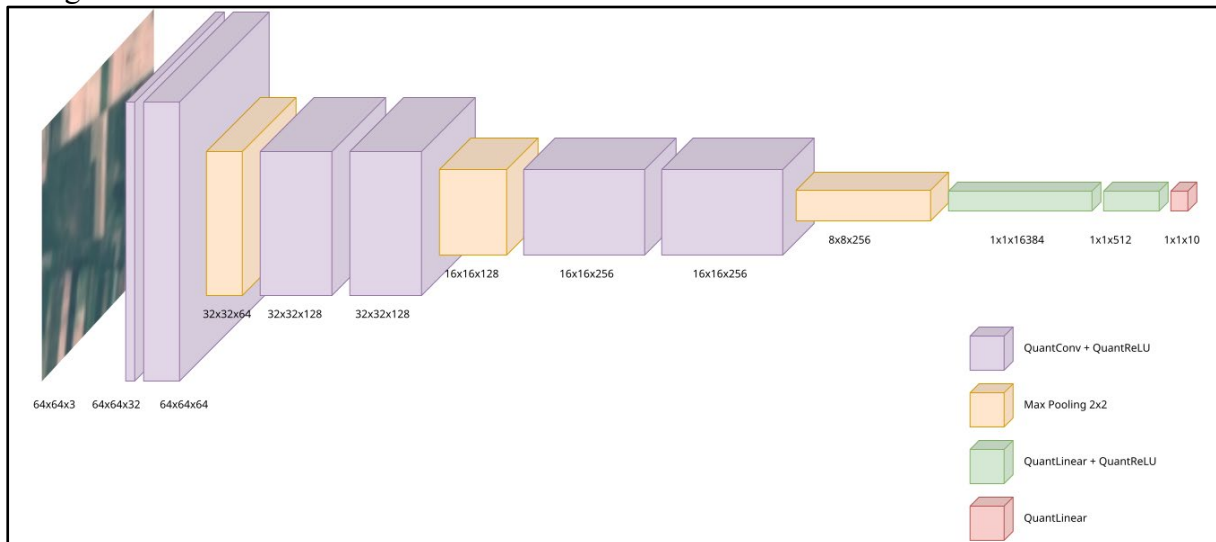


Fig. 1: - Custom CNN Architecture

The results were satisfactory, with an 89.30% accuracy on the testing set. A Google Colab notebook of the experiment, showcasing the implementation of the model, the training loop and the testing loop can be found here [5]. The next step in the workflow focused on quantization of the model with the help of Brevitas [6] framework. This required implementing a version of the previous model using the quantized equivalent PyTorch layers provided by



Brevitas (e.g.: QuantConv2D instead of Conv2D). This way, the original 32-bit floating point PyTorch model was converted to an 8-bit integer Brevitas model. The quantized model was then exported to the QONNX [7] intermediate representation format, necessary for importing the model into FINN. After training, the resulted accuracy on the testing set reached 84.16%, only a ~5% decrease in accuracy from the original model. Synthesizing the model using FINN was not possible since some of the layers exceeded the maximum bit width limit of 8192 imposed by the framework.

Conclusions: The current results of the quantized model are promising and must be deployed on real hardware in order to test the system's real performance. Further modification of the model is needed before synthesis. The upcoming steps of the project include optimizing the current model, HLS synthesis using FINN, building a load balancer supporting multiple instances of the model, and deployment on the Zynq ZCU102 MPSoC board [9]. Additionally, the models benchmarking should also include metrics other than accuracy to provide a more holistic view.

Acknowledgements: Cpt. Conf. Univ. Dr. Ing. Mihai COCA.

Keywords: FPGA, Edge Computing, Quantized Neural Networks, Satellite Images, Image Classification, Zynq.

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4) Cyber Attack Detection System Using Machine Learning Techniques

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Introduction: The continuous evolution of cyber threats necessitates the development of intelligent and adaptive detection mechanisms. Traditional intrusion detection systems (IDS) often struggle with high-dimensional network traffic data and require significant computational resources. To address these challenges, we propose a Cyber Attack Detection System (CADS) based on Information Extreme Machine Learning (IEMML), which integrates information theory



principles with Extreme Learning Machines (ELM) for rapid and efficient cyber threat detection.

IEML leverages entropy-based feature selection and the high-speed learning capabilities of ELM to enhance both detection accuracy and computational efficiency. Unlike conventional deep learning methods, ELM eliminates the need for iterative backpropagation, enabling real-time analysis of network traffic data while maintaining high generalization performance.

Methods and Results: Our approach consists of three main components:

- **Feature Selection & Optimization:** We apply mutual information and entropy-based ranking to select the most informative features from network traffic datasets, reducing redundancy and computational complexity;
- **Classification using IEML:** We utilize Extreme Learning Machines (ELM) for intrusion detection, benefiting from their ability to train in a single forward pass without iterative weight updates;
- **Adversarial Robustness & Adaptive Learning:** We integrate Shannon entropy and Kullback-Leibler divergence to improve decision boundaries and enhance model resilience against adversarial attacks.

Conclusions: The results indicate that Information Extreme Machine Learning (IEML) is a highly efficient and scalable approach for cyber threat detection. By leveraging information-theoretic feature selection and ELM's rapid training capabilities, our proposed system offers real-time adaptability and high detection accuracy with minimal computational overhead. This study highlights the potential of IEML in developing next-generation autonomous cybersecurity solutions capable of mitigating emerging cyber threats.

Acknowledgements: Special considerations to Univ. Conf. Dr. Eng. Luciana Morogan for the guidance and insightful feedback throughout the course of this project.

Keywords: *Cybersecurity, Intrusion Detection, Machine Learning, Extreme Learning Machines, Information Theory, Network Security, Adversarial Robustness.*

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5) Artificial Intelligence-Based Application for Satellite Image Analysis

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Introduction: Satellite imagery is a valuable resource for early detection and monitoring of natural disasters. This paper presents an AI-based application for satellite image analysis, enabling rapid identification and assessment of disaster impacts.





Methods and Results: The proposed methodology employs a structured pipeline consisting of three main stages: image enhancement, cloud removal, and disaster impact assessment. Specifically, the pipeline includes an image enhancement block utilizing the Near-Infrared (NIR) band and histogram normalization to improve the quality of RGB images, a cloud removal block designed to eliminate cloud cover from enhanced satellite imagery, and a disaster impact assessment module for analyzing enhanced PlanetScope satellite images.



The image enhancement block receives a raw PlanetScope image as input and applies NIR-based enhancement methods as detailed in [2], combined with histogram equalization to improve contrast, detail, and pixel distribution, as described in [3].

The cloud removal module utilizes generative adversarial networks (GANs), following the methodology outlined in [1]. Satellite images are processed in 512x512 pixel patches, which are subsequently recombined to reconstruct a cloud-free version of the original imagery.

Additionally, the disaster impact assessment module employs convolutional neural networks (CNNs), as described in [4], to detect changes associated with natural disasters. This module processes the cloud-free, preprocessed images generated by the earlier pipeline stages. While the current study focuses primarily on wildfire detection, the CNN architecture can be adapted to other types of natural hazards by obtaining relevant datasets and retraining the network accordingly.

Due to the limited availability of freely accessible PlanetScope data, the GAN and CNN models were initially trained on Landsat-8 imagery and later fine-tuned using a smaller set of PlanetScope images.

The performance evaluation of the models employs specific metrics. For the GAN model, Peak Signal-to-Noise Ratio (PSNR) and Structural Similarity Index (SSIM) were used, where higher values indicate superior image reconstruction quality. The GAN module achieved a PSNR of 30.232 and an SSIM of 0.954. For the preprocessing stage, the Blind Image Quality Evaluator (BIQE) metric was applied, resulting in a BIQE score of 26.6023, with lower values indicating better preprocessing quality. The CNN module's performance was assessed using Intersection over Union (IoU), measuring the overlap between predicted and actual fire-affected regions, achieving an IoU score of 94.2%.

Conclusions: The proposed solution demonstrates strong potential for improving natural disaster analysis and monitoring. It can serve as a valuable tool for authorities, facilitating rapid damage assessment and informed decision-making in emergency situations.

Acknowledgements: Cpt. Conf. Univ. Dr. Ing. COCA Mihai.

Keywords: Remote sensing, GAN, CNN, AI, Natural hazards.

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6) Fake News Detection: A Machine Learning Approach

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Introduction: This document outlines the detection of fake news from the text using different machine learning and deep learning algorithms. The goal is to examine how the methodologies of text classification and processing differ in regards to finding the fake news in the online content.

Methods and Results: The Combined Corpus dataset [1] consists of a curated repository of news articles covering some of the most important topics, including politics, sports, education, and so on, where each article is labeled as 'fake' or 'real'. The text data was carefully processed by converting it to lowercase, removing URLs, punctuation, and stop words, and lemmatization. To convert the text data into numerical representations, vectorization techniques such as Bag-of-Words, TF-IDF and GloVe embeddings were used. For classification, several models were implemented, including k-Nearest Neighbors (KNN), Support Vector Machines (SVM), Convolutional Neural Networks (CNN), Long Short-Term

Memory networks (LSTM), Bidirectional Encoder Representations from Transformers (BERT), and Robustly Optimized BERT Pretraining Approach (RoBERTa). Additionally, Local Interpretable Model-Agnostic Explanations (LIME) was used to attempt to clarify the decision-making process of the classification models, thereby improving their overall interpretability.

Conclusions: A comparative analysis of the implemented models, evaluated under various preprocessing and vectorization strategies, revealed that transformer-based approaches yield superior performance in detecting fake news. The integration of explainable artificial intelligence (XAI) methods, such as LIME, further strengthens the transparency and reliability of the predictions, paving the way for more trustworthy automated misinformation detection systems.

Acknowledgements: Lect. dr. ing. Stelian SPÎNU.

Keywords: *fake news, machine learning, deep learning, text classification, LIME.*

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7) Artificial Intelligence-Based Application for Estimating Vegetation Attributes from Satellite Images

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Introduction: Estimating vegetation structure is essential for monitoring carbon stocks, biodiversity and ecosystem health. Traditional methods, such as ground surveys and airborne LiDAR (Light Detection and Ranging) and ALS (Airborne Laser Scanning) provide high accuracy but are costly and difficult to scale [1]. Deep Learning offers a scalable alternative, leveraging Sentinel-1 SAR (Synthetic Aperture Radar) and Sentinel-2 optical imagery to estimate LAI (Leaf Area Index) [3], while GEDI LiDAR fusion with Sentinel-2 enables canopy

height estimation [2]. By combining these models, our approach provides a cost-effective and accurate framework for biomass estimation and large-scale ecosystem monitoring.

Methods and Results: Our framework leverages deep learning to integrate multi-source remote sensing data for vegetation attribute estimation in the Romanian territory. For the LAI estimation, we first acquire multi-temporal remote sensing data from Copernicus, including Sentinel-1 radar data, LAI values derived from Sentinel-2 imagery and the associated scene classification masks. The data is organized into 256x256 pixel tiles, ensuring that all inputs are precisely aligned pixel by pixel. The methodology exploits temporal relationships by incorporating data from three consecutive time steps ($t-2$, $t-1$, and t), ensuring that past observations improve the robustness of current LAI estimations. Sentinel-1 data, which remains robust under suboptimal meteorological conditions, supports the optical information and the dataset is carefully curated to avoid imagery severely affected by the clouds. The model consists of two parallel encoders: one for Sentinel-1 radar data, which utilizes an autoencoder for feature extraction and another for Sentinel-2-derived LAI values, processed using convolutional layers. The extracted representations are then fused and passed through a U-Net [4] decoder to generate accurate LAI estimations [3].

For canopy height estimation, our framework relies on a fully convolutional deep learning model that operates on high-resolution Sentinel-2 optical imagery combined with sparse reference data from the GEDI LiDAR mission. The input data, comprising 12 optical bands upsampled to 10-m resolution and cyclically encoded geographic coordinates is partitioned into 256x256-pixel tiles to ensure precise pixelwise alignment. In addition, a geo-prior module learns to scale and shift predictions based on latitude-longitude information, further refining the canopy height outputs.

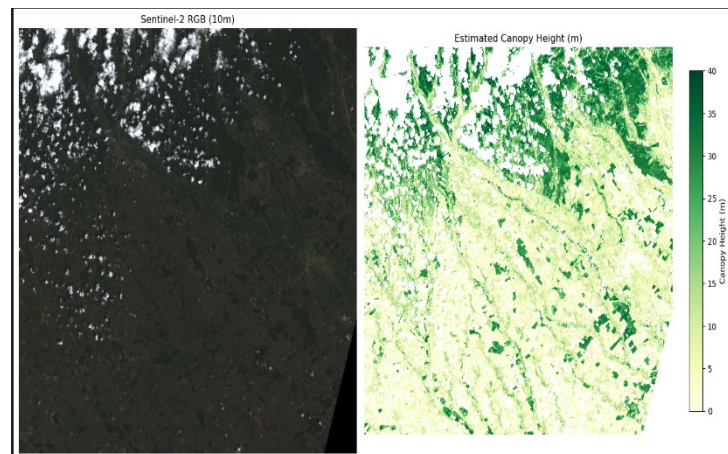


Fig. 1: Estimated canopy height of a Romanian zone

Training is performed in a sparse supervision setting: for each GEDI footprint, the corresponding Sentinel-2 image patch is extracted and its center pixel is assigned the canopy height value derived from GEDI.

The model is optimized using a Gaussian negative loss to simultaneously predict the mean canopy height and its associated uncertainty. During inference, multiple cloud-free image acquisitions per location are processed and the final canopy height estimate is obtained by merging predictions through inverse-variance weighting [2].

By combining the high-resolution LAI maps with the dense canopy height estimates, our framework produces integrated vegetation maps that offer a comprehensive view of the ecosystem. The fusion of these two data layers enables the correlation between horizontal vegetation density and vertical canopy structure, allowing for the derivation of key biophysical parameters such as aboveground biomass, carbon stocks and forest structural complexity. Using established biomass conversion factors, the aboveground biomass (AGB) was computed as a function of both LAI and canopy height, so the carbon stocks were subsequently estimated by applying a carbon fraction coefficient.



Conclusions: This integrated approach enhances our ability to monitor vegetation dynamics, assess ecological stability and support applications in sustainable forest management, biodiversity conservation and climate change mitigation.

By leveraging deep learning and multi-source satellite data, our method provides a scalable and cost-effective solution for large-scale vegetation analysis.

Acknowledgements: Cpt. Conf. Univ. Dr. Ing. COCA Mihai.

Keywords: Remote sensing, CNN, Deep Learning, Vegetation Monitoring, Canopy Height, Leaf Area Index.

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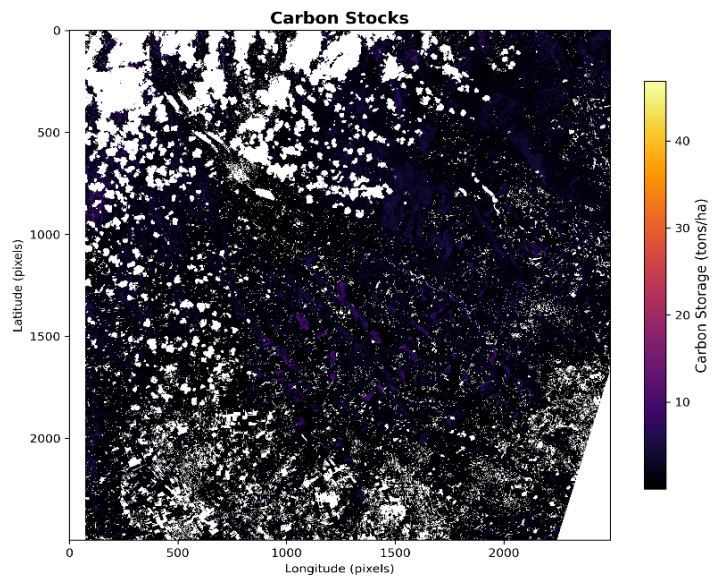


Fig. 2: Spatial distribution of estimated carbon stocks (tons/ha). Warmer colors indicate regions with high carbon storage and darker shades represent areas with lower biomass accumulation.

8) Field-Deployable Kubernetes Cluster: Enhancing Computing Capabilities in Remote Environments for MLops

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Introduction: In modern operational environments, technology plays a crucial role in enabling fast and efficient decision-making. Military units and security structures must analyze real-time data even in isolated areas, where connectivity to centralized infrastructure is limited or unavailable. To address this challenge, this project proposes the development of a portable MicroK8s cluster, capable of running Machine Learning applications and distributed computing tasks directly in the field. This system extends the computational power of a tactical laptop, allowing real-time model retraining without relying on external data centers. By leveraging MicroK8s for lightweight orchestration and integrating AI toolkits like Kubeflow, the solution ensures scalability, adaptability, and operational resilience in mission-critical environments.



Methods and Results: This project develops a deployable MicroK8s-based Kubernetes cluster for real-time machine learning model retraining in field operations. The cluster comprises 4× Raspberry Pi 4B (4GB RAM) worker nodes and 2× Raspberry Pi 4B (8GB RAM), connected via a POE TP-Link Managed Switch. A custom 3D-printed rack ensures portability. The cluster runs Ubuntu 22.04 (64-bit) and utilizes MicroK8s for lightweight orchestration [1]. The software stack includes Charmed Kubeflow for ML workflows [2], Docker for containerization, Prometheus & Grafana for monitoring, and Jupyter Notebooks for interactive development. Each Raspberry Pi is configured as a node within the distributed MicroK8s cluster, with a head node managing workloads. ML models are containerized and deployed via Charmed Kubeflow Pipelines, supporting fine-tuning and real-time retraining using new field data. Docker Hub is used for storing and updating models. Monitoring is handled through Prometheus for performance metrics collection, Grafana for visualization, and the Kubernetes Dashboard for resource management.

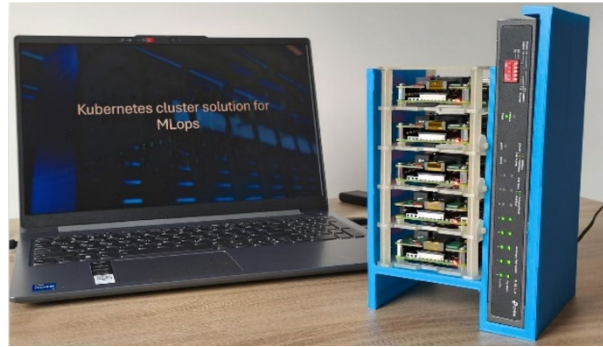


Fig. 1: Cluster rack

Conclusions: The deployment of this MicroK8s-based cluster effectively extends the computational capabilities of a standard laptop, enabling real-time model retraining and AI adaptability in isolated environments. By distributing ML workloads across multiple Raspberry Pi nodes, the system significantly improves processing efficiency and reduces dependency on centralized data centers. The results demonstrate that integrating portable edge computing with Kubernetes orchestration enhances operational efficiency, providing a scalable and resilient solution for field-based AI applications.

Acknowledgements: Associate professor PhD. Annamaria SARBU.

Keywords: *MicroK8s, portable, edge computing, machine learning, model retraining.*

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9) From Likes to Love: Understanding Emotions in Social Media through Sentiment Analysis

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Introduction: Sentiment Analysis represents the computational study of people's sentiments, attitudes, and emotions expressed in written language. Social media platforms host a large volumes of raw data uploaded by users in the form of text, videos and audio, which can be transformed into valuable information. This paper presents a Sentiment Analysis approach applied to social media posts from Facebook and Tiktok, with the primary objective of analyzing user opinions expressed in comments and their engagement with various posts. A key component of our system is optimizing bidirectional encoder representations from the transformers approach (RoBERTa), utilizing global vectors for word representation (GloVe)



word embedding features [1], enabling it to capture nuanced emotions and contextual cues, thus enhancing sentiment classification in social media content.

Methods and Results: Our project aims to develop a web application, with a primary focus on analyzing collective sentiments related to cyberbullying. The initial step in the development process is data collection. Web scraping is an autonomous data mining technique used to gather information from the Internet and other common databases [2]. Using Selenium's web driver, we establish a persistent login session to automate the retrieval of social media posts and seamlessly navigate through their dynamic content. BeautifulSoup and XPath are employed to extract key elements from social media posts, such as comments, images, videos, and post descriptions. While BeautifulSoup facilitates HTML parsing, XPath enables precise navigation and selection of relevant content within the document structure. Considering that English is not the primary language for most social media users, with only 13% of the global population speaking English, the raw data we collect often spans a wide range of languages. To overcome this multilingual challenge, we use machine translation API to standardize the data before conducting sentiment analysis. DeepL excels in handling large volumes of text, translating multiple languages simultaneously while preserving context, original meaning, and sentiment [3]. To further ensure consistency across the data, we applied additional text normalization techniques, such as standardizing whitespace, removing URLs and user mentions, and also converting emojis and emoticons into words. We utilize the pre-trained RoBERTa tokenizer from the Hugging Face Transformers library, which employs a subword tokenization technique based on Byte Pair Encoding (BPE). Post-tokenization, sequences are padded or truncated to a fixed length to ensure uniformity across all input data. In addition to RoBERTa's contextual embeddings, we also integrate Global Vectors for Word Representation (GloVe) embeddings, which capture semantic relationships between words by representing them as fixed-length vectors. These GloVe embeddings are preprocessed, converted into PyTorch tensors, and integrated as complementary features. This combination of RoBERTa's contextual embeddings and GloVe's semantic embeddings enhances the model's ability to understand both the contextual and semantic aspects of the text. [1]. A key aspect of our cyberbullying detection approach is fine-grained classification, which enables the identification of specific categories of harmful content rather than a simple positive-negative-neutral polarity. This method categorizes content into six classes: Religion, Age, Not Cyberbullying, Other Cyberbullying, Gender, and Ethnicity. This detailed classification provides a deeper understanding of the various types of cyberbullying that can manifest in social media interactions.

Conclusions: By integrating the capabilities of fine-tuned RoBERTa with GloVe word embeddings and a fine-grained classification model, our system effectively captures both contextual and semantic nuances in user-generated content, providing a comprehensive understanding of diverse sentiments and cyberbullying instances across social media platforms. Additionally, machine translation through DeepL helped standardize multilingual data for accurate analysis. Our approach demonstrated the effectiveness of BERT in understanding complex social media language, providing a solid foundation for future advancements in sentiment analysis applications.

Acknowledgements: Special thanks to Lecturer Ph.D. Stelian Spînu for his invaluable support and guidance.

Keywords: *Deep Learning, Fine-grained Classification, Machine Translation, Social Media, Multilingual Data, Fine-tuned.*

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10) Human Violence and Dangerous Activity Detection using I3D and YOLOv8

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Introduction: With crucial applications in public safety, real-time detection of dangerous activities is a major challenge in computer vision. This study utilizes Inflated 3D[1] for classifying dangerous actions into two categories: "fight" or "noFight". YOLOv8[2] is used for detecting dangerous objects such as knives, guns and identify people involved in altercations within fight-classified video frames. By studying of video input, the system learns to identify patterns associated with dangerous actions, providing a reliable incident detection solution.

Methods and Results: The objective of this study is to create a model which can distinguish between violent and non-violent actions in video sequences while detecting dangerous objects and identifying persons involved.

The dataset was created by merging multiple datasets together (vfd-2000[3], UBI Fights[4]) to ensure full representation of dangerous actions from different angles and perspectives. To standardize the dataset, the videos were divided into smaller videos, each one with a maximum duration of 5 seconds. Every video was labeled as "fight" or "noFight", resulting in approximately 70000 videos. COCO Dataset[5] is used for knives and people detection, respectively "weapon-detection Dataset" [6] for weapon detection.

Inflated 3D is a deep learning architecture that extends 2D Convolutional Neural Networks into 3D by adding a temporal dimension . A pre-trained Inflated 3D Convnet model trained for action recognition on Kinetics dataset extracts keyframes and generates feature vectors in npy format. The vectors are then processed by MLP network (Multi-Layer Perceptron) to classify actions as dangerous or non-dangerous. MLP network uses BatchNormalization and Dropout for regularization, with ReLU activations in hidden layers and a sigmoid activation for binary classification.

YOLOv8 (You Only Look Once) is a fast real-time object detection model. YOLO improves video analysis by detecting harmful objects – if a weapon is detected, the video input is considered as a threat. The videos flagged as dangerous will be further analyzed to detect people involved in the violent actions, using YOLOv8 people detection feature.

The metrics used to evaluate the system's performance in a practical way are accuracy(82.1%), precision(79%), recall(87%), F1-score, AUROC – 86% (Area Under the Receiver Operating Characteristic Curve) and Equal Error Rates for action classification. For objects and people detection, mAP (Mean Average Precision) , MOTA (Multiple Object Tracking Accuracy) will measure tracking reliability.

Conclusions: Deep Learning can improve our lives by detecting real-world violence. The system enhances safety by enabling early threat identification, reducing response time.



Future developments may focus on growing datasets and refining accuracy in practical situations.

Acknowledgements: Cpt. Conf. Univ. Dr. Ing. Mihai COCA.

Keywords: *dangerous activities, I3D, YOLOv8, MLP, AUROC, EER.*

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11) Speech Recognition Software Application

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Introduction: Speech recognition has become an essential component of modern human-computer interaction, enabling applications in security, healthcare, and emergency response systems. However, most state-of-the-art Automatic Speech Recognition (ASR) systems focus on widely spoken languages like English, leaving underrepresented languages, such as Romanian, with limited resources.

This research aims to develop an ASR system specifically for Romanian, with a focus on integrating it into ODIN112, the "Real-time Speech-to-Text Transcription System for the Romanian Language and Emotional State Recognition in 112 Emergency Calls" research project. The project also includes the creation of a Romanian speech corpus enriched with regionalisms, neologisms, xenisms, and jargons, ensuring a more comprehensive linguistic representation [1].

The main objectives of this study are to develop a robust automatic speech recognition (ASR) system specifically designed for the Romanian language, to create and annotate a high-quality speech dataset, and to integrate and test the ASR system within ODIN112.

Methods and Results: The first step in building an efficient ASR model is curating a diverse and representative dataset. The Romanian speech corpus was compiled from open sources, including online streaming platforms such as YouTube and Spotify, which were used to collect spontaneous and formal speech. Additionally, crowdsourced contributions from native speakers across different regions of Romania were gathered to ensure linguistic diversity. Transcriptions of emergency calls, where legally permissible, were also included to provide real-world applicability. Furthermore, Mozilla Common Voice (Romanian, version 17.0), an open dataset, was integrated to include validated speech samples from diverse Romanian speakers.



Audio recordings will be validated through a voting mechanism, where a transcription is accepted only if confirmed by at least two independent reviewers through ValCheck, a web application used for validation. The application is interactive and visually pleasing, providing an intuitive interface for reviewers. Each reviewer creates an account and gains access to the recordings stored in the database. Reviewers can edit the current transcription of a recording, adjust timestamps, or add new phrases in cases where the automatically generated transcriptions are incorrect. Additionally, reviewers can export validated collections for use as datasets or import other collections into the application for review and correction. Moreover, reviewers can invite other members to join, facilitating collaborative dataset validation and refinement.

The ASR model was developed using Whisper by OpenAI, a state-of-the-art neural architecture for speech-to-text transcription. Whisper was fine-tuned on Romanian-specific data, with a particular focus on audio modified using the GSM-FR codec, ensuring the processed speech closely resembles real telephone conversations. This approach enhances the model's ability to accurately transcribe emergency calls and other phone-based speech scenarios [2].

Training was performed using the PyTorch framework, with GPU acceleration for enhanced efficiency. The dataset was split into training (80%), validation (10%), and testing (10%) subsets to ensure robust model generalization.

Conclusions: This research develops and integrates a Romanian ASR system into ODIN112 to enhance call processing efficiency. It improves Romanian ASR capabilities by creating a high-quality speech corpus and fine-tuning Whisper for greater accuracy. Real-time integration streamlines emergency response operations while ensuring data security and privacy. Future work will focus on expanding the corpus with diverse speakers, improving noise robustness, and formally evaluating Whisper in emergency contexts. By addressing the lack of Romanian ASR resources, this project lays the foundation for advancements in speech processing, digital communication, and security applications.

Acknowledgements: This research was conducted under the supervision of Lt. col. conf. univ. dr. ing. Ștefan-Adrian Toma.

Keywords: *Speech Recognition, Automatic Speech Transcription, Romanian Language, Whisper, Emergency Call Processing.*

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12) Analysing and Securing AI Models Against Noise-based Attacks in Digital Images

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Introduction: Given the current context of security in Artificial Intelligence, without proper defensive techniques, input taking models are exposed to certain threats based on the type of attack used. This paper revolves around noise injection exploits. Adversarial attacks and malicious payload embedded into images using steganography algorithms are the two primary topics.





Methods and Results: Detecting noise in images is a complex process due to a broad range of methods that can be utilized in the process of altering the visual content, each introducing distinct types of perturbations that may significantly differ in magnitude, structure and detectability. It is difficult to create generalized detection strategies effective against all potential modifications.

We analyze each image provided as input to the AI model, and if noise is detected within the image, we must identify the type of noise. Specifically, the aim is to determine whether it is random noise intended solely to mislead the model into making incorrect predictions, or if the noise conceals a malicious payload, such as a potentially hidden script.

To perform this analysis, each image will initially undergo noise-detection filtering utilizing multiple algorithms, including statistical analysis, spectral methods, and spatial-domain filters. If noise is detected within an image, further examination will determine the type of noise: whether it is random noise intended solely to mislead the AI model into incorrect predictions or steganographic noise potentially concealing malicious payloads. For the steganographic detection phase, we will employ an AI-based classifier specifically trained on datasets containing images embedded with payloads using various known steganographic algorithms. This includes popular steganographic techniques such as Least Significant Bit (LSB), Discrete Cosine Transform (DCT), Steganography System of Bit N (SSB-N).

If malicious steganographic content is identified, the hidden payloads or scripts will be extracted for subsequent analysis and statistical evaluation. In cases where the detected noise is purely adversarial, designed to deceive the AI model, filtering techniques will be applied to smooth the image and mitigate potential misclassification.

Conclusions: This approach highlights the vulnerabilities present in AI-based image classification systems, emphasizing the importance of robust noise-detection and steganographic analysis. The proposed methods contribute significantly towards developing more secure and resilient AI models capable of effectively distinguishing between benign image alterations and malicious manipulations.

Acknowledgements: Conf. Univ. Dr. Ing. Luciana MOROGAN.

Keywords: *Noise Detection, Steganalysis, AI Security.*

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13) Real-Time 3D Tracking of Objects using ZED 2i Camera and YOLOv12 Fine-Tuning

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Introduction: This research develops and evaluates a high-precision system for real-time 3D tracking of ping pong balls using the ZED 2i stereo camera [1] integrated with YOLOv12 object detection [2, 3]. The work addresses challenges in accurate ball tracking across varied environmental conditions through a multi-modal approach combining deep learning with stereo vision techniques. This research connects to the WALLRAD project [4] by complementing its through-wall radar imaging capabilities with visual tracking, potentially enhancing the system's overall object detection and tracking performance.





Methods and Results: The methodology employs specialized YOLOv12 model trained on a comprehensive dataset combining multiple public pingpong ball images collections with custom footage in diverse environments. A significant challenge addressed in this research is the motion blur effect inherent in tracking fast-moving objects like ping pong balls. To overcome this limitation, the following strategies were implemented:

- Data augmentation with simulated motion blur effects of varying directions and intensities while preserving original labels
- Creation of an expanded training dataset specifically designed to recognize balls with motion blur
- Reduced resolution to VGA (640x480) enabling higher frame rates

Evaluation across validation data explored performance at different confidence thresholds (0.1, 0.2, 0.3, 0.5). Compared internally, these thresholds revealed distinct F1 curve profiles: non-linear curves at 0.1 and 0.2 indicated unreliable detections, while the curve stabilized towards linearity at 0.3, suggesting a balance between recall and precision. At a higher threshold of 0.5, the F1 curve showed steady improvement (starting from 0.6), favouring precision over initial recall. This internal comparison allowed identification of an optimal operating point for the system.

The fine-tuned system demonstrated exceptional performance for this visual tracking task, achieving:

- Detection accuracy of 97.1% mAP@0.5 as evidenced by precision-recall analysis, surpassing previous methods which achieved lower mAP@0.5
- F1 score of 0.95 at optimal confidence threshold (0.493)
- 96% true positive rate with minimal false negatives (3.6%).

Comprehensive testing across various lighting conditions demonstrates the system's robustness:

- Low light (equivalent to twilight conditions)
- Standard indoor lighting (typical office/home environment)
- Bright conditions (equivalent to daylight)

The fusion approach combines stereo depth information from the ZED 2i camera [1] with YOLOv12 detections through a custom algorithm that dynamically weights each modality based on detection confidence and scene characteristics.

Conclusions: This work contributes to computer vision research with practical applications that can enhance the WALLRAD project's [4] capabilities. While WALLRAD focuses on through-wall radar imaging using ultra-wideband SAR systems, our visual tracking system provides complementary sensing modalities that could improve overall detection performance. The combination of radar-based positioning from WALLRAD with our visual tracking system creates potential for multi-modal sensing solutions in security applications, offering improved tracking of objects and people in complex environments. Future work will explore integrating these systems for enhanced object detection and tracking capabilities in challenging scenarios where neither modality alone would be sufficient.

Acknowledgements: Lt. col. conf. Dr. Ing. Ștefan-Adrian TOMA.

Keywords: *Confusion matrix, YOLOv12, F1 score, Deep Learning, fine-tuning, mAP(mean average precision).*

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14) Software Package for Time Series Analysis of Satellite Images

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Introduction: The analysis of satellite imagery time series has become essential in Earth observation applications, including terrain deformation monitoring, infrastructure stability assessment, and environmental studies. Synthetic Aperture Radar (SAR) interferometry provides a robust method for detecting surface displacements with millimeter accuracy [3]. However, processing large SAR datasets remains computationally demanding. This research aims to develop a software package for SAR interferogram analysis and persistent scatterer detection using deep learning-based data compression techniques. The project integrates autoencoder neural networks with complex-valued weights to compress SAR data efficiently while preserving phase information crucial for interferometric applications [2].

Methods and Results: The first step in this research involves curating SAR data from Sentinel-1 missions, processed using the Sentinel-1 Toolbox (S1TBX) and the SNAP (Sentinel Application Platform) software [1]. SAR time-series data are preprocessed through calibration, coregistration, and interferogram formation steps [4]. The persistent scatterer interferometry (PSI) method is employed to detect stable reflection points over time [3].

The ongoing phase of the research explores the integration of deep learning models—specifically, autoencoders based on complex-valued neural networks—as a means of reducing data dimensionality while preserving interferometric phase integrity [2]. These models are being developed and trained using a variety of SAR datasets collected under different acquisition conditions to ensure generalization capabilities.

Preliminary evaluations aim to assess the extent to which such compression strategies can reduce storage needs without degrading the accuracy of deformation measurements [3]. Current observations suggest that, with appropriate model design and training strategies, it is possible to retain essential interferometric features even after compression [2]. A comprehensive evaluation across larger datasets and diverse scenarios is essential to fully assess the method's overall performance.

Conclusions: This study presents a software package for SAR time-series analysis, integrating deep learning for data compression and improving interferometric processing. The results show that compression reduces storage needs while maintaining analysis accuracy. The system successfully processes and analyzes SAR time-series data, making it a useful tool for a wide range of geospatial applications. Future improvements will focus on enhancing noise robustness, refining detection algorithms, and expanding the dataset for better generalization.

Acknowledgements: This research was conducted under the supervision of Lt.col.conf.univ.dr.ing. Ștefan-Adrian Toma.

Keywords: *SAR Interferometry, Persistent Scatterer Analysis, Deep Learning, Data Compression, Autoencoder, Time-Series Analysis.*

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15) Applications of Machine Learning Algorithms for Extracting Relationships Between Entities From Datasets

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Introduction: The goal of this project is to develop a model capable of estimating the geographic location of input images from Romania. Our approach builds upon GeoCLIP, a globally pre-trained model for geo-localization. GeoCLIP is a CLIP-based geo-localization model that employs a specialized location encoder, which "incorporates positional encoding with random Fourier features to efficiently encode GPS coordinates and mitigate spectral bias in MLPs" [1], that exhibits weaker results when applied specifically to Romania.

Methods and Results: To construct the dataset, multiple APIs were explored to collect landmark images and metadata:

- **Nominatim** [2]: While not ideal for retrieving images, it provided valuable insights for structuring queries in other APIs.
- **Mapillary** [3]: Offered a large volume of images, but most were captured from dashcams and lacked a clear landmark focus.
- **OpenStreetMap (Overpass API)** [4]: Used to extract structured landmark data from cities, facilitating targeted image retrieval.
- **Google Places API** [5]: Provided the most reliable results, likely due to Google's mature and widely used database.

My first approach involved obtaining landmark coordinates via the Overpass API and defining a border box around the location, which was then used in queries to the Mapillary API. However, this method did not significantly improve results, with 70–80% of the retrieved images being considered irrelevant.

Ultimately, the best-performing approach combined the Overpass API for structured landmark extraction with the Google Places API, ensuring a more reliable dataset for model training. Approximately 80% of the retrieved images from Google places API had the landmark as the main subject, while around 10% featured the landmark in the background or were considered irrelevant.

Conclusions: This project focuses on developing a model for estimating the geographic location of images from Romania, building upon the globally pre-trained GeoCLIP model. Since GeoCLIP performs poorly in this region, a new training dataset was created by combining OpenStreetMap's Overpass API for landmark extraction with Google Places API for high-quality image retrieval. The next step is fine-tuning GeoCLIP using this dataset to improve its geo-localization accuracy in Romania.

Acknowledgements: Cpt. Conf. Dr. Ing. Coca Mihai.

Keywords: *Machine Learning, Geo-location, Romanian landmarks.*

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16) Mobile Application for Controlling and Optimising the Management of Smart Devices in a Residential Environment

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Introduction: Smart home automation has become an essential aspect of modern living, enabling users to control and monitor various household devices remotely. However, ensuring seamless interoperability between devices from different manufacturers, maintaining low-latency local control, and prioritizing security remain significant challenges. This paper presents a smart home system that integrates multiple communication protocols to enable a highly flexible and secure automation solution. Unlike traditional smart home platforms that rely heavily on cloud services, this system emphasizes local processing, reducing dependency on third-party providers and enhancing user privacy. The proposed architecture enables control of diverse devices, ensuring comprehensive smart home automation.

Methods and Results: The proposed smart home system follows a modular and decentralized architecture, ensuring secure and efficient control of multiple connected devices. The system enables local device management, minimizing reliance on external cloud services to enhance both privacy and reliability. Communication between devices is handled through a lightweight messaging protocol (MQTT)[1], allowing real-time interaction with minimal latency.

To establish secure connectivity, the system supports wireless device pairing and onboarding, ensuring seamless integration of new smart home components. Devices communicate through 3 possible protocols: Bluetooth Low Energy (BLE)[2], UPnP (UnPlug and Play)[3] or mDNS[4], enabling interoperability between different manufacturers and device types. Advanced device discovery mechanisms facilitate automatic detection of new devices within the network, allowing for a user-friendly setup process.

The system implements strong authentication and access control measures, ensuring that only authorized users can send commands or retrieve data from smart devices. Secure data encryption techniques are applied to all transmitted and stored information, protecting user privacy at every stage of interaction.

A centralized automation engine coordinates tasks and routines across various smart home components. Users can define custom automation rules based on environmental conditions, time schedules, or user preferences. These automations operate independently within the local network, ensuring responsiveness even without an active internet connection.

For user interaction, the system provides a cross-platform interface, accessible through mobile application. This interface offers an intuitive control panel, enabling users to monitor device status, send commands, and configure automation settings in real time. Additionally, the system supports voice control integration and remote access options, enhancing convenience without compromising security.

Conclusions: The proposed smart home system enhances automation flexibility by integrating multiple communication protocols to support a wide range of devices. By combining efficiency, security, and ease of use, this smart home system offers a scalable and privacy-focused solution for home automation, allowing users to manage their devices with minimal technical expertise while maintaining complete control over their personal data.

Acknowledgements: Coordinator teacher: Prof. univ. lect. Dr. Ștefania Niță.

Keywords: *IoT, Automation, Pairing, Smart, Device, Confidentiality.*

References:





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17) Artificial Intelligence-Based Systems for Identifying Artificially Generated Photo and Video Content

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Introduction: Deepfake technology allows the creation of highly realistic fake images and videos, raising concerns about misinformation, digital security, and cognitive warfare—where manipulated media is used to deceive and influence public perception. This paper introduces a custom 4-layer CNN model designed for detecting deepfake content with 97.5% accuracy. The model is tested against other popular methods and proves to be faster and more reliable. It is also adapted for video analysis, making it a practical tool for identifying fake media in real-world scenarios.

Methods and Results: The deepfake detection model was developed and trained using Google Colab, which provided access to T4 GPUs for faster processing. The model was built using Python with TensorFlow and Keras libraries. The dataset[1] used for training was OpenForensics, sourced from Kaggle, containing both real and fake human face images. All images were resized to 256×256 pixels and divided into three sets: 70% for training, 15% for validation, and 15% for testing. To improve the model's accuracy, data augmentation techniques were applied, such as flipping, rotating, shifting, zooming, and adjusting brightness. The model was designed as a four-layer Convolutional Neural Network (CNN). It included four layers with filters of increasing sizes: 16, 32, 64, and 128. Each layer used a 3×3 filter with ReLU activation to detect patterns in the images. To make training more stable, batch normalization was added after each layer. Max-pooling was applied to reduce image size while keeping important features. Dropout layers were also included to prevent the model from memorizing the training data instead of learning general patterns. After feature extraction, the output was flattened and passed through a fully connected layer with 256 neurons. Finally, a single neuron with a sigmoid activation function classified images as real or fake.

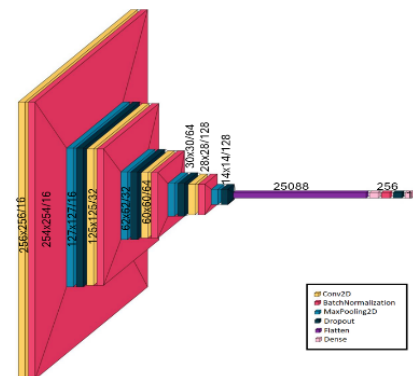


Fig. 4: CNN architecture

Training was conducted for 22 epochs using the Adam optimizer with a learning rate of 0.0005 and a binary cross-entropy loss function. Early stopping was used to prevent overfitting. The training process on a T4 GPU took 4 minutes and 44 seconds per epoch, totaling 1 hour and 44 minutes. The model achieved a 98.2% accuracy on training data, 97.15% on validation data, and 97.5% on test data. When compared with other models like DenseNet, Xception [2], EfficientNet[3], and a five-layer CNN[4], the proposed model achieved the highest accuracy while being more efficient.



To extend the model's applicability to deepfake video detection, the algorithm analyzed every tenth frame of a video, classifying each frame individually and averaging the predictions to determine the final classification. This approach worked effectively for detecting manipulated videos, demonstrating its potential for real-world deepfake detection.



Fig. 5: Classification of images using the designed CNN

Conclusions: The developed four-layer CNN achieved strong performance in detecting deepfake images, outperforming other existing models while maintaining efficiency. Its extension to photo and video classification proved effective for real-world applications. This approach provides a reliable solution for combating deepfake threats in digital security and misinformation detection.

Acknowledgements: Coordinator of project Mr. Lect. Annamaria Sârbu, Ph.D.

Keywords: *deepfake detection, convolutional neural network, image classification.*

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18) Synthetic Aperture Radar Images Analysis

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Introduction: Synthetic Aperture Radar (SAR) is an advanced remote sensing technology that enables high-resolution imaging of the Earth's surface, regardless of weather conditions or lighting. Unlike optical sensors, which rely on sunlight, SAR actively transmits microwave signals and records their reflections, making it highly effective for monitoring terrain, detecting changes, and analyzing surface deformations over time. [1]

This method operates by simulating a large antenna (or "aperture") through the motion of the radar sensor, typically mounted on satellites, aircraft, or drones. This technique enhances spatial resolution, allowing for detailed observations of land deformation, urban infrastructure, glaciers, and natural disasters such as earthquakes or landslides.

The project focuses on time-series interferometric analysis using SAR data, integrating both Small-Baseline Subset (SBAS) interferometry and Persistent Scatterer Interferometry (PSI). SBAS is used for analyzing distributed scatterers over large areas, providing broad-scale



deformation trends [2], while PSI identifies stable, highly reflective points, enabling precise measurements of localized displacement [3]. The goal is to develop a software application that processes co-registered SAR images, generates interferograms, unwraps phase information, removes topographic effects, and ultimately extracts deformation time-series data. By leveraging open-source tools and advanced mathematical techniques such as Singular Value Decomposition (SVD), this project aims to improve the accuracy and efficiency of SAR-based deformation monitoring for both regional-scale analysis and targeted infrastructure stability assessments.

Methods and Results: The process of obtaining deformation time-series data from SAR images follows a structured workflow that integrates multiple open-source tools. The initial step involves acquiring Single Look Complex (SLC) images corresponding to the area of interest. This is achieved using PYGMTSAR [4], which automates the retrieval of SAR data by specifying the geographical coordinates of the target region. PYGMTSAR also facilitates Small Baseline Subset (SBAS) interferometry, optimizing the selection of interferometric pairs based on their spatial and temporal baselines. SBAS is particularly useful for mapping large-scale ground deformation over time by analyzing distributed scatterers across wide areas.

Once the SLC images are obtained, they undergo pre-processing and interferogram generation using the ESA SNAP software [5]. This stage involves co-registering the images to ensure precise pixel alignment, followed by the calculation of interferograms, which represent the phase difference between image pairs. Additional steps, such as filtering and phase flattening, are applied to improve the signal quality and reduce noise before further processing.

The next critical step is phase unwrapping, performed using SNAPHU (Statistical-Cost Network-Flow Algorithm for Phase Unwrapping) [6]. Since interferometric phase values are wrapped within a range of $-\pi$ to $+\pi$, SNAPHU resolves these ambiguities by reconstructing the continuous phase field. This allows for the extraction of absolute displacement measurements, essential for quantifying surface deformation over time. The unwrapped phase data is then used in further analyses, such as Singular Value Decomposition (SVD) for estimating deformation trends.

If we require Persistent Scatterer Interferometry (PSI), the StaMPS (Stanford Method for Persistent Scatterers) software is used [7]. Unlike SBAS, which focuses on distributed scatterers, PSI detects stable, highly reflective points (such as buildings or rock formations) to measure localized deformation with millimeter precision. StaMPS processes unwrapped phase data, applying corrections to minimize atmospheric noise and improve accuracy. By integrating both SBAS and PSI, the workflow provides a comprehensive approach, capturing both wide-area deformation trends and precise point-based displacements, enhancing the reliability of the final SAR time-series analysis.

The final output provides an accurate deformation time series, enabling detailed monitoring of land movements and structural stability in the observed region.

Conclusions: Synthetic Aperture Radar and interferometric analysis provide powerful tools for monitoring ground deformation with high precision. By integrating different interferometry tools and methods, and applying them to the images we obtained from specialized satellites, this project enhances the accuracy and reliability of deformation monitoring.

Acknowledgements: Lt. col. prof. univ. dr. ing. Ștefan-Adrian TOMA.

Keywords: *Synthetic Aperture Radar, Interferometry, Small-Baseline Subset, Persistent Scatterer Interferometry, Phase Unwrapping, Time-Series Analysis.*

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19) Automatic Classification System of Dishes based on Artificial Intelligence

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Introduction: Automatic food classification is a key area of interest in the restaurant industry, facilitating efficient menu management and enhancing user experience. This study presents an intelligent food image classification system based on convolutional neural networks, capable of accurately identifying and categorizing culinary dishes. The model used is EfficientNet-B1, optimized through transfer learning to ensure a balanced trade-off between accuracy and computational efficiency.

Methods and Results: The implementation was done using the PyTorch framework, with training and inference performed locally on limited computational resources. The model was evaluated on a randomly selected 10-class subset of the Food-41 dataset, which is a well-structured subset of the larger Food101 dataset, with 1000 uniformly distributed samples per class. Following the training process, the model achieved 90% accuracy on the training set, and after loading and evaluating the saved model on the test set, it reached an impressive 95.60% accuracy. Additional metrics include precision (95.67%), recall (95.60%), and F1-score (95.59%). The confusion matrices and loss curve provide a detailed view of model performance, indicating a stable learning process with no significant overfitting. The training pipeline included advanced data augmentation techniques, such as resizing, random horizontal flip, rotation, color jitter, affine transformations, random erasing, normalization, and early stopping.

Conclusions: The proposed model is scalable and suitable for integration into a web-based application aimed at automating restaurant menu management. This solution significantly reduces human error and streamlines the food classification workflow, offering a robust, intelligent tool for culinary image recognition.

Acknowledgements: Coordinator – Conf.Univ Dr. Eng. Popescu Florin-Gabriel.

Keywords: *food classification, EfficientNet, convolutional neural network, PyTorch, web integration, deep learning.*

20) Web Platform for Resource Management in the Hotel Industry

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Introduction: Resource management is one of the most important stages for any industry. This paper presents a web platform that focuses on optimizing operations related to





creation, allocation, and modification by integrating AI modules and classic algorithms for data processing.

Methods and Results: The system is a web platform that automates the management processes of hotels, rooms, related elements (facilities, various types), reservations, and users. The functionalities are defined in detail according to the three types of users (platform administrator, hotel manager, client). The access level is structured hierarchically, allowing each user type specific access to the platform's functionalities.

The system is built on an architecture based on multiple interconnected components:

- **Client (UI)** – Represents the graphical interface through which users interact with the platform, developed using React.
- **Application Server** – Responsible for data processing, business logic implementation, and request management between the client and server, developed in Node.js.
- **Identity Verification Server** – A security-dedicated module that ensures the validation of hotel managers' identities during the registration process. This server verifies the information entered by the user through a dual authentication method:
 - *Document verification* – Comparing the entered data with the information on the identity card.
 - *Facial verification* – Comparing the user's captured image at the time of registration with the photo on the identity card to prevent fraud.

For facial recognition implementation, OpenCV is used, employing the following techniques:

- *Haarcascades* – Detecting the face in the photo taken during authentication.
- *LBPH* (Local Binary Patterns Histograms) – Comparing the detected face with the photo on the identity card for identity validation.

The application utilizes multiple methods and APIs to enhance its functionality:

- **ChatGPT** – Used for generating descriptions of hotels and rooms based on the provided data.
- **Stripe** – For securely processing payments.
- **Google Authentication** – For user authentication.
- **Company Verification** – Based on the tax code to validate businesses and ensure their authenticity. **NACE Code Verification** – Ensures that the NACE code matches the hotel industry.
- **Email Notifications** – Used for various operations, such as confirming reservations, etc.
- **Leaflet** – Provides support for interactive maps, allowing users to view them directly on the platform.
- **Nominatim** – Used for geolocation services.
- **Cloudinary** – For efficient image storage and management.
- **Universal-tutorial API** – Provides information about countries, regions, and cities, enriching the application's database.

Conclusions: This paper presents a web platform that optimizes hotel resource management through AI and classic algorithms. It automates key processes such as reservations and user management, with secure identity verification and tailored access levels for different users. By integrating APIs such as ChatGPT, Stripe, and Leaflet, the platform enhances functionality, security, and user experience, providing a comprehensive solution for hotel management.

Acknowledgements: Lect. dr. Dana VÎLCU.

Keywords: *Client, Application Server, Identity Verification Server, Haarcascades, LBPH.*



21) Intelligent Drone for Person Recognition: AI-Based Image Processing and Autonomous Navigation

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Introduction: Artificial intelligence is a powerful tool for real-time image processing and autonomous decision-making. In drone technology, AI-driven person recognition enables facial detection, tracking, and identification, enhancing applications in security, surveillance, and automation.

Methods and Results: The developed system integrates multiple artificial intelligence and computer vision modules to enable real-time person recognition and autonomous navigation using the DJI Tello drone. The architecture consists of face detection, face tracking, and person recognition modules, each optimized for performance and efficiency. The primary technologies used include OpenCV and TensorFlow for image processing, along with Firebase for cloud-based facial data storage.

For face detection, YuNet was chosen over HaarCascade due to its superior accuracy and speed in detecting faces in real-time video streams. The system employs a deep learning-based approach for face recognition using FaceNet. Each detected face is converted into a feature embedding and compared against a database stored in Firebase. The embeddings are generated using a pre-trained FaceNet model, ensuring high accuracy while maintaining computational efficiency. A threshold-based Euclidean distance metric is used for identity verification, with a confidence level above 92% in practical tests.

To ensure optimal performance, a comparative analysis was conducted between different algorithms for each module. HaarCascade and Dlib-based detectors were tested but proved less effective in low-light conditions and at varying distances.

To enable autonomous drone navigation and safe interaction, an accurate distance estimation module was implemented. The system leverages monocular depth estimation using the Depth Anything v2 model, combined with traditional focal length-based distance approximation.

Conclusions: Autonomous drones equipped with AI represent a significant advancement in robotics, offering practical applications in security, surveillance, and human-computer interaction. The ability to recognize individuals, estimate distances accurately, and navigate autonomously opens new possibilities for real-world deployments. This project demonstrates how combining deep learning, computer vision, and embedded systems can create efficient, intelligent drone systems, paving the way for further research in AI-driven robotics and autonomous aerial platforms.

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Keywords: *Artificial Intelligence, Deep Learning, Face Recognition, Face Tracking, Autonomous Drones, Computer Vision, YuNet, FaceNet, Depth Estimation, Depth Anything v2, TensorFlow, Firebase, OpenCV, Real-Time Image Processing, Monocular Vision.*

22) Human Action Recognition in Video Sequences

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Introduction: Human action recognition in video sequences is a crucial task in computer vision, with applications spanning security, healthcare, sports analytics, and human-



computer interaction. The primary goal of this study is to explore various deep learning models for effectively recognizing and classifying human actions in video data. Given the complexity and variety of human movements, the challenge lies in developing models that can capture both spatial and temporal features to accurately classify actions. To address this, we experiment with multiple approaches, including convolutional neural networks (CNNs), transformer-based models, and hybrid models incorporating recurrent layers and pose estimation techniques.

Methods and Results: We explore multiple architectures for human action recognition, evaluating their performance on the UCF50 dataset. The methods considered include convolutional neural networks (CNNs), recurrent neural networks (RNNs) using pose landmarks, transformer-based models, and a hybrid approach that integrates both video frames and pose landmarks.

Long Short Term Memory (LSTM) Approach: MediaPipe is used to extract pose landmarks from each frame, forming a sequence of skeletal representations. These sequences are then processed by a Long Short-Term Memory (LSTM) network, a type of recurrent neural network (RNN), to capture motion patterns over time.

Convolutional Neural Network (CNN) and LSTM Approach: First, 3D CNNs extract spatial features from individual video frames. These extracted features are then fed into an LSTM network, which captures temporal dependencies across frames to model motion dynamics.

1D CNN Approach: A 1D CNN is used to process sequential data. Pose landmarks extracted with MediaPipe are fed into the 1D CNN to capture temporal patterns.

Multi-Input Model: This approach combines CNNs for spatial feature extraction from video frames and an LSTM network for temporal modeling using pose landmarks extracted with MediaPipe.

Conclusions: Among the various approaches evaluated, the combination of Convolutional Neural Networks (CNNs) and Long Short-Term Memory (LSTM) networks has yielded the best results.

Acknowledgements: The author acknowledges the support of Stelian Spinu for guidance throughout this research.

Keywords: *Human Action Recognition, Deep Learning, CNN, LSTM, Pose Estimation, MediaPipe.*

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23) Implementation of Embedded Applications using Model-Based Design Methods

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Introduction: Model-Based Design (MBD) has emerged as a powerful methodology for developing embedded systems, offering advantages in efficiency, maintainability, and reliability. This paper presents the implementation of signal processing algorithms on embedded platforms, utilizing MBD techniques with SCADE [1] and Simulink [2]. The primary objective is to compare traditional manual coding in C/C++ with automatic code generation facilitated by these tools, demonstrating the benefits of MBD in embedded system development.



Methods and Results: The study involves the design and implementation of key signal processing algorithms, including periodic signal generation, Finite Impulse Response (FIR) filtering, and audio effects such as reverberation and 3D sound synthesis. These algorithms are deployed on embedded platforms such as Analog Devices BlackFin [3] and ARM-based processors. A crucial aspect of the research is the validation of these implementations in real-time environments, ensuring performance efficiency and resource optimization.

A structured methodology is followed: initial algorithm design is conducted in C/C++, followed by MBD-based reimplementation using SCADE [1] and Simulink [2]. The automatically generated code is then deployed on the embedded hardware, and its performance is assessed against the manually coded version. Key evaluation metrics include execution speed, memory footprint, and real-time capabilities. Additionally, at least one algorithm is implemented on an embedded platform running a real-time operating system (RTOS), highlighting the challenges and considerations in real-time embedded software development.

Beyond implementation, this research provides comprehensive documentation, including tutorials on signal processing algorithms, embedded hardware configurations, and MBD workflows. These resources aim to facilitate knowledge transfer and practical application for engineers and researchers interested in adopting MBD for embedded signal processing applications.

Conclusions: The results of this study underscore the advantages of MBD, particularly in accelerating development cycles, reducing human errors, and improving maintainability. The comparative analysis between traditional and MBD-based implementations highlights trade-offs in performance and code efficiency, providing valuable insights into the feasibility of MBD in resource-constrained embedded environments. Future research directions include extending this work to more complex algorithms, optimizing generated code, and exploring additional embedded platforms.

Acknowledgements: Lt. col. conf. dr. ing. TOMA Ștefan-Adrian.

Keywords: *Model-Based Design, Embedded Systems, Signal Processing, SCADE, Simulink, Real-Time Systems.*

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11. COMPUTER ENGINEERING, CYBERSECURITY AND CRYPTOGRAPHY

1) Security and Privacy in Communication Systems

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Introduction: In today's digital landscape, ensuring security and privacy within communication systems is crucial for protecting individuals and organizations from unauthorized access, data breaches, and cyber-attacks. This abstract explores the importance of security and privacy, the challenges faced, strategies for mitigation, and future trends in the field.

Methods and Results: The evolving threat presents numerous challenges, including sophisticated cyber-attacks, data encryption complexities, user awareness deficiencies, and regulatory compliance requirements.

Encryption is a fundamental technique for securing data, ensuring confidentiality and integrity. Multi-factor authentication (MFA) strengthens access control mechanisms, reducing unauthorized access risks. Regular security audits and updates are necessary to identify vulnerabilities and mitigate risks proactively.

User education is a crucial aspect of security, as human error is often a significant factor in breaches. Compliance with legal and regulatory frameworks is essential for organizations handling sensitive information. Secure communication channels, such as end-to-end encryption, play a key role in safeguarding data from interception.

Recent incidents, such as cyber-attacks on critical infrastructure and telecommunications networks, highlight the necessity of strong security measures. Additionally, the emergence of advanced AI-driven systems presents new privacy risks, as these systems may access and process sensitive personal data.

Conclusions: Security and privacy are foundational pillars of communication systems, essential for maintaining trust and integrity. Proactively addressing current challenges and adapting to emerging trends are imperative for safeguarding digital communications.

Keywords: *Security, Privacy, Communication Systems, Encryption, Cybersecurity.*

2) Designing Resilient Branch Office Networks: A Unified Approach to Advanced Security and Dynamic Connectivity

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Introduction: In recent years, the need for secure and reliable teleworking solutions has become more urgent—especially after the challenges posed by the COVID pandemic. This paper presents a comprehensive approach to deploying a standardized network architecture across branch offices for Party Organizer Team. The objective is to ensure seamless connectivity, robust security, and efficient communication in a distributed environment, reflecting modern network engineering principles.

Methods and Results: A layered analysis approach was adopted to evaluate and configure the network infrastructure. The project involves the integration of multiple devices



such as FS S3900 and Cisco Catalyst switches, a Cisco 2901 router, VoIP phones, and Wi-Fi access points. Key configurations include:

- **VLAN Setup and Trunking:** Segmentation into distinct VLANs for DMZ, production, management, and voice ensured isolation and optimized traffic flow.
- **Router On A Stick (ROAS) & DHCP Configuration:** The router was configured with sub-interfaces and 802.1Q encapsulation to route traffic between VLANs, while dynamic IP assignment was managed through a DHCP server.
- **Security Measures:** Implementation of FreeRADIUS for authentication, DHCP snooping, and ACLs fortified the network against spoofing, starvation, and DoS attacks.
- **Testing and Validation:** Extensive tests—ranging from connectivity and inter-VLAN communication to VoIP call setup and simulated attack scenarios—confirmed the robustness and resilience of the configuration.

Conclusions: The implemented network architecture successfully supports high-speed internet access, secure VoIP communication, and dynamic network management across branch offices. The thorough integration of layered security measures not only protects against common threats but also demonstrates the practical application of modern network design principles in a real-world setting.

Keywords: *Advanced Networks, VLAN, DHCP, OSPF, VoIP, RADIUS.*

References:

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- [2] Guidelines for Secure VoIP Deployment;
- [3] Best Practices for DHCP Snooping and ACL Implementation.

3) Current Techniques for Implementing Anti-Malware Engines

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Introduction: This paper proposes a sandbox environment for file analysis on Windows Systems. The program implements three different methods of detection: a modified Aho-Corasick for fast scanning, intensive scanning through Convolutional Neural Networks (CNNs), and cloud-based scanning via VirusTotal API. The improvement of static detection techniques is an overdue factor and the inclusion of CNN-based detection might be the missing piece in the data protection puzzle.

Methods and Results: The first method implements a modified version of the Aho-Corasick algorithm [1], which searches only the initial part of the selected files to detect potential malware entry points while reducing false positives generated from a thorough search. The cloud-based detection enhances detection accuracy through API calls to the VirusTotal platform, cross-referencing diverse security sources in real time. Moreover, it provided a valuable comparison to the other detection methods.

The novelty factor of this system lies in the CNN-based method. Although, previous studies on targeted malware detection through CNNs exist [2], [3], the databases containing the sample files were kept private. To address this issue, a structured database was built using 5000 malicious files from MalwareBazaar and 5000 benign files obtained from personal devices. Each file was converted into a 128x128x3 RGB image and processed through three convolutions layers with max polling. This multi-tasking CNN first determines if the file is malicious, then categorizes it into the correct malware family, thereby offering deeper insights into potential damage.



Conclusions: The proposed solution offers a comprehensive approach to static analysis by bridging traditional and innovative approaches.

Acknowledgements: Special considerations to Togan Mihai and Paul Gagniuc for the guidance and insightful feedback throughout the course of this project..

Keywords: *Anti-malware Engines, CNN, Aho-Corasick, Cybersecurity.*

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4) Security Incident Management Using SOAR Technologies

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Introduction: In the current context of continuously evolving cyber threats, security incident management represents a critical challenge for any organization. The rapid pace and increasing complexity of cyberattacks have surpassed manual response capabilities, requiring efficient, rapid, and automated solutions. In this context, SOAR (Security Orchestration, Automation, and Response) technologies become indispensable for managing and mitigating the impact of security incidents.

SOAR technologies integrate orchestration, automation, and response into a cohesive framework, enabling security teams to manage incidents quickly and efficiently by significantly reducing the time needed for threat identification, analysis, and neutralization. By automating repetitive workflows and orchestrating existing tools and solutions, these technologies facilitate a coordinated response, reducing the risk of human error and optimizing resource utilization. Additionally, SOAR can seamlessly integrate with various types of security technologies, such as SIEM (Security Information and Event Management), EDR (Endpoint Detection and Response), and security application APIs, enhancing their effectiveness and providing a comprehensive security infrastructure.

Methods and Results: SOAR (Security Orchestration, Automation, and Response) technologies offer a high level of integration with various cybersecurity solutions, including SIEM platforms, EDR solutions, ticketing applications, threat intelligence databases, and security analyzers. These systems are essential for optimizing detection, investigation, and incident response processes, helping to reduce reaction time and improve the efficiency of security teams.

In this presentation, I have chosen to use Shuffle, an open-source SOAR platform, due to its flexibility and extensive integration capabilities with various security technologies. Unlike commercial solutions, Shuffle provides users with the freedom to adapt and customize automation workflows, facilitating interoperability with other essential systems for monitoring and protecting cybersecurity infrastructures.

To demonstrate this capability, I have integrated Shuffle with an ELK stack component (ElasticSearch, Kibana, Beats), complemented by Suricata and Zeek, which are used for collecting, analyzing, and correlating security events at the network level. Additionally, I have implemented connections with MISP, Cortex, and The Hive, three essential solutions for sharing threat indicators, automatically analyzing threats, and managing security incidents.



Furthermore, I have integrated Velociraptor, an advanced system for endpoint monitoring and incident response.

To test the functionality of the Shuffle platform in combination with these solutions, I have developed several simulated attack scenarios. These scenarios illustrate various methods that attackers may use to compromise endpoints within an infrastructure composed of workstations, including: sending malicious emails to deliver infected files or trick users into disclosing sensitive credentials; attacking the network to which the infrastructure is connected using techniques such as unauthorized scanning, vulnerability exploitation, or traffic interception and injecting malware and ransomware through advanced methods to compromise systems and extort the organization.

Through these scenarios, the goal is to highlight the importance of each previously mentioned tool in detecting and preventing cyberattacks. By analyzing the obtained results, I was able to demonstrate how integrating Shuffle into a well-structured security ecosystem can contribute to improving incident response time, reducing the administrative burden on security teams, and increasing the overall efficiency of cybersecurity defense processes.

Conclusions: The implementation of SOAR (Security Orchestration, Automation, and Response) technologies plays a crucial role in enhancing the efficiency of a SOC (Security Operations Center) by providing advanced capabilities for automation, orchestration, and rapid incident response. Given the increasing complexity of cyber threats and the high volume of alerts managed daily by a SOC, integrating a SOAR solution like Shuffle significantly contributes to optimizing operational processes and improving response time. A modern SOC without an automated incident management system can become overwhelmed by the large number of alerts and the need for manual verification of each threat.

Acknowledgements: I acknowledge the support and guidance of Colonel Prof Eng. Ion Bica in the development of this work.

Keywords: *SOAR, SIEM, Algorithms of detection, NIDS, Automation.*

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5) Open-source Windows-native Application for File Synchronization with Secure Data Deduplication

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Introduction: Data deduplication is a widely used technique to optimize storage by reducing redundancy, significantly decreasing storage costs and enhancing efficiency. However, security challenges such as content learning attacks and data leakage remain concerns. In this paper, we present implementation of a secure deduplication system, designed for seamless Windows integration. Our solution incorporates cryptographic techniques, such as convergent encryption and Merkle trees [1], alongside a proxy-based deduplication mechanism, ensuring security even when using public storage solutions.

Methods and Results: Our architecture consists of three main components: a Windows service, a proxy server, and a file management system. The Windows service, developed using .NET 8 and WPF, integrates directly with Windows File Explorer, providing synchronization without requiring a dedicated application. The proxy server, built with Python FastAPI,



performs deduplication and caching while interacting with the file storage server. The backend is an ASP.NET Core Web API designed for scalability and security.

The system ensures optimized performance by leveraging a proxy-based deduplication mechanism, reducing redundant file transfers and improving synchronization efficiency. The deduplication mechanism is enhanced by a timestamp-based synchronization protocol, which resolves conflicts without manual intervention. Furthermore, cryptographic security is ensured through AES-GCM encryption combined with SHA3-512 hashing [2] for data integrity.

Conclusions: Our proposed solution focuses on usability and efficiency in cloud-based file deduplication while maintaining security measures. The Windows integration eliminates the need for standalone client applications, increasing adoption potential. Performance optimizations enable faster data synchronization while ensuring robust encryption and secure deduplication.

Acknowledgements: Cpt. Assoc. Prof. Eng. Iulian ACIOBĂNIȚEI.

Keywords: Data Deduplication, Merkle Hash Tree, Merkle Tree, Proof of Ownership.

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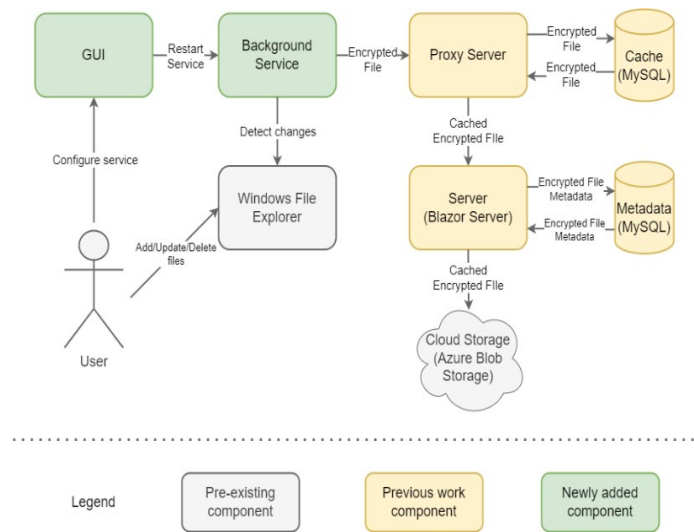


Fig. 6: Architecture Diagram

6) End-to-end Encrypted Real-time Messaging Application

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Introduction: In the era of digital communications, where messaging through various social networks has become widely accessible, a fundamental question arises: do we truly have privacy and to what extent can we trust the companies that provide us with this so-called "security guarantee"? By comparing existing solutions and analyzing potential directions for a proof-of-concept application that enhances transparency and usability for all user categories, we developed a mechanism based on the latest security technologies. Our mechanism offers a higher level of security than those implemented by popular platforms such as Meta based infrastructures.

The novelty that the application wants to expose to the large public is the use of hybrid cryptography, a combination of modern symmetric and asymmetric schemes with post-quantum added capabilities (referring in particular to methods of countering a possible attack with a very high computational power of a quantum computer). The core that provides the basis, implementation and validation of the field of post-quantum cryptography in solving man-



in-the-middle/brute-force and other attacks with a very high computational power is the post-quantum key exchange protocol PQXDH (Post-Quantum Extended Diffie-Hellman), proposed by Signal [1]. This protocol is based on both public key cryptography (asymmetric) and the introduction of new mathematical problems that are difficult to solve, even with the computational power of a quantum computer. These types of problems are from the mathematical field of lattices, through the Learning with Errors (LWE) or Ring-LWE methods such as Crystals-Kyber, a post-quantum Key Encapsulation Mechanism (KEM) standardized by NIST [2].

Methods and Results: Lots of online sources have been consulted in order to orchestrate the research paper, such as multiple articles, books, papers and Wikipedia, and the suitable information has been selected. The application aimed to demonstrate its basic functionalities through a mobile application on Android with the purpose of expanding them in a cross-platform environment and being available on platforms such as iOS, Windows, Linux and even through a web interface. End-to-end encryption assumes that no one, including the server, can decrypt their private messages through transmission medium [3]. In order to achieve and demonstrate this, algorithms such as Double Ratchet, ECDH (Elliptic Curve Diffie-Hellman), Dilithium2 post-quantum digital signatures were used within the post-quantum key exchange protocol mentioned above along with AES-256 standard encryption [5]. Real-time communication for messages is guaranteed through the Web Sockets protocol (it achieves bidirectional communication between the client and the server, therefore reducing the need to send large amounts of data in HTTP packets, this protocol being an upgrade of HTTP) and for voice-video communication we used the WebRTC API [7].

Conclusions: The implications of this research suggest that we are living in times that require early prevention and countermeasures of attack methods and surfaces, expecting the adversary to hit us with enormous computational power, and, at the same time, the need to develop new solutions that guarantee the security of real-time communication environments.

Acknowledgements: Special considerations to Col. Prof. Dr. Eng. Mihai Togan and Lt. Eng. Assoc. Teacher Andrei Brînzea, for the guidance and special interest shown in this research..

Keywords: *Messaging Application, Post Quantum Cryptography, End-to-end encryption, Real-time communication, NIST.*

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7) An Implementation for a True Random Number Generator using Public Sources

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Abstract: In today's digital age, safeguarding valuable information has become a critical challenge. With data security becoming paramount, encryption stands as the pillar for protecting sensitive information. A fundamental requirement for robust encryption is the generation of high-quality random numbers. While pseudo-random number generators (PRNGs) have long been a standard solution, this project focuses on true random number generators (TRNGs) that derive randomness from natural and unpredictable phenomena, offering a higher degree of entropy.

In this project, we explore innovative methodologies for TRNG development using natural phenomena, focusing on ambient radio signals and NASA's solar imagery. To ensure high-quality randomness, we will conduct rigorous analyses using NIST standards [1], calculating Shannon entropy for each data source to evaluate their effectiveness. Inspired by the potential of TRNGs to enhance security [2], combined data streams will undergo transformations, including multi-layered XOR operations and SHA3-512 hashing.

By introducing resourceful solutions to randomness inspired by natural phenomena, this project aims to contribute to the ongoing exploration of new methodologies for enhancing data security. Our findings emphasize the potential for leveraging innovative sources of entropy to strengthen encryption techniques and protect sensitive information in an increasingly digital world.

Keywords: *Entropy, TRNG, Data Security, Encryption, NASA Solar Imagery.*

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8) Centralised Platform for Dark Web Data Collection and Monitoring

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Introduction: The dark web has become a significant yet largely illicit area of the internet, hosting activities ranging from the sale of stolen personal data and fraudulent transactions to exchanges of sensitive information between malicious actors. Given its inaccessibility through conventional search engines and reliance on encrypted networks such as Tor and I2P, the dark web serves as a valuable intelligence source for law enforcement agencies, cybersecurity organizations, and companies concerned with protecting their assets. A centralized platform for collecting and monitoring dark web data offers an efficient solution for systematically extracting, analyzing, and responding to emerging cyber threats. By automating data collection and integrating advanced analysis techniques, such a platform enhances threat detection capabilities and contributes to a safer digital environment.

Methods and Results: The proposed platform is designed to automate data collection from various dark web sources, including forums, marketplaces, and encrypted chat services. The system manages multiple web crawlers through a centralized interface, allowing customized data collection based on the specific monitoring needs of organizations. It enables automated data collection from predefined sources while actively monitoring suspicious



activities such as the sale of stolen data, discussions on software vulnerabilities, and the planning of cyber-attacks. It also integrates the capability to search the dark web for specific topics of interest, ensuring comprehensive threat detection and intelligence gathering. Additionally, the platform integrates advanced data analysis techniques using artificial intelligence (AI) and natural language processing (NLP) to detect patterns and generate real-time alerts. To address the challenges associated with dark web monitoring, the system incorporates data filtering and organization techniques to manage large volumes of unstructured information. Furthermore, the platform continuously adapts to the evolving nature of encrypted networks by updating crawling strategies and refining analysis models to enhance accuracy and efficiency.

Conclusions: The development of a centralized dark web monitoring platform significantly enhances the ability to detect and respond to cyber threats in real-time. The integration of AI-driven analysis improves the accuracy of threat identification, while the secure storage and encryption mechanisms ensure data confidentiality. This platform is a valuable tool for cybersecurity professionals, law enforcement agencies, and enterprises seeking to strengthen their digital security posture.

Acknowledgements: Conf.univ.dr. ing. Luciana MOROGAN.

Keywords: *Dark web monitoring, Web crawling, Artificial intelligence, Natural language processing, Cyber threat detection, Tor network.*

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9) Services for Validating Electronic Attestations of Attributes

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Introduction: In today's fast-paced digital world, electronic attestations of attributes within digital wallets hold significant potential for facilitating secure and reliable interactions. The paper presents a mobile application designed to validate digital wallet-issued attestations which follow the eIDAS 2 standards for interoperable digital identity service delivery. The system focuses on developing a flexible verification method which protects attestation authenticity while providing both safety and ease of use for service providers.

Methods and Results:

The mobile application is designed to validate electronic attestations of attributes according to the eIDAS 2 framework, which provides legal foundation for secure digital identity services in the European Union. A blockchain-based registry verifies the status of attestations through its

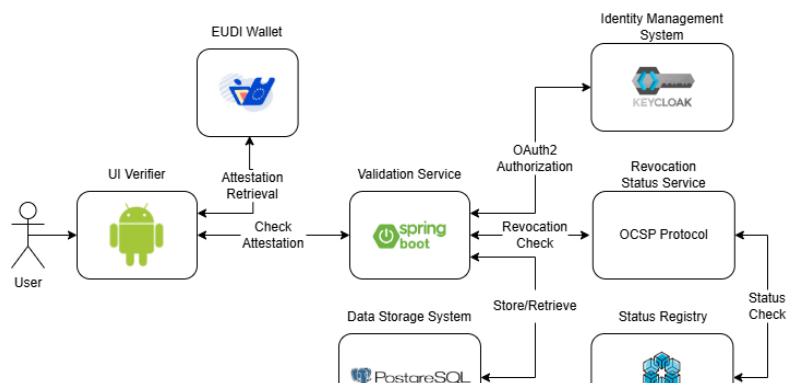


Fig. 1: Architecture Diagram



transparent and immutable system which is validated by trusted lists. The system provides an easy way to control fundamental user data which includes names, addresses and birth dates. The EUDI Wallet enables users to access their attributes through its interface which offers a convenient method to process digital transactions. The verifier system provides users with two verification options: it enables them to create QR codes for initiating transactions or to scan QR codes from their wallet to simplify the verification steps.

Credential validation is performed by checking the digital signature, expiry date, and other security attributes, ensuring the integrity and validity of each attestation. The solution supports SD-JWT format which enhances its ability to store attestation data effectively by complying with current digital identity standards. Keycloak is used for managing user authentication and authorization, providing a secure login system that protects access to the verification process.

Conclusions: All things considered, this solution serves as a comprehensive tool for individuals seeking secure and efficient validation of electronic attestations. The application provides developers with an accessible integration pathway, enhancing the scalability of identity ecosystems.

Acknowledgements: *Cpt. Assoc. Prof. Eng. IULIAN ACIOBĂNIȚEI.*

Keywords: *eIDAS2, Keycloak, SD-JWT.*

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10) DiffScout: A Python-Based Tool for Efficient Differential Cryptanalysis of SPN Ciphers

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Introduction: Differential cryptanalysis is a fundamental technique for evaluating the security of symmetric-key cryptographic algorithms, particularly substitution-permutation network (SPN) ciphers. Identifying optimal differential characteristics — high-probability differential transitions through multiple encryption rounds — is a computationally intensive problem. Traditional approaches often rely on constraint solvers or exhaustive search methods, which can be inefficient and resource-demanding. This paper presents **DiffScout**, a Python-based tool designed to improve the discovery of optimal differential characteristics by leveraging modified symbolic AI techniques and search algorithms. DiffScout aims to provide an efficient and scalable approach to differential cryptanalysis by incorporating heuristic-driven search strategies.

Methods and Results: DiffScout employs a combination of enhanced *A search** and *Monte Carlo Tree Search (MCTS)* to explore the differential propagation space. These algorithms prioritize promising differential characteristics, reducing the computational overhead compared to traditional brute-force or constraint-solving techniques. The tool systematically evaluates differential transitions, balancing exploration and exploitation to efficiently navigate the search space.

The framework has been tested on the lightweight block cipher **GIFT**, a widely studied SPN-based encryption scheme. Experimental results demonstrate that DiffScout efficiently identifies high-probability differential characteristics, reaching up to 9 rounds of GIFT with a



probability of 2^{-42} , with the potential for generalizing characteristics beyond 9 rounds. Additionally, DiffScout achieves higher probability differentials compared to existing solver-based methods. Compared to traditional differential cryptanalysis approaches, DiffScout maintains competitive performance while significantly optimizing the search process. These findings suggest that heuristic-driven search methods can serve as a practical and effective alternative to constraint-based techniques in differential cryptanalysis.

Conclusions: DiffScout introduces a novel application of AI-based search strategies in differential cryptanalysis, offering a practical tool for cryptanalysts. By integrating adaptive pathfinding techniques, the framework streamlines the identification of optimal differential characteristics, enhancing the efficiency of security evaluations for SPN ciphers. Future work will focus on extending the tool's capabilities to a broader range of cryptographic primitives and optimizing its performance for larger-scale encryption schemes.

Acknowledgements: We would like to acknowledge Togan Mihai for guidance and support throughout the research process.

Keywords: *Differential Cryptanalysis, Substitution-Permutation Networks, Heuristic Search, A* Algorithm, Monte Carlo Tree Search, Lightweight Ciphers, GIFT.*

11) The Whole is Greater than the Sum of its Parts: A Self-Hosted Alternative Solution to Managing IoT in the Future

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Introduction: The usage of IoT is growing bigger year by year in the consumer market and there still exists a conflict between end-users and manufacturers concerning the security of the clients' data compared to the usability of the products^[1]. As such individuals have to decide whether their privacy is worth their comfort. This paper provides an alternative solution to managing IoT services and devices that has a security-first approach to managing your data, but all the while taking into account that there still exists a technical overhead that could be overcome to ease the process toward a more secure IoT network^[2].

Methods and Results: The current market of management in IoT can be broken down in two categories:

1. Cloud-based IoT management platforms: AWS IoT Core, Azure IoT Hub, Google Cloud IoT Core etc. These platforms stand as the best in terms of cost-effectiveness and sustainability because it leverages the amount of users it can service at a time and the initial investment made in hardware is easily supported by the service fees. The main problems are: huge amount of data from multiple sources are circulating in the "cloud" and data breaches or unauthorized access through various methods break the trust in these solutions. These large volumes of data pose a serious target for cybersecurity attacks or insider threats. We also have to take into account the practice of some companies of selling aggregated, anonymized data as per their privacy policy.
2. Self-hosted/Custom end-user IoT management platforms: these solutions provide a greater flexibility in terms of privacy, letting the end-user decide their own access controls and if they decide at all to expose themselves to the Internet. The drawbacks that slow down this initiative include: the initial investment could easily be overwhelming for an average end-user and the greater flexibility could also pave the way for cybersecurity vulnerabilities that can be easily avoided.

This sharp contrast between the two categories can be addressed in various ways, which we will discuss: creating a community concerning the best practices to secure your data locally,



funding towards educating the use of such devices in a local environment, studying the cost-effectiveness of such services that are self-hosted in comparison to management of large amounts of users through various data center methods, creating an open-source platform of tools and methodologies that help create a secure starting point for individuals.

Conclusions: The presented solutions stand as a starting point for a decentralized network of IoT systems that can help the average individual transition to a more secure management of their data through user-friendly IoT services.

Acknowledgements: Cpt. Lect. Dr. Eng. Iulian ACIOBĂNIȚEI.

Keywords: *Internet of Things, data security, decentralisation, network, self-hosting.*

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12) PKCS#11 Wrapper-Based Attacks: Hidden Signature Generation

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Introduction: A PKCS#11 Wrapper-Based Attack is a technique that manipulates cryptographic signing operations by intercepting and modifying API calls within a PKCS#11 module. This approach allows an attacker to alter the signing process without directly modifying the original cryptographic software. By acting as an intermediary, the wrapper can extract or manipulate cryptographic signatures while ensuring that the legitimate application continues to function as expected.

Methods and Results: This project introduces a wrapper-based PKCS#11 attack, designed to intercept and manipulate the digital signing process. The attack is implemented using three main components: a custom installer, a PKCS#11 wrapper, and a C2 server, each contributing to the attack's execution while remaining undetected by the user.

The attack begins with a custom installer, built using Inno Setup, which facilitates the deployment of the malicious components. To maintain stealth, the installer downloads and installs Zoom as a decoy while simultaneously injecting the PKCS#11 wrapper into the System64 directory and modifies the Windows Registry to replace the legitimate PKCS#11 module in Adobe Acrobat with the malicious wrapper.

The PKCS#11 wrapper, written in C, acts as an intermediary layer between Adobe Acrobat and the cryptographic module. When a user signs a document, the wrapper redirects the request to the PKCS#11 module, ensuring that the expected signature is returned. Before the signature is transmitted to the Adobe application, the wrapper intercepts

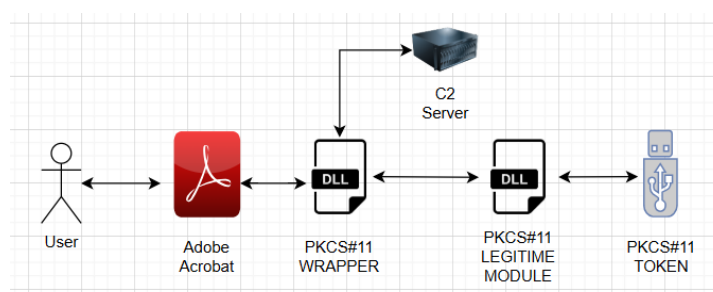


Fig. 7: Architecture of PKCS#11 Wrapped-Based Attacks

the request from Adobe Acrobat for available objects and sends the user's certificate to the C2 server. At the same time, the wrapper requests a separate hash from the C2 server and signs it without the user's knowledge. After signing, the additional signature is sent back to the C2



server, and then the wrapper delivers the correct signature to Adobe Acrobat. This process allows the attack to remain hidden while extracting cryptographic signatures.

The C2 server, built with Java Spring Boot, receives the extracted signatures and embeds them into its own stored PDF. It generates a hash for a selected document using DSS and sends this hash to the wrapper for signing. Once the wrapper returns the signature, the server adds it to the PDF, making it appear as if it was signed normally. By using the certificate exfiltrated earlier, the C2 server ensures the unauthorized signature is correctly integrated into the manipulated document.

Conclusions: To conclude, this project demonstrates how a wrapper-based PKCS#11 attack can compromise the digital signing process while remaining undetected. By intercepting cryptographic operations, it exfiltrates signatures and certificates, enabling unauthorized private key usage.

Acknowledgements: Cpt. Assoc. Prof. Eng. IULIAN ACIOBĂNIȚEI.

Keywords: *Digital Signature, PKCS#11 Wrapper Attack, Windows Registry Modification, Stealth Attack.*

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13) Implementation of a Secure Password Management System

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Introduction: In today's digital landscape, managing multiple online accounts often leads to poor password hygiene, including reuse and weak credentials, making compromised passwords a major attack vector. This paper presents the design and implementation of a secure password management system that integrates end-to-end encryption and advanced cryptographic techniques to mitigate security risks while ensuring usability.

The system's key objectives include strong cryptographic security, intuitive browser integration, password generation and evaluation, and end-to-end encrypted storage for credentials. By enhancing digital security and user convenience, this study contributes to improving credential management for individuals and organizations.

Methods and Results: The Secure Password Management System was designed as a web-based platform with an integrated browser extension, ensuring strong security through end-to-end encryption (E2EE) and cryptographic best practices. Sensitive data is encrypted using AES-256, while password hashing employs PBKDF2 with adaptive iterations to mitigate brute-force attacks. Authentication is reinforced through multi-factor authentication (MFA) and a zero-knowledge architecture, ensuring that even the system provider cannot access user credentials.

The platform integrates a browser extension for secure autofill, password generation, and real-time strength evaluation, improving usability while maintaining security. Performance tests confirmed that encryption overhead remains minimal, ensuring fast and efficient operations. Security assessments, including penetration testing and threat modeling, validated the system's resilience against common cyber threats. User testing indicated that security awareness improved through the password strength evaluator, while the intuitive design enhanced adoption. The results demonstrate a well-balanced combination of cryptographic security, efficiency, and user experience, making the system a robust solution for password management.



Conclusions: The development of a Secure Password Management System validated the integration of end-to-end encryption (E2EE), AES-256, and PBKDF2 in a web-based platform with a browser extension. Security assessments confirmed its resilience, while performance tests showed minimal overhead. Usability testing highlighted improved security awareness and adoption. The results emphasize the role of cryptographic security in credential management, balancing security, efficiency, and usability.

Acknowledgements: The author acknowledges Professor Ion Bica for his professional guidance and support in the development of this research. His expertise contributed to the refinement and validation of the proposed approach.

Keywords: *Password management, cryptographic security, end-to-end encryption, AES-256, PBKDF2, digital security.*

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14) Arkime: Enhancing Network Traffic Analysis

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Introduction: In the realm of cybersecurity, effective monitoring and analysis of network traffic are paramount for identifying and mitigating potential threats. "Arkime" is an open-source tool designed to facilitate large-scale packet capturing, indexing, and searching, thereby enhancing the capabilities of network administrators and security professionals in analyzing network traffic.

Methods and Results: Arkime operates by efficiently capturing network packets, supporting various methods such as pcap files, live interfaces, and remote data streams. Once captured, these packets are indexed based on criteria like IP addresses, protocols, ports, and timestamps, enabling swift and precise searches through extensive datasets. A notable feature of Arkime is its ability to perform retrospective analysis, allowing users to investigate past network traffic to troubleshoot issues or examine security incidents long after data capture. The tool's support for a wide array of network protocols ensures its applicability across diverse network environments. Moreover, Arkime's customizable and extensible architecture permits the development of custom parsers, plugins, and alerts, facilitating seamless integration into existing security workflows. Visualization tools within Arkime assist in identifying traffic patterns and anomalies, simplifying the detection of suspicious activities. The robust community support surrounding Arkime contributes to its continuous development and the sharing of best practices.

Conclusions: Arkime significantly enhances network traffic analysis through its comprehensive features, scalability, and adaptability. Its effectiveness, however, is contingent upon proper configuration, deployment, and integration into an organization's network monitoring and security infrastructure.

Keywords: *Arkime, Network Traffic Analysis, Packet Capturing, Retrospective Analysis, Network Security.*



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15) Integrated Sensing and Communication (ISAC) in 5G and Beyond

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Introduction: The deployment of dense cellular networks within 5G infrastructure introduces new opportunities for sensing applications. Existing communication networks can be repurposed for sensing with minimal modifications to hardware, signaling strategies, and communication protocols. By utilizing reference or synchronization signals as sensing waveforms, Internet-of-Things (IoT) devices and cellular networks can integrate sensing functionalities efficiently and cost-effectively.

Advanced Integrated Sensing and Communication (ISAC) strategies enable seamless integration of sensing and communication functionalities across all radio emissions, utilizing both pilot and payload signals. This approach enhances coordination within networks and fosters new applications in various industries, including smart cities, autonomous systems, and industrial automation.

Methods and Results: ISAC technology enables multiple innovative applications, including enhanced localization and tracking, area imaging, drone monitoring, and spatial-aware computing. It also supports smart home and in-cabin sensing, human activity recognition, and vehicle-to-everything (V2X) communication, including vehicle platooning and simultaneous localization and mapping. In the industrial sector, ISAC contributes to smart manufacturing, industrial IoT, and remote sensing applications. Additionally, it enhances environmental monitoring and human-computer interaction.

The adoption of ISAC within 5G and future 6G networks ensures more precise sensing capabilities while maintaining efficient communication. Compared to traditional sensing solutions, ISAC-based implementations require fewer infrastructure modifications, reducing costs while expanding the range of real-time applications.

Furthermore, the transition to 6G will bring notable advancements, including significantly higher data transmission speeds, improved download and upload times, and enhanced connectivity for ultra-dense networks. These improvements will further support ISAC applications, enabling more robust and accurate sensing across various domains.

Conclusions: Integrating sensing capabilities into existing communication networks through ISAC represents a transformative step toward intelligent, interconnected environments. By repurposing existing 5G and future 6G infrastructure, ISAC enables efficient and scalable sensing solutions. This approach enhances industries such as transportation, healthcare, environmental monitoring, and industrial automation, ultimately driving innovation in next-generation wireless systems.

Keywords: 5G, 6G, *Integrated Sensing and Communication, IoT, Smart Networks, Wireless Sensing.*

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- [3] <https://www.greyb.com/blog/6g-companies/>.



16) Automated Man-in-the-Middle (MITM) Attack Tool for Penetration Testing

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Introduction: In the field of cybersecurity, Man-in-the-Middle (MITM) attacks pose significant threats to network security. This paper presents an automated Python-based tool for performing MITM attacks using ARP poisoning. The primary objective of this project is to simplify the process of intercepting network traffic, providing security professionals and penetration testers with an efficient means of evaluating network vulnerabilities. By automating packet manipulation and redirection, the tool offers a streamlined approach to identifying security risks in a controlled environment.

Methods and Results: The tool is designed to be user-friendly, enabling even those with limited experience in network attacks to conduct penetration tests effectively. It facilitates data flow analysis, aids in detecting weaknesses in security implementations, and supports the enhancement of defensive strategies. By automating the MITM attack process, the tool eliminates the need for extensive manual intervention, allowing testers to focus on threat mitigation strategies.

Additionally, the tool integrates various modules for traffic interception, packet analysis, and data extraction. These features enable penetration testers to assess security measures comprehensively, providing insights into the effectiveness of encryption protocols and authentication mechanisms. The results obtained through controlled simulations demonstrate how attackers exploit network vulnerabilities, emphasizing the need for proactive security measures.

Conclusions: Understanding and simulating attack techniques is essential for developing stronger network defenses and ensuring data integrity. This tool serves as both an educational resource and a practical asset for security testing. By demonstrating real-world attack scenarios, cybersecurity professionals can enhance their awareness of potential threats and improve their defensive capabilities. Ethical use of such tools is crucial in fostering a proactive approach to cybersecurity.

Keywords: *Cybersecurity, Penetration Testing, Man-in-the-Middle, ARP Poisoning, Network Security, Ethical Hacking.*

17) Service for Issuing Qualified Electronic Attestations of Attributes

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Introduction: We live in an increasingly digital world, where technology continues to transform every aspect of our lives. In that manner, The European Digital Identity Wallet initiative aims to provide citizens with secure digital identification and credential management capabilities. This paper presents an implementation which focuses on developing a credential issuance infrastructure that ensures security and privacy, while sticking to relevant standards. The system enables secure issuing of Qualified Electronic Attestations of Attributes (QEAAAs) through an OpenID4VCI-based architecture which integrates with the EU Digital Identity Reference Wallet.



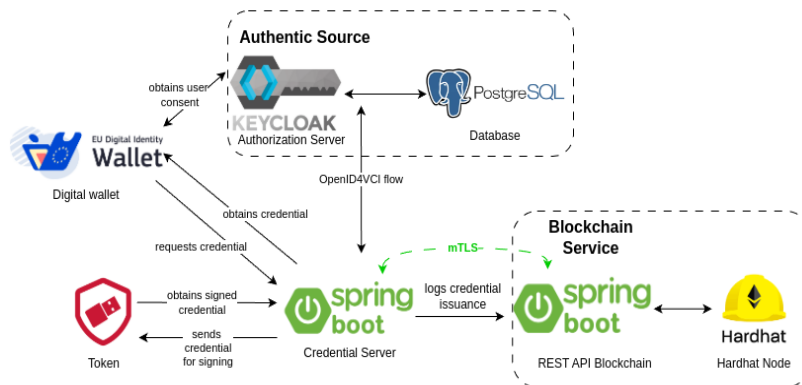


Fig. 8: Architectural Diagram

Methods and Results: The implementation consists of three primary components: an Authorization Server, a Credential Server, and a Blockchain Service. The Authorization Server is built upon Keycloak, providing user authentication and authorization flows via OpenID Connect which are modified to comply with the OpenID4VCI protocol. The Blockchain Service exposes a REST API that interacts with a Hardhat node running an Ethereum smart contract to log credential issuance events, thereby enhancing auditability. The Credential Server handles credential requests and signs the generated credential based on the information obtained from the Authentic Source, and it also logs the issued credentials in the Blockchain Service.

Conclusions: The developed service provides a comprehensive solution for issuing QEAs in a form that meets the requirements of the EU regulation. The integration of blockchain technology enforces the security and auditability of the credential issuance process. Furthermore, it offers a complete implementation according to the Verifiable Credentials Data Model v2.0, while the modular architecture ensures scalability and maintainability.

Acknowledgements: CPT. Assoc. Prof. Eng. Iulian ACIOBĂNÎȚEI, PhD – MTA.

Keywords: *EU Digital Identity, Verifiable Credentials, OpenID4VCI, Blockchain.*

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18) ZKFlag: A Secure Solution on Feature Flag Management

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Introduction: Feature flags are mechanisms that provide flexible deployment by enabling or disabling certain features of an application in real time without modifying its source code. This technology helps developers accelerate the delivery of new features while reducing the risks associated with implementation through strategies such as progressive rollout.

Methods and Results: ZKFlag, built with Spring Boot, integrates with client applications via an SDK or REST API, ensuring flexibility across different programming languages. The platform is designed to support multiple projects, each managing its own set of



feature flags and multiple instances. For example, this structure can be applied to a vacation management application used across multiple military units. All the flags that will be used are defined within the project. Each application instance corresponds to a military unit where the solution has been deployed. Access control within projects and instances is managed through a Role-Based Access Control system, guaranteeing secure and granular permission management.

ZKFlag implements essential functionalities specific to feature flag solutions, bringing several improvements over them. First, the evaluation of a flag takes place at the environment level (e.g., production, development, testing) within an instance, allowing more precise customization compared to project-level settings. Additionally, the platform allows scheduling the activation or deactivation of a flag at a specific date and time, or activating it only for a predefined period. Each flag within an instance can have an associated payload, which can either be a text or a custom image, thus offering dynamic content control.

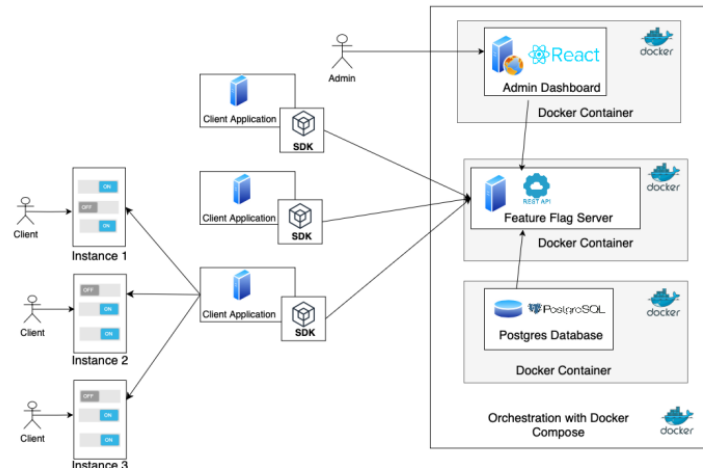


Fig. 1. Arhitecture Diagram

The ZKFlag platform provides a significant security advantage by integrating Zero-Knowledge Proof (ZKP) technology. Through ZKP, we can evaluate flags based on sensitive information such as date of birth or age, without explicitly disclosing this data to the feature flags server. As a result, ZKFlag enhances the application's usability, allowing security-focused organizations to use feature flags without compromising data confidentiality.

Conclusions: By implementing the ZKFlag platform, we have developed a practical solution for managing feature flags, with a strong focus on the protection of sensitive data and the flexibility of integration across various environments.

Acknowledgements: Cpt. Lect. Dr. Eng. IULIAN ACIOBĂNIȚEI.

Keywords: *Feature Flags, ZKP, RBAC, Dynamic Content Control.*

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19) Research Concerning using Specialized Communication Systems for the Transmission of Radar Information

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Introduction: The transmission of radar information plays a crucial role in various fields, including air traffic control, defense operations, and surveillance. Efficient radar communication ensures the seamless transfer of critical data, enabling real-time situational



awareness and decision-making. With the growing need for high-speed, secure, and interference-resistant transmissions, advancements in specialized communication systems are essential. This research explores the latest developments in radar communication technologies, focusing on enhanced data transmission techniques, network integration, and security measures. By addressing these challenges, the study aims to contribute to the ongoing evolution of reliable and adaptive radar communication systems.

Methods and Results: This research employs a combination of theoretical analysis and experimental simulations to evaluate the effectiveness of specialized communication systems for radar data transmission. The study focuses on key parameters such as signal strength, frequency, modulation techniques, and error correction mechanisms to determine their impact on radar data transmission efficiency.

To analyze the effects of signal strength and frequency on air target detection, simulations were conducted using MATLAB and other software tools. Different modulation techniques, including amplitude modulation (AM), frequency modulation (FM), and phase modulation (PM), were tested to identify the most efficient method for secure and high-speed radar communication. The study also explores adaptive frequency management, ensuring optimal performance even in environments with high interference or limited bandwidth.

The results demonstrate that higher signal strength and optimized modulation techniques improve detection accuracy and transmission reliability. The use of forward error correction (FEC) methods significantly reduces data loss, while dynamic spectrum allocation enhances communication stability. Additionally, integrating radar communication with wireless and satellite networks has shown potential for improving real-time data sharing and decision-making.

By implementing advanced security measures such as cryptographic protocols and authentication mechanisms, the study also highlights the importance of secure radar data transmission, particularly for military and aviation applications. These findings contribute to the development of more efficient, adaptive, and secure radar communication systems, enhancing operational efficiency across various industries.

Conclusions: This research project investigates specialized communication systems used for radar data transmission.

The effective and reliable transmission of radar information is critical for applications such as air traffic control, surveillance, and defense operations.

With increasing demands for high-speed, secure, and interference-resistant data transmission, specialized communication technologies are constantly evolving to meet these requirements.

Keywords: *radar communication, modulation techniques, signal processing, data transmission, network security.*

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20) Development of an Email Message Encryption System to Protect Data Confidentiality

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Introduction: Ensuring secure transmission is essential for protecting user data in applications. However, with the increasing number of threats, relying solely on the basic encryption provided by most transmission protocols is no longer sufficient. More specifically, email communication—a common practice in today's digital world—often involves sensitive data that requires an additional layer of protection. To address this challenge, the proposed system utilizes multiple encryption algorithms, ensuring that email messages remain accessible only to the intended recipient—even excluding the service provider. In this paper, the system's structure will be presented, along with an explanation of how it processes and stores both sensitive data and metadata.

Methods and Results: The system presented in this paper utilizes both symmetric and asymmetric encryption to protect user data, specifically email messages. It follows the fundamental steps of the PGP [1] encryption scheme but integrates stronger algorithms, such as AES-256 [2] for symmetric encryption, RSA [3] with 4096-bit keys for asymmetric encryption and SHA512 [4] for hashing, as the original PGP algorithms are no longer considered secure.

This system is composed of multiple well-structured components, each with a clearly defined function aimed at ensuring both privacy and authenticity while remaining user-friendly. Users interact with the system through an easily accessible web application, which enhances security directly within the client's browser while preserving all the features of a standard messaging platform for a seamless experience. Additionally, the application includes its own email server, designed to efficiently handle message transmission and storage. Encrypted emails are stored using an object storage system, while message metadata and user information are kept in a database. To further protect user privacy, all sensitive information is encrypted.

Conclusions: In summary, the system described in this paper aims to provide stronger security and confidentiality than most email applications. User data is never exposed in plaintext, ensuring that only the user has access to sensitive information. The application seamlessly combines high security with ease of use, keeping the underlying complexity hidden while safeguarding user data at every step.

Acknowledgements: Coordinator teacher: Prof. univ. lect. Dr. Ștefania Niță.

Keywords: *Email, Encryption, Privacy, Security, Authenticity, Confidentiality.*

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21) An AI-Powered Learning Assistant for Exam Preparation

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Abstract: Artificial intelligence (AI)-assisted learning has become a promising direction in education, providing students with interactive and personalized tools for exam preparation. LearningCoach is an AI-based application designed to support self-assessment and knowledge consolidation.

LearningCoach allows students to upload relevant educational resources, and intelligent algorithms automatically generate questions of different types (grid, short answer, essay, association), adapted to the user's level of preparation.

It uses advanced Large Language Models (LLMs) to analyze uploaded materials and extract key concepts. Based on these, the system formulates questions that test both basic knowledge and in-depth understanding of the subject. Students receive real-time feedback, including detailed explanations and suggestions for improving performance. Furthermore, the app learns from the user's previous interactions, adjusting the level of difficulty and identifying knowledge gaps to optimize the learning experience.

LearningCoach represents an useful tool for academic preparation, offering students an efficient and interactive way to self-assess. By using artificial intelligence, the application personalizes the learning path and contributes to a better understanding of the study material.

Acknowledgements: Conf. Univ. dr. Andrei Bautu.

Keywords: *Artificial intelligence, large language models, personalized learning.*

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22) Automated Network Scanning Tool for Penetration Testing

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Introduction: In the field of cybersecurity, network reconnaissance is a fundamental technique used to evaluate the security and integrity of a network. This paper presents an automated Python-based tool that simplifies and accelerates the process of scanning local area networks (LANs). By leveraging the Scapy library, the tool can identify active devices, gather MAC addresses, detect unauthorized or rogue devices, and perform ARP-based scanning, which can serve as a precursor to Man-in-the-Middle (MITM) attacks. The primary objective of this project is to provide penetration testers with a streamlined solution for conducting network assessments efficiently.

Methods and Results: The tool is designed to assist penetration testers in identifying devices connected to a network, facilitating the mapping of network structures. It includes functionalities for MAC address spoofing, which allows testers to impersonate devices and bypass MAC-based filtering mechanisms. Additionally, its ARP-based scanning capabilities enable security professionals to conduct in-depth reconnaissance, which is essential for ethical hacking and security testing.

One of the key advantages of this tool is its ability to detect rogue devices that may have unauthorized access to a network. By automating the identification of unknown devices,





penetration testers can proactively address potential security risks. The controlled simulations conducted using the tool highlight its effectiveness in identifying vulnerabilities and enhancing network security strategies.

Conclusions: Effective network scanning is a crucial aspect of penetration testing. By automating the process of detecting vulnerabilities and unauthorized devices, this tool equips security professionals with an efficient method for strengthening network defenses. Understanding network structures and identifying weaknesses play a vital role in mitigating cybersecurity threats. This project serves as an essential resource for penetration testers seeking to improve the security posture of local networks.

Keywords: *Cybersecurity, Penetration Testing, Network Scanning, ARP Spoofing, Ethical Hacking, Network Security.*

23) Exploiting the Public Sector: Ransomware Risks in Government Procurement Processes

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Introduction: Ransomware has become one of the biggest cybersecurity threats to critical government infrastructure. These attacks not only cause financial damage, but can also shut down essential services and expose sensitive data to the public. One of the most effective ways cybercriminals infiltrate government systems is by hiding ransomware in seemingly innocuous PDF documents used in government procurement. Government procurement involves a constant exchange of documents between government offices and suppliers/providers/performers of products/services/works, so hackers take advantage of this by hiding malware inside PDF files that look just like any other official document.

Methods and Results: The use of the electronic public procurement system (S.E.A.P.) is mandatory for all public procurement processes in Romania, regardless of the value of the contract. The platform allows the use of a comprehensive suite of tools and functionalities to facilitate the entire public procurement process, including the publication of tender notices, the submission of bids, the evaluation of technical and financial proposals and the award of contracts. Through S.E.A.P., contracting authorities can initiate, publish and monitor public procurement procedures, while maintaining direct and transparent communication with potential bidders throughout the process. [1]

Public procurement is fundamental to government operations, enabling critical infrastructures to acquire goods, services and works needed to effectively perform their duties. However, the process also presents significant cybersecurity challenges, particularly when relying on unsecured channels for document exchange. One of the most pressing concerns is the risk posed by ransomware, a type of malware designed to encrypt various extensions and demand payment for their decryption. In the context of public procurement, cybercriminals exploit vulnerabilities inherent in document transmission methods, disguising malicious payloads in seemingly legitimate files. A plausible ransomware attack scenario will be examined in which an adversary uses the procurement process to compromise the critical infrastructure of a contracting authority.

The attack will be initiated after the publication of a tender notice in the specially dedicated section of the S.E.A.P. electronic platform. Since the S.E.A.P. electronic platform allows unrestricted access to public procurement advertisements, an attacker does not need an official account to view the contracting authority's advertisements. By analyzing the posted requirements, the attacker gathers information regarding the products/services/works required,



the deadlines for submitting the offer and the email address designated for submitting the documents. This unrestricted access provides the foundation for a cyber-attack with high success rates.

After receiving the offer, the contracting authority identifies a new procurement opportunity, without assuming that the adversary has created a strategic cyberattack. The attacker prepares the documents required for the procurement in the official form, which includes the qualification documents, technical proposal, financial proposal and other documents requested by the contracting authority.

Within the PDF, the ransomware is embedded using sophisticated evasion techniques, such as JavaScript-based exploits and macro-enabled payloads. These methods ensure that, when opened, the document triggers the execution of the malware, compromising the target system.

Once the infected document is complete, the attacker initiates a highly convincing phishing campaign based on public procurement requirements. The fraudulent bid is submitted via email, taking advantage of the common practice of transmitting documents through unsecured communication channels. The email is meticulously crafted to mimic legitimate correspondence, using domain spoofing techniques to make the sender's address appear credible.

Instantly, the contracting authority staff within the public procurement structure download and open the document, the ransomware execution is activated. By exploiting software vulnerabilities and misconfigurations, the malware gains a foothold in the system, executing privilege escalation techniques to gain administrative control. The ransomware then initiates its main function, namely encrypting the contracting authority's files. As a final step, the attacker sends a ransom note, demanding payment in cryptocurrency to restore access to the encrypted files.

The consequences of such an attack are major. The contracting authority faces significant operational paralysis because access to its own data is obstructed. The contracting authority is then faced with a difficult decision: pay the ransom, which does not guarantee data recovery, or initiate a costly and extensive remediation effort. At the same time, cybersecurity specialists must track the origins of the attack, identify exploited vulnerabilities, and implement mitigation strategies.

The vulnerabilities inherent in document exchange via electronic tools such as email highlight the need for a more secure procurement workflow. A key mitigation measure would be to develop a special and mandatory section within secure document transmission platforms, such as S.E.A.P., with advanced security protocols. By implementing document uploads exclusively in a controlled environment, the S.E.A.P. electronic platform can integrate automated malware scanning mechanisms, restrict executable content, and authenticate user identities before files are uploaded.

Conclusions: As cyber threats targeting public policy processes continue to evolve, integrating emerging technologies into cybersecurity frameworks becomes imperative. Artificial intelligence-based threat detection systems provide real-time analysis of incoming documents, identifying potential malware signatures before files reach end users. Security platforms could rely on blockchain to provide an additional layer of integrity, ensuring that document submissions remain tamper-proof and verifiable. To effectively counter ransomware risks, e-platforms like S.E.A.P. should move from reactive security approaches to proactive, intelligence-driven defense mechanisms.

Keywords: *Ransomware, SEAP, Critical Infrastructures, Cybersecurity, RaaS.*



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In: Proceedings of the International Conference on Cybersecurity and Cybercrime (IC3), Vol. X, pp. 230-240. CyberConRomania, 2023.

24) Development of an EVM-compatible Blockchain Bridge in the Verifiable Credentials Context

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Introduction: In blockchain technology, bridges have become essential for enabling interactions between different blockchain networks. This paper introduces a web application highlighting the importance of a blockchain bridge in facilitating communication between two networks that use the Ethereum protocol but employ different consensus mechanisms. The system establishes a secure communication method between these networks, modeled on the infrastructure of Verifiable Credentials.

Methods and Results: The web application distinguishes the functions of two actors (Issuer and Verifier) in the Verifiable Credentials Ecosystem, which operate on blockchain nodes within different private consensus networks. The application connects seamlessly with the MetaMask wallet, enabling blockchain transactions through the Web3 library. Parties can easily select between the two available networks using MetaMask, which enhances the user experience and simplifies interactions with the blockchain. The system features two Proof-of-Authority networks with distinct consensus mechanisms: Clique and QBFT.

In Clique, validators propose blocks in rotation without needing votes from others. Conversely, QBFT requires a block proposal and at least two-thirds of the validators to approve it for a block to be validated. The Verifiable Credentials Ecosystem consists of two smart contracts designed for the two actors, each operating with specific functionalities. These contracts are characterized by enhanced security, ensuring that any call or transaction made by the actors is safe and reliable.

The blockchain bridge, meticulously designed, enables robust and secure bidirectional communication between the two networks. It is crafted to monitor events from the network specified by the Validator to ensure optimal performance. When a VC Hash validation event is detected, the cross-chain oracle promptly identifies this signal and activates the verification function on the corresponding network associated with the Issuer. This seamless interaction culminates in the bridge capturing the essential response and securely storing it within the verifier's network, thereby guaranteeing that all communications are executed with the utmost reliability and security.

Conclusions: This solution highlights the critical importance of a blockchain bridge in decentralized applications for ensuring interoperability between different networks. The bridge enhances functionality and improves the overall user experience across blockchain ecosystems by facilitating secure communication.

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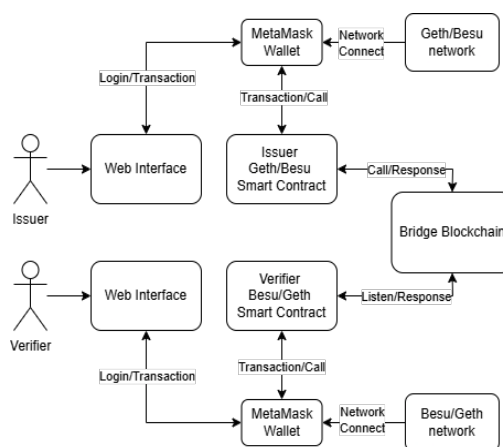


Fig. 1: Architecture Diagram



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Keywords: *Clique, QBFT, Proof-of-Authority, MetaMask, Web3.*

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12. MATHEMATICS APPLIED IN ENGINEERING

1) Transport Routes for Containers Using Set Matrices

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Introduction: The optimization of container transport routes is a crucial aspect of modern logistics, influencing efficiency, cost, and environmental impact. This paper explores the use of set matrix formalism as an innovative mathematical approach to modeling transport networks. Unlike traditional numerical or non-numerical matrices, set matrices consist of elements that are themselves sets, introducing a new algebraic structure that requires modifications to existing mathematical frameworks.

Our research builds upon the foundational work of Francesco, who initially proposed the application of set matrices in this context. Through an extensive analysis and refinement of these concepts, we aim to enhance the theoretical underpinnings and practical applications of this approach.

Methods and Results: To develop a more comprehensive model, we examine alternative transport routes and assess their efficiency using set matrices. This approach allows us to represent and analyze transport connections more flexibly than conventional graph-based methods.

A key contribution of this study is the integration of new mathematical ideas and corrections, guided by Professor Mihai Rebenciuc, whose expertise and insights have significantly shaped our theoretical advancements. By refining the algebraic structure of set matrices, we achieve improved results in route optimization and logistics planning.

Additionally, we extend previous applications of set matrices to real-world scenarios, demonstrating their potential in dynamically adjusting transport routes based on external factors such as demand fluctuations and infrastructure changes. Our findings suggest that this methodology provides a robust framework for optimizing container transport networks.

Conclusions: The introduction of set matrices in transport route modeling represents a promising advancement in logistics and mathematical optimization. Our research not only builds upon Francesco's foundational work but also refines and extends its applicability through theoretical enhancements guided by Professor Rebenciuc. Future research will focus on further validating this method by capitalizing on von Neumann's idea of grounding game theory, as well as through computational simulations and real-world case studies.

Acknowledgements: We extend our gratitude to Professor Mihai Rebenciuc (mihai.rebenciuc@upb.ro) for his valuable guidance and contributions to refining the theoretical framework of this research. We also acknowledge Francesco's pioneering work, which served as the foundation for this study.

Keywords: *Set matrices, container transport, logistics optimization, mathematical modeling, transport networks, algebraic structures.*

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2) Comparison Between HOSVD and 3D-DCT for Large-Scale Image Compression and Processing

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Abstract: In applied mathematics and engineering, efficient image processing techniques are crucial in data compression, feature extraction, and dimensionality reduction. This study compares two widely used methods: Higher-Order Singular Value Decomposition (HOSVD) and Three-Dimensional Discrete Cosine Transform (3D-DCT), applied to large-scale image datasets. HOSVD, a tensor-based generalization of the SVD, captures multidimensional correlations and provides a compact representation of image data. On the other hand, 3D-DCT extends the traditional DCT to three dimensions, effectively reducing redundancies in volumetric image structures.

Our objective is to analyze and compare the performance of these techniques based on key metrics such as reconstruction accuracy, compression ratio, and computational efficiency. Preliminary findings suggest that while HOSVD offers superior feature extraction capabilities in high-dimensional datasets, 3D-DCT excels in computational speed and energy compaction efficiency. The results of this study contribute to a better understanding of the strengths and limitations of these approaches, guiding the selection of optimal techniques for large-scale image analysis and engineering applications.

Keywords: *Higher-Order Singular Value Decomposition (HOSVD), Three-Dimensional Discrete Cosine Transform (3D-DCT), Data compression, Multidimensional correlations.*

3) The Mathematics Behind Active Noise Cancellation

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Introduction: This paper aims to decipher the mathematics which makes Active Noise Cancellation possible. We will consider the general equation of a sound wave and the method used by headphones with Active Noise Cancellation to effectively cancel out any unwanted sound waves, with both a clear physical demonstration and a mathematical one using the Fast Fourier Transform, applied in the case of an example-wave.

Methods and Results: In practice, headphones with Active Noise Cancellation technology exhibit external microphones, which intercept any ambient sounds and a processor which translates them from time domain into frequency domain and generates a signal opposite in phase to the noise, which will then be played through the speakers and interfere with the ambient sound waves, effectively mitigating them.

To illustrate this, let us consider the noise inside a commercial airplane with a frequency of 1000 Hz and an amplitude of 85 dB. The equation of this sound wave is:

$$y(t) = 85 \sin(2000\pi t), \text{ the antiwave being } y'(t) = 85 \sin(2000\pi t + \pi).$$

Through destructive interference, the resulting wave is:

$$y''(t) = y(t) + y'(t) = 85[\sin(2000\pi t) + \sin(2000\pi t + \pi)] = 85 \cdot 2 \sin(2000\pi t + \pi/2) \cdot \cos(-\pi/2) = 0.$$

Thus the noise has been cancelled.

To simulate the exact calculations performed by an ANC headset, let us define a noise signal $x[n]$ with 4 samples: $x[0]=1$, $x[1]=-1$, $x[2]=1$, $x[3]=-1$, where the argument of the



function represents a moment in time and the result is the amplitude of the sound wave at each moment.

In order to obtain the frequency domain representation of the noise, we will apply the Fast Fourier Transform: $X[k] = \sum_{n=0}^{N-1} x[n]e^{-i\frac{2\pi}{N}kn}$, where $N = 4$ is the number of samples of the signal and k represents the frequency index.

For $k = 0$: $X[0] = \sum_{n=0}^3 x[n]e^{-i\frac{2\pi}{4}0 \cdot n} = \sum_{n=0}^3 x[n] = x[0] + x[1] + x[2] + x[3] = 1 - 1 + 1 - 1 = 0$

Similarly, for $k = 1$, using $e^{i\alpha} = \cos\alpha + i\sin\alpha$: $X[1] = 0$.

For $k = 2$: $X[2] = 4$.

For $k = 3$: $X[3] = 0$.

In order to mitigate this noise signal, the headphones generate an anti-noise signal. To illustrate this, we will use the inverse Fast Fourier Transform and convert the signal back to the time domain.

The anti-noise signal $y[n]$ is defined as:

$$y[n] = \frac{1}{N} \sum_{k=0}^{N-1} X[k]e^{i\frac{2\pi}{N}k \cdot n}$$

The inverse FFT result is: $y[0] = 1$, $y[1] = -1$, $y[2] = 1$, $y[3] = -1$.

Combining the noise signal $x[n]$ with the anti-noise signal $y[n]$, we observe that $x[n] + y[n] = 0$, meaning that we have mitigated the noise through total destructive interference.

Conclusions: While any intercepted signal is originally in time domain, using it as such would hinder real-time noise cancellation due to the complexity of the waveform representation. Converting the signal to frequency domain using the FFT facilitates the identification of unwanted frequencies.

Acknowledgements: Assoc. Prof. Antonela Toma, Center for Research and Training in Innovative Techniques of Applied Mathematics in Engineering, University Politehnica of Bucharest.

Keywords: *Waves, Cancellation, Fast Fourier Transform.*

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4) Mathematical Foundations of Autonomous Systems in Military Engineering

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Introduction: Automatic systems are becoming a fundamental component of modern military engineering, offering increased operational efficiency and decision-making capabilities with minimal human intervention. These systems rely on mathematical frameworks to process sensor data, optimize movement, and execute tasks under dynamic conditions. Among the key mathematical tools shaping automatic systems in military engineering are the Laplace transform (for continuous linear systems), the Z-transform (for discrete linear systems), and automatic system theory. These concepts provide the foundation for system stability, predictability, and optimization in complex operational environments.





Methods and Results: This study explores the mathematical principles that govern automatic military systems, focusing on system response, and optimization. Control theory ensures that automatic platforms maintain stability and execute precise manoeuvres. Using feedback loops and dynamic equations, these systems can adjust in real time to external forces, disturbances, and mission constraints.

Linear systems can be broadly classified as continuous or discrete. Continuous linear systems are often analysed using the Laplace transform, which is essential in analysing system dynamics, enabling engineers to simplify differential equations and design controllers that optimize system performance. By transforming time-domain functions into the frequency domain, Laplace analysis allows for precise tuning of control systems in automatic drones, robotic vehicles, and missile guidance systems. Similarly, discrete linear systems, which operate on sampled data, are often analysed using the Z-transform, providing analogous benefits in the discrete-time domain.

Automatic system theory further refines how these machines operate independently. It provides a framework for modelling system behaviour, ensuring long-term stability and efficiency. Using differential equations (for continuous systems) or difference equations (for discrete systems), phase-space analysis, and equilibrium assessments, this theory helps predict how automatic systems will evolve over time in response to inputs and environmental changes. Stability analysis, a crucial aspect of automatic system theory, determines whether a system will return to its equilibrium state after a disturbance. Techniques such as stability analysis and frequency-domain methods (e.g., Bode plots, Nyquist criterion) are used to assess the stability of both continuous and discrete automatic systems.

In military applications, these mathematical tools enable automatic platforms to navigate terrain, track targets, and adjust mission parameters dynamically. Optimization techniques complement these models by improving efficiency in trajectory planning, energy management, and multi-agent coordination. Together, these mathematical foundations ensure that automatic military technologies can operate with precision, adaptability, and resilience in high-stakes environments.

Conclusions: The integration of Laplace transforms (for continuous systems), Z-transforms (for discrete systems), and automatic system theory enhances the reliability and performance of military automatic systems. However, as these technologies become more advanced, challenges arise in maintaining predictability, security, and adaptability under real-world conditions. Future research must focus on refining mathematical models to improve robustness and mitigate vulnerabilities. Understanding these foundations is critical to ensuring that automatic military systems remain efficient, controlled, and strategically valuable in modern warfare.

Keywords: *Automatic systems, military engineering, Laplace transform, Z-transform, automatic system theory, system stability, optimization, system response, feedback loops, dynamic equations, continuous linear systems, discrete linear systems, differential equations, difference equations, stability analysis, military applications.*

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5) Application of Quaternions and the Fourier Transform in Video Frame Processing

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Introduction: The paper's objective is to utilize RGB-based pure quaternions and the Fourier transform to process a camera's video output in order to obtain information about moving objects and changes in velocity. In video frame processing, efficient analysis of motion dynamics is crucial for applications such as object tracking, motion estimation and real-time surveillance. One of the particular applications of our project is the detection and monitoring of house fires.

Methods and Results: Our motion detection algorithm is based on Optical Flow, but instead of utilising intensities, it encodes information about the pixel's RGB values using quaternions. Optical flow assumes that a pixel's intensity remains constant as it changes spatial direction, but this condition may create problems in situations that include dynamic variation of light. We thus introduce a similar algorithm (Quaternion Optical Flow - QOF), that instead relies on the property that a pixel's RGB values during its motion stay approximately constant, or experiences proportional change. Thus, the differential constraint now becomes a system of three differential equations:

$$\begin{cases} \frac{\partial \hat{R}}{\partial t} + v_x \frac{\partial \hat{R}}{\partial x} + v_y \frac{\partial \hat{R}}{\partial y} = \epsilon_R \\ \frac{\partial \hat{G}}{\partial t} + v_x \frac{\partial \hat{G}}{\partial x} + v_y \frac{\partial \hat{G}}{\partial y} = \epsilon_G \\ \frac{\partial \hat{B}}{\partial t} + v_x \frac{\partial \hat{B}}{\partial x} + v_y \frac{\partial \hat{B}}{\partial y} = \epsilon_B \end{cases}$$

where, ϵ_R , ϵ_G and ϵ_B are the respective errors of the pixel's motion on each color channel. The values $\hat{R}$, $\hat{G}$, and $\hat{B}$ are given by the normalised quaternion of a pixel. Thus, for:

$$q = Ri + Gj + Bk$$

we obtain the normalised quaternion:

$$\hat{q} = \frac{R}{\|q\|}i + \frac{G}{\|q\|}j + \frac{B}{\|q\|}k.$$

To solve the system of differential equations for the column vector $\vec{v}$, we will perform Least Square:

$$\vec{v} = \arg \min_{\vec{v}} \|A\vec{v} + \vec{b}\|^2 = -(A^\top A)^{-1} A^\top \vec{b}$$

where,

$$A = \begin{bmatrix} \frac{\partial \hat{R}}{\partial x} & \frac{\partial \hat{R}}{\partial y} \\ \frac{\partial \hat{G}}{\partial x} & \frac{\partial \hat{G}}{\partial y} \\ \frac{\partial \hat{B}}{\partial x} & \frac{\partial \hat{B}}{\partial y} \end{bmatrix} \quad \vec{b} = \begin{bmatrix} \frac{\partial \hat{R}}{\partial t} \\ \frac{\partial \hat{G}}{\partial t} \\ \frac{\partial \hat{B}}{\partial t} \end{bmatrix}$$

Thus, obtaining the vectors for each pixel, we can plot them as a vector field and represent the motion shown in the video. We can plug the vectors obtained using Least Square back into the differential systems, and obtain the epsilon values for each color channel to observe the relative error output of the algorithm.

A problem that the algorithm may encounter is that the frames of the video could suddenly be affected by colored lighting. Colored lighting is tricky to handle for this algorithm since it relies on proportional hue consistency, and it becomes more complicated if that colored



light evolves dynamically. We solve this through a color correction based algorithm for static light and, for dynamic light, we introduce a system which performs FFTs on the temporal averages of each color channel, extracting dominant frequencies, amplitudes and phases. Then, we reconstruct the signal which predicts the behaviour of the colored light, such that we can instantly color correct the predicted color-influenced frames.

If a specific channel is prioritized, we apply weighted emphasis to pixels with higher values in that channel, motion detection being focused on the channel's respective differential equation.

Conclusions: This work presents an alternate Optical Flow algorithm that attempts to fix the program's main flaws. It further includes additional algorithms if unfavourable conditions such as colored light or unwanted colored pixels are present, to further improve the program's robustness in applied scenarios.

Acknowledgements: Assoc. Prof. Antonela Toma, Center of Research and Training in Innovative Techniques of Applied Mathematics in Engineering, University Politehnica of Bucharest.

Keywords: *RGB, FFT, Quaternions, Optical Flow, Motion estimation.*

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6) Overview of Methods Used in Time Series Analysis and Forecasting: A Comparative Study

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Introduction: Abstract: This paper provides a summary and overview of the currently available methods for time series analysis and forecasting. With the increasing popularity of neural networks, this work also emphasizes the continued relevance of traditional, less complex methods that have remained in use over the years. Additionally, a comparative study is conducted, examining the knowledge required for implementation, the complexity of each method, and their advantages and disadvantages, particularly in terms of ease of integration for general users. The discussion is complemented by practical implementations and the necessary theoretical foundations for a better understanding of the methods.

Keywords: *time series analysis, forecasting.*

7) Trilateration Under Measurement Uncertainty: Estimating Positions with Noisy Distance Data

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Abstract: Trilateration is a fundamental technique for determining an unknown position based on known reference points and distance measurements. However, in practical applications, measurement uncertainties - such as sensor noise, environmental factors, and



signal interference - introduce errors that can affect localization accuracy. This paper explores the impact of measurement uncertainty on trilateration and presents methods for mitigating its effects. We analyze error propagation in distance measurements, discuss probabilistic and optimization-based approaches to improve position estimation, and evaluate their effectiveness through simulations. The findings provide insights into enhancing robustness in real-world localization systems, including GPS, wireless networks, and robotics.

Keywords: *Trilateration Errors, Position Uncertainty, Multipath Effects, Optimization Techniques.*

8) Geographic Matrices Of Set: Applications of Matrices of Sets in Antropic Activity and in Selecting Climatically Appropriate Engineering Solutions

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Introduction: Using collections of data as a starting point, it is often useful to analyze, compare and predict meteorological conditions of locations all over the globe, with the aim to aid in travel, industry, military activity, engineering and various other facets of human life. This paper aims to build upon the methods proposed by R. Di Francesco by expanding the studied datasets and the target use-cases, while also improving the formulas and refining the mathematical expressions.

Methods and Results: Applying matrices of sets, annual variations in temperature in cities of importance across the globe are compared and put into perspective to optimize engineering solutions, travel considerations and more. Mathematically, our scope is refining and expanding the basis of matrix multiplication. Aspects such as material choice in construction and machine components can be greatly influenced by temperature, such as in the case of thermal expansion and elastic behavior. In electronics and electrical engineering, material properties are also affected. Using our results, such aspects may be geographically and meteorologically adapted. The project is actively evolving.

Conclusions: Geographically oriented matrices of sets constitute a field of study which holds promising possibilities for improvement and expansion, being a subject which allows for the development of practical solutions across the board, in a multitude of fields, and taking into account various parameters.

Acknowledgements: We would like to thank Professor Mihai Rebenciuc (mihai.rebenciuc@upb.ro) for his aid and guidance in researching and writing this paper. We also recognize Francesco's groundbreaking work, which laid the foundation for this study.

Keywords: *Climate, Environment, Matrices of sets, Travel, Meteorology.*

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9) Mathematical Approaches Regarding Filtering, Modulation and Demodulation of Received signals. Audio Study Case

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Introduction: This paper presents an audio signal processing experiment focusing on filtering, modulation, and demodulation techniques. To apply our knowledge acquired so far in the faculty we decided to implement a rudiment of a radio with 2 different audio signals obtained before. Therefore, the objective is to analyse and manipulate audio signals using **Digital Signal Processing (DSP)** techniques, specifically employing **Low-Pass (LPF)** and **High-Pass Filters (HPF)**, signal modulation, and demodulation. The primary goal is to combine two audio signals, analyse their spectral characteristics, and apply filtering to extract individual components.

Methods and Results: Two audio files are loaded (fig. 1.a.), each sampled at different frequencies and to ensure uniformity in processing, the number of samples is trimmed to the shortest available length. We were also interested in understanding of how the frequency and the impulse will respond if we would apply a **Low Pass Filter** with an order of magnitude of 100; the result is what we have expected in the sense that all the frequencies greater than 5000 Hz will be cut-off during this operation. (fig. 1.b.)

The **Power Spectral Density (PSD)** of both signals is then computed using the Welch method, which is a non-parametric technique for estimating the power of a signal at different frequencies. It involves segmenting the signal into overlapping segments, applying a window function to reduce spectral leakage, computing the **Discrete Fourier Transform (DFT)** of each segment, and then averaging the periodograms. This approach results in a smoother and more

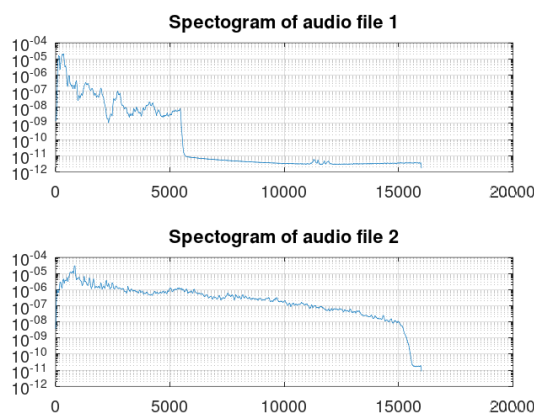


Fig. 1: a. Spectrogram of the original audio files

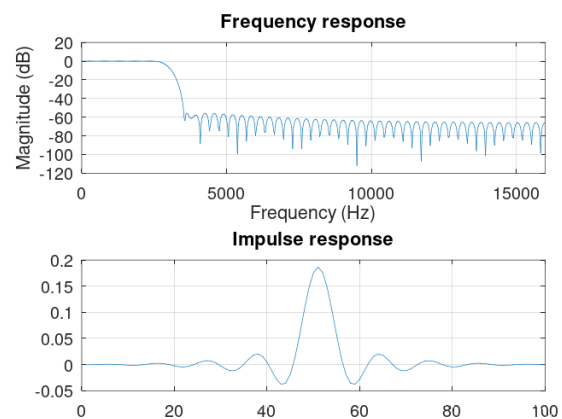


Fig. 1: b. Frequency and impulse response of the original audio files

reliable spectral estimate than a single periodogram. A **Low-Pass FIR Filter** with an order of 100 and a cutoff frequency of 3 kHz is designed and applied to both signals. The frequency response and impulse response of the filter are visualized and after filtering, the **DSP** of the filtered signals is again computed, showing attenuation of high-frequency components. Each filtered signal is modulated onto a carrier: **4 kHz** for the first and **12 kHz** for the second.



The modulation process results in frequency shifting and the two modulated signals are then combined to create a composite signal. The filtered audio signal can be seen in fig. 2.a. and the result after modulation have taken place is described in fig. 2.b. Finally, the aggregated signal spectrogram can be seen in fig. 3. To recover the original signals, the composite signal is filtered using two bandpass filters: a low-pass filter (cutoff at 7 kHz) to extract the first signal and a high-pass filter (cutoff at 8 kHz) to extract the second signal. PSD analysis confirms

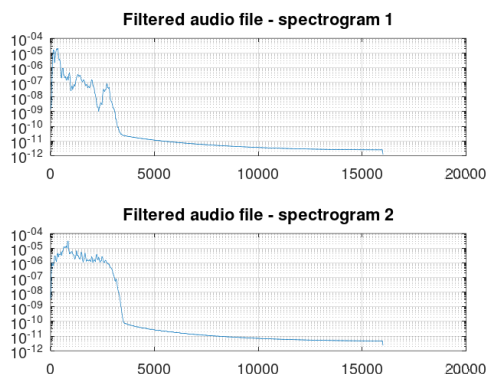


Fig. 2: a. Audio files filtered obtained during the implementation of the algorithm

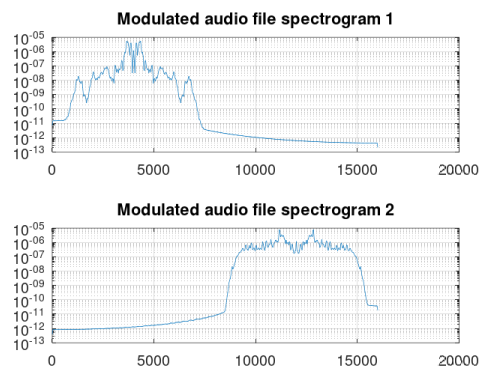


Fig. 2: b. Spectrogram of the modulated signals

successful separation of the components. The demodulation process involves multiplying the extracted signals with their respective carriers, followed by **Low-Pass Filtering** to recover the baseband signals. The recovered signals are then analysed using spectral methods and played back to verify the effectiveness of the process.

Conclusions: This study confirms that using appropriate filtering and modulation strategies, although quite simple, allows for effective separation and recovery of audio signals from a composite waveform. These techniques are highly relevant in military applications such as secure communications, signal intelligence, and electronic warfare, but also in the civil area especially in telecommunications. To showcase the potential applications, we implement during our algorithm a successful extraction and a playback of the original signals.

Acknowledgements: Assoc. Prof. Toma Antonela and Dr. Octavian Postăvaru from Center for Research and Training in Innovative Techniques of Applied Mathematics in Engineering, 'Traian Lalescu' (CiTi), Bucharest, Romania.

Keywords: Discrete Fourier, Filtering, Modulation, Frequency, Impulse.

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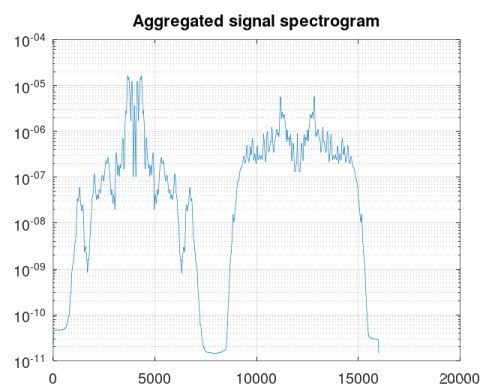


Fig. 3. Spectrogram of aggregated signal spectrogram



10) Continuity Condition in a Mathematical Model of Turbulence Based on the Dynamics of 2 Fluids

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Introduction: This paper presents an advanced mathematical model for turbulence based on the interaction of multiple fluid components, with a particular focus on ensuring the continuity condition in turbulent flows. The model builds upon the concept that turbulence can be represented as a heterogeneous mixture of several interacting fluids, each governed by its own equation of motion. A closed system of equations is formulated to describe the relative motion between these fluids, ensuring that the continuity condition is rigorously satisfied across the entire turbulent flow field.

Methods and Results: The proposed model describes turbulence as a system involving multiple interacting fluids, each occupying a distinct volume within a mixture. The velocity of the mixture is then expressed as a weighted sum of the velocities of the individual fluids.

To formalize this approach, the model introduces a mixed area, denoted as ΔS_i , which consists of contributions from different fluids. The total mixed area is the sum of the sub-areas occupied by each fluid component. The mass flux of each fluid passing through the mixed area is determined by the product of the density, velocity, time and the respective sub-area. The sum of these fluxes must be equal to the total mass flux through the entire mixed area, ensuring mass conservation.

By normalizing these expressions with respect to the total area, the velocity of the mixture is formulated as a weighted average of the velocities of individual fluids. The weighting factor is represented by an area fraction parameter, denoted as α , which expresses the proportion of the mixed area occupied by each fluid. The resulting velocity equation incorporates the contributions of all fluid components while ensuring that their sum satisfies the continuity condition.

To incorporate turbulence, the model applies Reynolds decomposition, where the velocity of the mixture is separated into its mean and fluctuating components. The fluctuating velocity varies over time, and this variation is captured by an additional parameter, denoted as γ_i . The continuity condition, which states that the divergence of velocity must be zero for an incompressible fluid, is then applied to the decomposed velocity terms. This leads to a final expression that ensures mass conservation is maintained even in the presence of turbulence.

The general case assumes that all interacting fluids have the same density, simplifying the continuity condition. It considers two surfaces, ensuring mass conservation across the turbulent flow. This approach maintains consistency in velocity averaging, making it applicable to various turbulence scenarios while preserving the fundamental principles of incompressible fluid dynamics.

Two particular cases are explored to generalize the model for different density conditions and an increasing number of interacting fluid components. The first case considers the scenario where the two fluids in the mixture do not share the same density, requiring a refined mathematical approach to ensure mass conservation. The area occupied by the first fluid is assumed to be proportional to a factor β , leading to expressions for the densities of the two fluids as $\rho_2 = \rho / (1 + \beta)$ and $\rho_1 = \beta \cdot \rho / (1 + \beta)$. The total mass flux is then calculated as the sum of contributions from both fluids, ensuring that the continuity condition remains valid. Using the definition of velocity averaging and area fractions, the velocity of the mixture is expressed as a function of α , β and the individual fluid velocities. The final formulation reveals that the weighting factor α is influenced by β , indicating that the relative density of the fluids affects their respective contributions to the total velocity. The results show that when α



stabilizes at 0.5, the continuity condition remains unchanged, confirming that the mass conservation principle is preserved despite density variations. The second case extends the model to three interacting fluids, introducing an additional degree of complexity. The total mixed area now consists of three sub-areas, and the velocity of the mixture is expressed as a weighted sum of the three fluid velocities. The area fractions α_1 , α_2 , and α_3 sum to unity, ensuring that all fluids contribute proportionally. Assuming equal contributions from all three fluids, the velocity expression simplifies, demonstrating that the model remains consistent regardless of the number of fluid components. This extension confirms the robustness of the proposed approach, showing that it can be generalized to multi-fluid turbulence modeling while preserving mass conservation.

There is also a C++ program that simulates the velocity evolution of a system composed of interacting fluids under a simplified turbulence-like process, ensuring that the overall mass conservation principle remains intact.

Conclusions: This developed model provides a novel approach to turbulence by treating it as an interaction between multiple fluid components. It successfully integrates mass conservation, velocity fluctuations, and numerical implementation to offer a viable alternative to traditional turbulence modeling techniques. The consistency of the results with theoretical expectations highlights the potential of this multi-fluid approach in advancing turbulence research and fluid dynamics simulations.

Acknowledgements: Assoc. Prof. Toma Antonela, *Center for Research and Training in Innovative Techniques of Applied Mathematics in Engineering*, Faculty of Applied Sciences, National University of Science and Technology Politehnica Bucharest.

Keywords: *Turbulence Modeling, Multi-Fluid Dynamics, Continuity Condition, Reynolds Decomposition.*

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11) Mathematical Model used for Determining the Kinematic Trajectory of an Aircraft Guided Missile

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Introduction: The AIM-9 Sidewinder is a short-range, infrared-guided air-to-air missile, widely used since its U.S. development in the 1950s. It is supersonic (Mach 2.5), highly maneuverable, and tracks targets by their heat signature. The modern AIM-9X version enhances targeting angles and integrates with advanced systems. A key success was in the 1982 Lebanon War, where Israeli jets used AIM-9L missiles to dominate Syrian aircraft. A routing law is required to determine the optimal trajectory that ensures precise interception of a moving target based on the equations of kinematic motion.



Fig. 1: Air-to-air missile.

Methods and Results: Starting from the relative speed of the rocket to the target:

$$\vec{v}_{rel} = \vec{v}_r - \vec{v}_t,$$

which is related to the missile's relative coordinates to the target, D and q , by vectorial relationship:

$$\vec{v}_{rel} = \dot{D} \cdot \vec{i}_D + D \cdot \dot{q} \cdot \vec{i}_q,$$

you can get a very simple mathematical model of the tracking process described by the following system of equations [4]:

$$\begin{cases} \frac{dD}{dt} = -v_r \cdot \cos \gamma - v_t \cdot \cos q; \\ D \cdot \frac{dq}{dt} = -v_r \cdot \sin \gamma + v_t \cdot \sin q. \end{cases}$$

The first equation is "Rate of change of distance D ":

$dD/dt < 0$ means the missile is approaching the target, $dD/dt > 0$ the rocket is distancing itself (the minus signs appear because both speeds contribute to the decrease in distance. The missile is approaching the target, and the target can also come towards the missile. Without these signs, the equation would describe a distance that increases, which would not be correct for an interception process.

The second equation is "Rate of change of angle q ":

$D \cdot (dq/dt) < 0$ means the missile is approaching the target, $dD/dt > 0$ the rocket is distancing itself (in the second equation, the minus sign indicates that the lateral component of the rocket speed causes a reverse rotation of the target line, while the plus sign shows that the lateral movement of the target directly contributes to the change of the tracking angle).

We take the case where $\gamma=0$ and the system of equations will result:

$$\begin{cases} \frac{dD}{dt} = -v_r - v_t \cdot \cos q & (1) \\ \frac{dq}{dt} = \frac{v_t}{D} \cdot \sin q & (2) \end{cases}$$

Now we give values to better understand:

- $v_r=500\text{m/s}$ – rocket speed (interceptor)
- $v_t=300\text{m/s}$ – target speed
- $q(0)=\pi/4$ rad (45°) – initial angle between racket direction and sight line
- $D(0)=5000\text{m}$ – initial distance between rocket and target

And the values will result:

- $dD/dt(0)=-500-300 \cdot 0.707= -712.13$ m/s
- $dq/dt(0)= (300/5000) \cdot 0.707= 0.0424$ rad/s

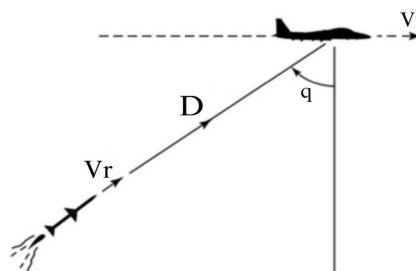




Fig. 2: Missile guidance [1]

Explanation:

The distance decreases by 712.13 m/s and the angle increases by 0.042 rad/s (that is, the rocket is rapidly approaching the target and the angle between the target direction and the sight line is slowly increasing).

Conclusions: Kinematic analysis of the process of tracking a target by an AIM-9 Sidewinder rocket, based on the simplified model in which the angle is zero, highlights the efficiency of interception under ideal conditions. By the above values we can realize that this behavior confirms that the missile progressively aligns with the target direction, which is essential for a successful interception. The study helps to understand the importance of relative speeds and tracking geometry in the design and optimization of guidance systems for passive infrared guided missiles.

Acknowledgements: Col (AF) Prof.Eng. Moldoveanu Cristian-Emil, PhD.

Keywords: *Guided missile, AIM-9 Sidewinder, Kinematic trajectory, Missile guidance, Target tracking, Relative motion, Interception model, Infrared homing, Air-to-air missile, Mathematical modeling.*

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12) Applications of the Collatz Conjecture in Nonlinear PID regulators

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Introduction: The Collatz conjecture, also known as the $3n+1$ problem, posits that for any positive integer n , the sequence defined by the iterative rules:

$$n_{i+1} = n_i/2 \text{ if } n_i \text{ is even}$$

$$n_{i+1} = 3n_i + 1 \text{ if } n_i \text{ is odd}$$

Eventually reaching 7, 4 and finally 1. The formulation may seem simple and direct but currently remains unproven. In this paper we do not attempt to provide a proof but to explore its potential applications in the domain of control theory, specifically its inherent unpredictable and iterative nature, in the design of nonlinear Proportional-Integral-Derivative (PID) regulators. Nonlinear PID controllers offer improved performance over linear PID controllers in complex systems, but their design requires a lot of effort. We investigate how the Collatz sequence can be utilized to introduce adaptive or switching behavior into PID control parameters and what PID sequences best comply to this conjecture's by simulating them in MATLAB.

Methods and Results: We propose a nonlinear PID controller where the proportional gain K_p is modulated by the Collatz sequence. Let $e(t)$ be the error signal, and let $n(t)$ be a positive integer, which we update according to the Collatz rules. We define: $K_p(t) = K_{p0} + \alpha f(n(t))$ where K_{p0} is a base proportional gain, α is a scaling factor, and $f(n(t))$ is a function derived from the Collatz sequence. For example, $f(n(t))$ could be $n(t)$ itself, or a normalized version. The digital implementation of the collatz sequence is done by updating $n(t)$ at discrete time





steps: $n(t+1) = n(t)/2$ if $n(t)$ is even, $n(t+1) = 3n(t) + 1$ if $n(t)$ is odd. We firstly tested this approach on a simulated second-order nonlinear system: $d^2y/dt^2 + 2\zeta dy/dt + y + \beta y^3 = u$, where y is the output, u is the control input, $\zeta=0.5$ and $\beta=0.1$. The PID controller is defined as: $u(t) = K_p(t)e(t) + K_i \int e(t) dt + K_d de(t)/dt$ with K_i and K_d kept constant. Simulations were performed using MATLAB. The initial value of $n(t)$ was chosen randomly. Specific results demonstrate that the Collatz-modulated K_p can lead to improved transient response and reduced overshoot compared to a standard linear PID, particularly in handling nonlinearities. The unpredictable nature of the Collatz sequence introduced a form of adaptive gain scheduling, allowing the controller to react dynamically to changes in the system state. We also observed that the choice of $f(n(t))$ and α significantly impacts performance. A practical approach to test the applicability of our previously described hypothesis is to have for each iteration the resulting Collatz values mapped back to prospective PID parameters. The performance of these candidate parameters is evaluated further on two MATLAB based simulations:

DC Motor: A standard DC motor model is employed to regulate angular speed. The fitness function emphasizes quick settling time, minimal overshoot, and stable steady-state behavior.

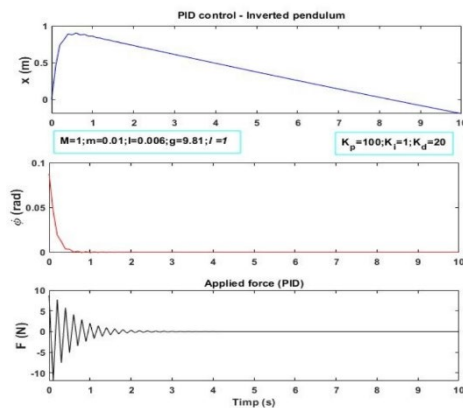


Fig. 1: PID tuning of inverted pendulum

Inverted Pendulum: A nonlinear inverted pendulum simulation on a cart is used to test how quickly and accurately the controller can bring the pendulum to the upright position and maintain balance. Key metrics include pendulum angle stability and the reduction of cart oscillations. We verify the accuracy of the PID tuning for the pendulum employing an heuristic method of using the Simulink module.

By analyzing the simulation outputs, we compare the Collatz-driven approach to conventional PID tuning strategies. Preliminary results demonstrate that Collatz-based tuning in specific can uncover parameter sets yielding stable control with competitive settling times and reduced overshoot in certain scenarios. However, as the

Collatz sequence exhibits inherently chaotic and non-monotonic behavior, additional heuristic mechanisms—such as bounding the parameter range or combining Collatz updates with gradient-based fine-tuning—has the potential to significantly enhance reliability and convergence.

Conclusions: This preliminary study shows that the Collatz conjecture can be used to introduce nonlinear adaptive behavior in PID controllers. The unpredictable and iterative nature of the Collatz sequence offers a unique approach to gain scheduling. While the results are promising, further research is needed to:

- Analyze the stability and robustness of the Collatz-modulated PID.
- Develop methods for optimal parameter selection and study what control systems find the conjecture best applicable.
- Investigate the performance on more complex nonlinear systems and real-world applications.
- Explore other ways to integrate the Collatz sequence into PID control.
- Implement how Kallman Filter can be optimized along with a Collatz sequence.

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Keywords: *Collatz conjecture, PID controller, nonlinear control, adaptive control, gain scheduling.*

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13. MILITARY SCIENCE

1) What if Fake Tanks And False Plans Could Win Real Battles?

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Introduction: Deception has long played a pivotal role in military strategy, shaping the outcomes of battles and entire campaigns. This presentation explores the historical and theoretical implications of using fake tanks, false plans, and other forms of strategic deception to mislead adversaries and gain a tactical advantage.

Methods and Results: One of the most influential figures in modern military deception was Dudley Clarke, a British intelligence officer whose innovative work during World War II transformed how nations approached covert operations. Clarke not only played a key role in establishing two renowned military units—the British Commandos and the Special Air Service (SAS)—but also became the architect of Allied deception strategy. His contributions earned him the title of "the greatest British deceiver of WWII."

Through case studies, such as Operation Cascade and Operation Bertram, peak of deception operations, this presentation highlights how misinformation can disrupt enemy decision-making processes and prove deception is not merely a supplementary tool but a strategic necessity in warfare. These deceptive measures force opponents to misallocate resources, delay critical actions, and second-guess their intelligence, directly influencing the outcome of key battles. Clarke's methods also laid the foundation for future deception campaigns, including Operation Bodyguard, which disguised the true location of the D-Day invasion and contributed to the success of the Allied landings in Normandy.

Conclusions: In conclusion, the effectiveness of military deception lies in exploiting cognitive biases and the fog of war, creating illusions that are difficult to verify under combat conditions. This presentation will examine how Clarke's techniques worked, why they were successful, and the long-lasting impact his innovations continue to have on modern military doctrine and intelligence operations.

Keywords: *Military Deception, Dudley Clarke, Covert Operations, intelligence, techniques.*

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2) The Dawn of Bulgarian Military Aviation from Myth to Battlefield

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Introduction: The idea of aviation in Bulgaria was born in early times and is supported by many myths and legends. In a very short period after the rise of the first heavier-than-air aircraft, the first flights with an aircraft in a combat environment were already available in



Bulgaria. Reconnaissance flights and bombing raids are carried out. Of course, there are theories for the implementation of the set tasks, which will be considered in more detail.

Methods and Results: Bulgarians have long dreamed of mastering flight, as reflected in their songs, legends, and folklore. A key legend tells of Master Manol, a builder who crafted wings to escape captivity but met a tragic fate. This dream gradually took shape, and by the early 20th century, Bulgaria took concrete steps toward aviation.

Just three years after the first powered flight, Bulgaria established an aviation department in 1906. By 1912, the country had trained its first military pilots, including Radul Milkov and Prodan Tarakchiev, who would make aviation history.

On October 16, 1912, during the Balkan War, Milkov and Tarakchiev conducted the first combat reconnaissance flight in Europe, gathering vital intelligence. The following month, Bulgaria made history again by pioneering aerial bombardment. Despite debates over which flight was the first true bombing mission, it is clear that Bulgarian pilots played a groundbreaking role in military aviation.

Conclusions: It is definitely expressed in the conviction that the question is not who, on what date and with what means was the first to carry out a combat effect from the air on the enemy, but in the fact that Bulgarian crews carried it out in the name of the national cause.

From these stated facts, it can be concluded that during the Balkan War, the new type of armed forces "Air Force" was born. At the same time, a new impetus is being given to world aviation.

Keywords: *plane, war, Bulgaria, aviation, flight.*

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3) Mercenaries Through the Ages: From Ancient Warfare to Modern Private Military Companies

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Introduction: Mercenaries have shaped warfare for centuries. Ancient Egypt hired Nubian archers, Greek city-states relied on hoplite mercenaries, and Rome recruited auxilia from conquered lands to strengthen its armies.

In medieval Europe, mercenaries played a major role, especially during the Hundred Years' War. "Free companies" of soldiers fought for the highest bidder, often using advanced tactics and weaponry. Leaders like Sir John Hawkwood became famous condottieri, influencing wars and politics. But mercenaries weren't always a blessing. Many turned to looting and extortion, bringing chaos and instability. Their loyalty was often questionable, driven more by money than allegiance. While they were formidable fighters, they also disrupted societies, leaving a lasting mark on history.

Methods and Results: Mercenaries have played a crucial role in warfare throughout history. In ancient Egypt, Nubian archers were valued for their skill, supplementing Egyptian forces (1). Similarly, Greek city-states hired hoplite mercenaries from Thessaly and Arcadia for their discipline and combat prowess. The Roman Empire relied on auxilia, non-Roman soldiers recruited from conquered territories, enhancing its military with diverse fighting styles.



During the medieval era, mercenaries were prominent in European warfare. The Hundred Years' War (1337-1453) saw the rise of "free companies"—bands of professional soldiers who fought for the highest bidder. Leaders like Sir John Hawkwood, an English knight and condottiero in Italy, exemplified their influence. While highly effective, these mercenaries often resorted to plunder and extortion, causing instability. Their impact extended beyond warfare, shaping medieval politics and disrupting societies. Despite their contributions, mercenaries' financial motivations and lack of loyalty frequently posed challenges for rulers and civilians alike.

The Golden Era: The "Golden Age" of mercenaries (mid-13th to mid-15th centuries) transformed Italy's military landscape. City-states like Florence, Venice, and Milan (2) replaced citizen militias with professional mercenary armies due to urbanization, distrust of citizen soldiers, and the need for specialized warfare skills. Condottieri, powerful mercenary captains like Sir John Hawkwood and Francesco Sforza, commanded skilled forces but often shifted allegiances for financial gain, contributing to Italy's political instability.

By the 16th and 17th centuries, nation-states and standing armies reduced mercenaries' influence in Europe. However, they remained central to colonial expansion. The Dutch East India Company (VOC) hired Swiss mercenaries in Indonesia, and the French Foreign Legion enforced French colonial rule. These forces played key roles in suppressing uprisings and maintaining control, often using brutal tactics that led to human rights abuses (3). Their legacy highlights the exploitative systems that shaped colonialism and its lasting impact.

The Modern Era: The 21st century has seen a resurgence of mercenaries through Private Military Companies (PMCs) like Blackwater (now Academi) and the Wagner Group. Blackwater Nisour Square massacre, which damaged its reputation despite continued operation

The Wagner Group (4), linked to Russian oligarch Yevgeny Prigozhin, has operated in conflicts across Africa, the Middle East, and Ukraine. Accused of human rights abuses, extrajudicial killings, and resource exploitation, Wagner has destabilized regions while supporting authoritarian regimes. Its recruitment of convicts for Ukraine sparked further ethical concerns (5).

Other PMCs, such as a Romanian-led group in the Democratic Republic of the Congo, highlight the expanding role of private military actors. These companies raise serious concerns regarding accountability, war crimes, and geopolitical influence. As PMCs grow in power, they challenge international law, complicating global security and human rights efforts.

Conclusions: Mercenaries have played a key role in warfare throughout history, adapting to changing political and military needs. From ancient Egypt to modern corporations, they've provided specialized skills, often at the expense of stability and accountability. Mercenaries have influenced wars, political power, and sometimes caused widespread violence.

In the 21st century, Private Military Companies (PMCs) like Wagner Group and Blackwater/Academi have blurred the lines between state militaries and private forces. Operating globally, they raise concerns about accountability, ethics, and the impact of privatized warfare. As PMCs grow, the debate over their regulation and influence on geopolitics remains increasingly relevant.

Acknowledgements: Lect.Univ.Dr. SOPON Diana-Annelisse.

Keywords: *Mercenaries, Wagner Group, Blackwater, Proxy Wars, Private Military Companies.*

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4) Assessment of Emergent Technologies in Modern Warfare

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Introduction: In the context of the most recent military conflicts, the trend of using new tools (the most interesting being AI driven UAV) available throughout the span of several years offered the possibility of defining their efficacy and costs.

Methods and Results: This study aims to draw several principles of usage for the novel developments in the field of mass produced, cheap and easy to use autonomous drones, capable of inflicting considerable damage for a minimal cost.

AI-driven drones have played a significant role in the Ukraine war, revolutionizing modern warfare by providing advanced reconnaissance, target acquisition, and autonomous attack capabilities. Both Ukrainian and Russian forces have increasingly relied on AI-powered drones for surveillance, artillery coordination, and precision strikes.

A prime example was the Ukrainian destruction of a Russian T-90M tank—one of Russia's most advanced tanks—by a low-cost FPV drone, showcasing the cost-effective lethality of these systems. Another key development is Ukraine's AI-assisted drone swarms, which operate in coordination to overwhelm enemy defenses. The Beaver drone, a long-range, AI-guided explosive drone, has been used to strike targets deep inside Russian territory, including fuel depots and military infrastructure. These drones can autonomously adjust their flight paths to evade air defenses, making them difficult to intercept.

On the Russian side, the Lancet loitering munition, developed by ZALA Aero, has been a game-changer. This drone uses AI-powered target recognition to track and destroy Ukrainian artillery, air defense systems, and even Western-supplied military equipment like M777 howitzers and German Leopard 2 tanks. Footage has surfaced showing these drones precisely hitting moving Ukrainian vehicles and military convoys. Additionally, Russia has employed AI-driven Orlan-10 reconnaissance drones, which use automated image processing to identify and relay enemy positions to artillery units in real time.

Beyond direct attacks, AI-powered drones have been used in electronic warfare and counter-drone operations. Ukraine has deployed AI-enhanced drones to detect and disable Russian jamming systems, while Russia has used autonomous electronic warfare drones to disrupt Ukrainian communication networks.





Conclusions: The rapid deployment and effectiveness of these drones have forced both sides to continuously innovate, leading to an arms race in drone warfare. The integration of AI has not only made drones more precise but has also reduced the need for human intervention, marking a shift in how wars are fought.

Keywords: *UAV, Swarm Warfare, Electronic Warfare.*

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5) Low-Cost FPV Drones in Modern Warfare: Tactical Efficiency and Strategic Impact

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Introduction: The rapid evolution of battlefield technology has led to the integration of low-cost First-Person View (FPV) drones as force multipliers in modern warfare. Initially designed for recreational use, these drones now serve dual roles—augmenting Command and Control (C2) by enhancing communication and intelligence gathering, while simultaneously providing direct support to operators through precision strikes. The conflict in Ukraine has underscored their effectiveness, where cost-efficient FPV platforms have neutralized high-value assets, disrupted logistics, and executed targeted eliminations. This research explores the tactical implications of FPV drone warfare, incorporating a hands-on approach to their construction, testing, and operational employment. Moreover, it will be proposed a solution for integrating the civil society in the support of armed forces, in an effective and secure manner.

Methods and Results: Modern conflicts reveal three key aspects of FPV drone deployment: real-time reconnaissance, decentralized strike capability, and synergy with EW operations. These drones enhance C2 by providing frontline units with live intelligence, executing rapid battlefield

At this point, this is how your quadcopter should look:

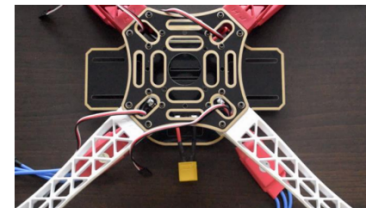


Figure 3. Frame

If the ESCs are soldered correctly, you've followed the color arrangement of the arms, and the screws are tightened, you're about halfway through the steps for the physical connections.

If, by chance, you happen to be missing some screws, 3 will be sufficient, on each side—I've tested this, and for test flights, there were no issues as long as the remaining screws are firmly tightened. There shouldn't be any problems.

Fig. 1: Drone guide

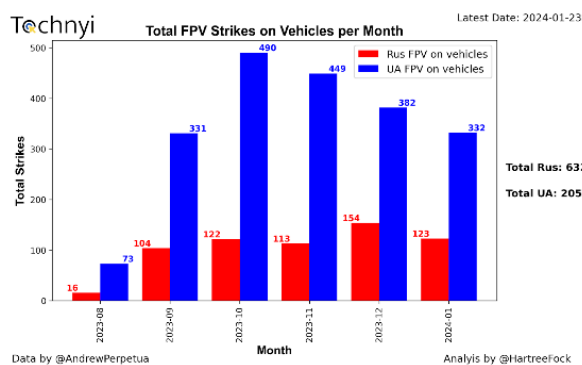


Fig. 2: a) Total FPV strikes on infantry [4]

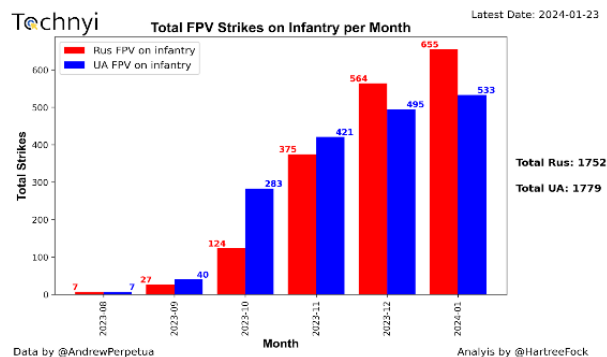


Fig. 2: b) Total FPV strikes on vehicles [4]

assessments, and disrupting adversary sensor networks. In offensive roles, their small radar signature and high-speed maneuverability enable



strikes on armored vehicles, artillery positions, and command posts. Recent battlefield analysis highlights swarm tactics, where multiple drones overwhelm enemy defenses, and integration with AI-driven targeting, increasing autonomy and precision.

Building upon these tactical principles, a prototype combat FPV drone was developed and tested. For battlefield adaptability, the drone utilizes an analog FPV system for low-latency control, though digital transmission enhances resilience against EW countermeasures. Payload integration tests demonstrated effective deployment of explosive ordnance up to 1.5 kg, validating its potential in kamikaze-style attacks or ISR (Intelligence, Surveillance, Reconnaissance) roles.

Field testing confirmed its effectiveness in decentralized operations: real-time intelligence gathering improved situational awareness for ground units, while coordinated FPV strikes successfully neutralized simulated enemy positions. The primary limitation remains vulnerability to jamming, necessitating continued development in signal hardening and AI-based autonomy.

Moreover, beyond analyzing the utility of FPVs in recent conflicts and their effect on the tactical field, I have prepared a blog-style guide on how to build an FPV drone from scratch to a ready-to-fly state, and how to operate it, as can be seen in the fig 1.

This guide aims to instruct any beginner or novice in the field to build their own FPV drone at minimal cost, which in conflict situations can be very useful for mass distribution to the population, making it possible for civil society to support the armed forces without sophisticated knowledge or equipment, in a very efficient and safe manner.

Conclusions: FPV drones represent a transformative element in contemporary military strategy. Their impact extends beyond tactical engagements, influencing broader operational doctrines by integrating seamlessly with modern C2 structures. By refining counter-jamming techniques and advancing AI-assisted flight control, these systems will further enhance force projection and operational effectiveness in hybrid warfare scenarios.

Acknowledgements: Associate professor PhD. Annamaria SARBU.

Keywords: *FPV drones, asymmetric warfare, C2 integration, electronic warfare, precision strikes.*

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6) The Art of War and Strategic Planning

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Introduction: The study of military strategy and the art of war has evolved significantly over centuries, influencing the outcomes of major historical conflicts. Strategic planning is at the heart of military success, guiding decision-making processes in both peacetime preparation and active engagements. This paper explores the core principles of strategic planning within the context of warfare, examining classic doctrines and their application to modern conflicts.



The aim is to assess how theoretical frameworks, particularly from Sun Tzu's *The Art of War*, continue to shape military strategy today.

Methods and Results: To explore the relevance of strategic planning in modern warfare, this study uses both historical case analyses and contemporary military examples. Historical conflicts such as World War II and the Gulf War provide insight into the application of classical strategies in a modern context. Additionally, the research investigates current military doctrines, which integrate principles such as surprise, flexibility, and deception, drawn from *The Art of War*. The results highlight the continued importance of adaptability in strategic planning, with an emphasis on technological advancements and intelligence gathering. Further, modern strategic challenges, such as cyber warfare and asymmetrical conflicts, illustrate the evolving nature of warfare and the adaptability of traditional strategic concepts. This paper concludes that while the methods of warfare change, the core principles of strategic planning remain highly applicable across time periods and technologies.

Conclusions: The core principles of *The Art of War* remain vital to military strategy and planning in the 21st century. The continuous application of strategic planning, emphasizing flexibility, adaptability, and knowledge of the environment, is essential for success in both conventional and unconventional warfare. The paper suggests that modern military leaders can benefit from revisiting these classical strategies to better address the complexities of contemporary warfare.

Acknowledgements: The authors would like to thank the Military Studies Department for their guidance and the Faculty of Strategic Studies for their ongoing support during the research process.

Keywords: *Strategic Planning, Military Strategy, The Art of War, Sun Tzu, Modern Warfare, Tactical Operations.*

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7) Consideration Regarding the Evolution of Tanks in the Current Tactical Field

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Abstract: The modernizations made to tanks in order to counter modern anti-tank weapons in the actual military context. We will analyze the influence of modern anti-tank weapons against modernized and non-modernized tanks, each individual modernization solution, every improvisation and their tactical effect. Through this research, we aim to identify the best modernization equipment, to increase the survival rate of tanks in modern battlefields and the eventual weak points of tanks. Moreover by identifying this weak points we can improve the survival rate of our own tanks in the Romanian Army.

Acknowledgements: I wish to express my sincere appreciation to *COL (ret) Assoc.Prof. Dumitru RADU*, for the guidance and support throughout the research process..

Keywords: *tank, anti-tank weapon, modernization.*

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8) Implementation of Real-World Maps in MR Applications for Unreal Engine and HoloLens 2

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Introduction: In order to classify the terrain's passability for the military purposes, cartographic studies are used to facilitate soldiers' orientation in the field [1]. As the technology advances, paper maps are being replaced by their interactive versions, allowing for faster data updates and integration with modern systems, including those used for military training [2], [3]. The development of technologies such as virtual reality (VR), augmented reality (AR), and mixed reality (MR) – also referred as extended reality (XR) [4] – enables the evolution of tools that redefine the maps' utilisation. An example of a civilian solution is an AR tool designed by Google, which, tracks the user's location and displays in real-time navigation directions to a given destination based on collected data [5]. A military example of map implementation in XR systems is the "Horus Eye Concept," developed as part of the Tactical Assault-Shooting Drill Simulator (TAD). It focuses on aggregating battlefield intelligence and generating operational images using HoloLens 2 glasses [6]. During the development of the concept of a MR-based military trainer for combating hostile unmanned aerial vehicles (UAVs), the authors of the abstract observed that a key element would be the implementation of real-world maps into the virtual environment generated using Unreal Engine. The system is designed to fulfil the requirements for creating a realistic training environment that improves soldiers' skills in countering UAVs.

Methods and Results: One of the key elements of the trainer concept development is the design of the system allowing for terrain orientation. The concept assumes geolocation data acquisition, virtual to real coordinates conversion and data display on the trainee's nearest environment real-world map. During the initial phases of the concept development the usage of built-in Unreal Engine tools was assumed. Because of the lack of geolocation measurement possibilities via HoloLens 2, and consequently the lack of support for any geolocation data processing tools, plugins implementation was considered. However, among publicly available solutions none were found designed for the problem specified by the authors. An attempt was made to generate real-world maps as separate web application due to numerous tools and reliable support of various geolocation data processing services. Nevertheless, this did not provide complete solution on map display on HoloLens 2. The tests were conducted using Web Browser plugin designed for webpages rendering directly in Unreal Engine applications. Web Browser allows to embed in the engine a web application located on the external server, local disk space or written directly into the Unreal Engine application's code. However, it has been established that Web Browser plugin does not support modern HyperText Markup Language (HTML)

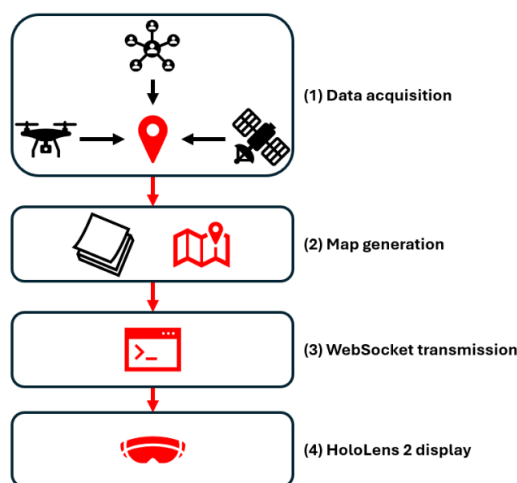


Fig. 2: Map implementation concept

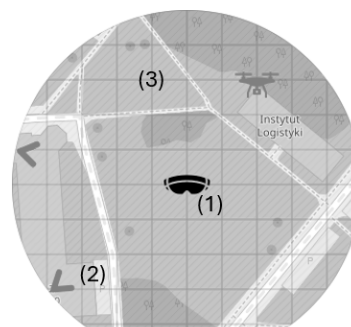


Fig. 1: Practical map implementation



stand ard, especially the “canvas” element – the key component of the system’s performance. As a result, the authors opted for the final concept presented in Fig. 1. Web application is designed to generate real-world map (2) based on gathered coordinates (1), subsequently an application’s screenshot is captured, which is converted to text message and sent to Unreal Engine application via WebSocket protocol (3). Engine application after decoding the text message to image, displays it on the glasses (4). Fig. 2. presents the concept’s practical implementation. Around the system’s user marker (1) there are another objects’ markers or arrows (2) indicating the direction of given object location, when object itself is located outside the area displayed on the map. A coordinates grid layer (3) is overlayed on the map, enabling easier and faster location report.

Conclusions: The implementation of real-world maps in MR-based applications developed using the Unreal Engine is an innovative solution that enables broad applications in projects where knowledge of one's geographic location is crucial. The use of the Leaflet.js library allows for the implementation of various map’s tile providers, such as Google Maps or Mapbox, depending on the needs of the system user. The minimap should be designed to be as intuitive and easy to read as possible for the user, within the assumptions of the concept. The use of indicators allows for the inclusion of all markers, even those outside the default view area, eliminating the need for manual map scaling. Providing coordinates and accurately determining position on a virtual battlefield that mirrors real-world conditions increases the efficiency of collaboration among the trainees.

Acknowledgements: The authors would like to thank Ms. Natalia Daniel, M.Sc. Eng., for the introduction to the world of science, over a year of collaboration, guidance, and hundreds of valuable insights and recommendations.

Keywords: *maps, Unreal Engine, MR, military training, land navigation, HoloLens*
2.

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9) Military Applications of An Exoskeleton

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Introduction: Tremendous technological progress has an impact on every aspect of human life. We live in an era where words like innovation, artificial intelligence, and smart technology describe not a vision of the future but a harsh reality indeed. These changes make the military and the medicine one of those institutions that must modernize daily. Today,





weapons are becoming smaller and more compatible, so the number of weapons in a soldier's backpack is increasing, which may cause some difficulties for the load transportation system of military personnel. [10] This requires an innovative solution – the so called “exoskeleton”.

Methods and Results: Using specific keyword combinations from various well-known scientific portals, this research applies the methodology of literature analysis in order to explore and summarize the different types of exoskeletons and their applications in the military and healthcare. For that we summed up information from over 10 sources from PubMed, Web of Science and NIH-National Library of medicine using 7 different keyword combinations.

An exoskeleton is a wearable device that improves the wearer's physical capabilities by reducing the stress mainly on the musculoskeletal system but also on many other systems as well. [10] Its main function is to support the user's structure when holding or manipulating a load and prevent excessive force from being concentrated in areas such as the hips, shoulders, knees, back, legs, etc. The development of exoskeletons and exosuits focuses on achieving more natural movements, reducing the equipment to a more superficial structure, and achieving lower energy consumption operation to extend its autonomy. Their prototypes have been developed by multiple countries with the United States, Russia, Israel, China, and South Korea dominating. [1]

There are many classifications of exoskeletons, but those used in the military can be divided into the following categories: Full body military exoskeletons; Lower body powered military exoskeletons; Passive military exoskeletons and fixed military exoskeletons. [1]

The use of human exoskeletons has led to the so-called human-machine system. The degree to which the machine parts help the individual is determined by measuring changes in 3 physiological signals. This is done by using the following methods: indirect calorimetry, electrocardiogram and foot contact force. The data is analyzed and optimized by the Bayesian optimization module. [2], [3]

There are many tasks in the military that can be facilitated and improved using developed exoskeletons, and almost all of them fall into one of these categories, including lifting and carrying heavy objects, improving movement and mobility, or certain combat tasks. One of the possible military applications of this innovation is for the Army supply specialist, who needs to organize supplies and continuously carry 50 to 100 pounds of items at military bases. Another field of application is the infantry - soldiers must act as members of fire teams during exercises and battles and help mobilize vehicles, troops and weapons, which also requires the maintenance and storage of weapons and ammunition. This job requires a lot of movement as well as heavy lifting, which is perfect for the use of lower body exoskeletons, allowing the upper body to rotate freely and remain stable during combat or marching on uneven terrain. [4], [8]

Heavy lifting can refer not only to weapons and ammunition, but also to carrying body weight. Evacuating the wounded in the „golden” hour is crucial for military medics. This also applies to those responsible for transporting soldiers. Exoskeletons will help them lift heavier colleagues while maintaining stability and speed. [4], [8]

This innovation can also be used in medical operations and Role 2 nursing aids [9], especially static exoskeletons, as it allows medics to maintain a high level of work for a long time. [5], [7] For example - a passive exoskeleton can hold the posture of the surgeon, reduce the tremors and increase work efficiency and durability. [6]

Finally, different types of exoskeletons have been used as various prosthetics and rehabilitation devices for deployed and injured soldiers. [10] This allows them to preserve their spirits and provides them with the possibility of an almost normal life after the battle is over.



The analysis revealed that a large number of articles supported the argument that exoskeletons could be of great help to soldiers and medical personnel both on and off the battlefield.

Conclusions: The use of exoskeletons and exoskeleton suits can ensure significant improvement to the abilities of soldiers by giving them strength, endurance, better protection, better accuracy, and enhanced stability. This allows them to carry and move heavy objects, prevent injuries and enhance the deployment and the rehabilitation of injured soldiers. It also makes marching on uneven terrain easier. Exoskeletons can help medics and rescue teams not only during medical evacuations on the battlefield, but also in rescue operations in the aftermath of natural disasters, man-made disasters and terrorist attacks. The successful implementation of this innovation can improve the performance of military medics in both Role 1 and Role 2.

Acknowledgements: Ch. Asst. Anna Karadencheva, PhD.

Keywords: *exoskeleton, innovation, military healthcare, medicine.*

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10) Study about Physical Activity and Eating Preferences of Cadets in Nikola Vaptsarov Naval Academy

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Introduction: Humans need continuous periodic food intake [6] which is necessary for maintaining the vital functions of the body. Food that contains the essential nutrients in sufficient proportions is a basic physiological need. Therefore, it is of particular importance to study the dietary habits of young people in relation to their lifestyle and activity. The purpose



of this study is to present data on the dietary preferences and physical activity of cadets from Nikola Vaptsarov Naval Academy.

Methods and Results: The study involves 129 cadets, including men and women aged 18-24 from various specializations. The object of study is the formed eating habits of students in the academy. The subject of the study is the influence of the military environment on the formation of physical activity and nutrition among cadets. The main tasks set out in the study are: study of physical activity among cadets in the scheduled daily sports activities and sports classes, collection of data on the diet and conducting questionnaires with the students. The survey begins with a passport part. The methods used are: IPAQ 7 questionnaire of the WHO and questionnaire [4] related to food preferences. Both are distributed via the Google Forms platform. The information obtained regarding the structured lifestyle, workload and diet serves as the basis for the analysis of the subjective perception of the level of physical activity and eating habits. The data from the conducted questionnaires indicates that 91% of trainees have a high level of physical activity. Objective data related to the physical training of future officers was obtained by reviewing the daily program and curriculum. The analysis outlines the following trend - established motor habits with an active movement time of 7 hours a day and a good culture regarding healthy eating and lifestyle.

Conclusions: The data presents current trends in the diet and physical activity of the cadets and their preferences. The conclusions indicate the positive influence of the military environment and lifestyle on creating a healthy daily routine. The summarized results can be used to compare the food consumption and physical activity level among cadets from different military academies, specialties and countries.

Acknowledgements: Prof. Dimitar Stavrev, MD, PhD, DSc ; Rositsa Nedeva, PhD.

Keywords: *Questionnaire, Diet, Habits, Cadets, Military, Physical activity.*

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11) Military Application of Da Vinci Robotics in Surgery , "Nikola Vaptsarov" Naval Academy, Varna Bulgaria

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Introduction: The integration of robotic-assisted surgical systems, particularly the DaVinci platform, has revolutionized modern surgical practices around the world. First robotic surgery was a concept of the armed forces. In recent years we are starting to see wide adoption of robotic-assisted surgery, not only in civil but in military hospitals, because robotic systems enable minimally invasive surgeries, which are beneficial due to reduced trauma, faster recovery times, and the ability to perform complex procedures with high precision. The

Bundeswehr [4], for instance, currently uses telemedical service and tries to digitalize its medical treatment.

Methods and Results: The materials and methods of the study consist of data processing from scientific journals and studies on the topic from 2020 to 2025 with focus on use of robotic surgery in military hospitals.

The limiting factor right now for treating injured soldiers is the availability of skilled surgeons to attend casualties. Life-saving operations on soldiers in combat zones could become possible thanks to a portable robotic surgeon that allows doctors to perform surgery on the battlefield without endangering themselves, therefore reducing NATO role 5 and 4 to role 2.

Conclusions: In conclusion, this report determines that robotic surgery has not yet achieved the required technical and logistical advancements to be effectively integrated into emergency medical care on the battlefield at NATO Role 2 and above [3,6]. While robotic surgery has demonstrated its applicability in major medical centers by minimizing surgical trauma and significantly reducing postoperative recovery time, its implementation in austere and high-intensity environments remains challenging. Nevertheless [5], substantial progress in the field is expected in the coming years, which may facilitate the successful integration of robotic surgery into military surgery.

Acknowledgements: First surgery clinic – Sv. Marina Hospital, Varna, Bulgaria.

Keywords: *DaVinci Xi system, Robotic surgery, Military medicine, Military surgery.*

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Fig. 1: DaVinci setup in Sv. Marina hospital

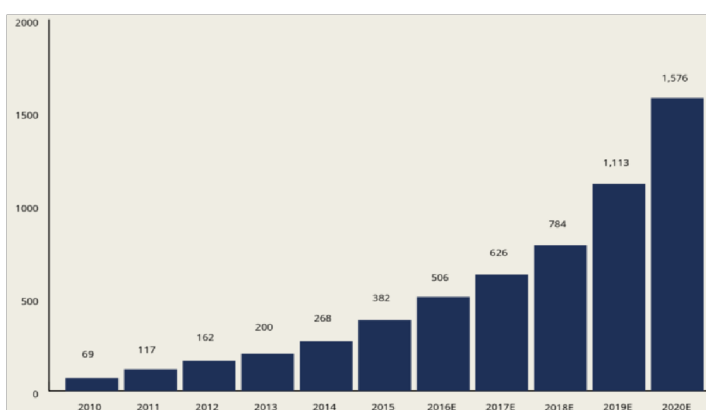


Fig. 2: Growth of installed surgical robots worldwide [2]



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12) Non-Surgical Debridement Of Burned Wounds in Mechanized Warfare: Innovations and Strategic Applications in Military Medicine

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Introduction: Burn injuries are a critical concern in mechanized warfare, where fuel-based explosions, incendiary weapons and vehicular fires contribute to a high incidence of thermal trauma among soldiers. Unlike conventional battlefield injuries, burns cause extensive tissue necrosis, prolonged inflammation and a heightened risk of infection, making them particularly difficult to manage in combat conditions. During World War II, the extensive use of armored vehicles, aircraft and fuel-based weaponry led to high rates of third and fourth degree burns, particularly among tank crews exposed to fuel combustions, pilots trapped in cockpit fires and naval personnel involved in ship explosions. The lack of effective field treatments resulted in high mortality rates due to septic complications and delayed evacuation.

Given the challenge of performing surgical debridement on the battlefield, there was an urgent need for a non-surgical alternative capable of removing necrotic tissue while preventing infection and accelerate recovery. One of the most promising solutions was the use of enzymatic debridement, particularly papain-based dressings, which offered a portable, efficient and easily applied treatment. This study explores the biomedical proprieties, application methods, and advantages of using papain, urea and chitosan dressings for burn wound management in military settings.

Methods and Results: The development of an effective battlefield debridement dressing requires a combination of enzymatic agents, antimicrobial compounds and structural materials designed to:

Rapidly break down necrotic tissue while preserving viable structures, prevent bacterial colonization, reducing the risk of infection-related complications maintain wound hydration and promote faster healing be easily stored, transported and applied under combat conditions.

The main substance of the solution that is used in necrotic tissue removal is papain, a cysteine protease enzyme derived from papaya (*Carica papaya*), widely recognized for its ability to hydrolyze denatured proteins without damaging healthy tissues. This selective enzymatic actions makes papain particularly valuable for non-surgical debridement as it removes necrotic eschar reducing the need for scalpel-based excision, it speeds up natural wound healing processes by promoting autolytic debridement and minimizes pain and trauma as it does not require mechanical scraping. In broader medical applications, papain is used in the treatment of chronic ulcers, diabetic foot wounds, pressure sores and burn injuries providing its clinical efficiency beyond military use.

The next substances are 1) *Urea*, 2) *Chitosan*, 3) *Antimicrobial agents*:

- 1) Urea plays a synergistic role by enhancing papain activity, it disrupts hydrogen bonds in necrotic proteins, making them more accessible for enzymatic breakdowns and it prevents wound desiccation, it acts as a natural humectant, ensuring that the wound remains moist and conducive to cell regeneration. In dermatology, urea-based formulations are used to treat xerotic skin conditions, keratolytic disorders and eschar-associated wounds reinforcing its biomedical versatility.



- 2) Chitosan is a hemostatic, antimicrobial and wound-healing agent, a biopolymer derived from chitin contributes to the dressing's effectiveness by accelerating clot formation, reducing blood loss in burn wounds, acting as a natural antimicrobial,
- 3) disrupting bacterial cell walls and inhibiting infection and it is stimulating fibroblast proliferation, enhancing granulation tissue formation and promoting faster re-epithelization. Chitosan is widely utilized in bio surgical applications, wound dressings and hemostatic bandages, making it an essential component for military first-aid treatments.
- 4) Antimicrobial agents are incorporated in the dressing to address burn wound susceptibility to bacterial infections. We can use silver nanoparticles (AgNPs) – known for their potent bacterial actions, they disrupt microbial DNA and respiration, reducing biofilm formation or polyhexanide (PHMB) – a synthetic broad-spectrum antimicrobial, effective against gram-positive and gram-negative bacteria, significantly lowering the risk of post-burn sepsis. These compounds enhance burn wound sterilization without the need for systemic antibiotics, a critical advantage in combat conditions where antibiotic supply may be limited.

The dressing is designed using a biodegradable absorbent fabric infused with active compounds offering:

1. Sterile vacuum-sealed storage ensuring long-term usability in field operations
2. Lightweight and flexible material allowing easy application over various sites.

Compatibility with secondary dressings, enabling further protection using gauze or bandages.

Results: Papain-based dressing achieved necrotic tissue breakdown within 6-12 hours accelerating wound clearance, infection rates were reduced by over 50% due to silver nanoparticles and PHMB and 85% of soldiers successfully applied the dressing independently proving its usability under stress.

Conclusions: Enzymatic debridement presents a critical advantage in military burn care, offering a rapid, effective and easily deployable solution for managing necrotic tissue and preventing infection in combat settings. Its ability to reduce surgical dependence makes it particularly valuable in scenarios where evacuation is delayed or medical resources are scarce. The vacuum-sealed dressing ensures that the soldiers and medics can apply treatment quickly, enhancing both survivability and operational readiness. Beyond burns, the technology holds potential for broader wound management applications, including blast injuries and chemical burns further strengthening its role in modern battlefield medicine. Continued research should focus on enhancing stability, optimizing enzyme formulations and integrating it into comprehensive trauma care protocols, ensuring its effectiveness across diverse and extreme military environments.

Acknowledgements: MD, PhDc Assistant Lecturer Petrescu Andrei.

Keywords: *Burn injuries, surgical debridement, papain, first-aid treatments, necrotic tissue.*

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14. GEOPOLITICS AND MILITARY HISTORY

1) The Formation of the “Axis of Upheaval” in the Context of Weapons Proliferation

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Introduction: Over the years, the formation of numerous alliances worldwide has been observed, each contributing to various political and economic shifts on the international stage. However, due to recent turmoil in the Middle East and Eastern Europe, the statement that not only alliances but also coalitions and axes of countries have the most significant impact on geopolitics would not be merely an assumption.

Methods and Results: The formation of the “Axis of Upheaval,” which refers to the cooperation between China, Iran, North Korea, and Russia, was already perceived in the late 1980s. Nevertheless, the development of the Russian-Ukrainian war has catalyzed cooperation among these countries. Due to the sanctions imposed on Russia by the European Union, these countries have strengthened their commercial ties, trading not only gas and oil but also advanced technology and weapons. The main focus of this paper is the proliferation of weapons among the “Axis of Upheaval” countries.

In early 2022, a joint agreement between China and Russia was signed, calling for “international relations of a new type,” which practically is an attempt to undermine the dominance of the United States and establish a new international order. Particular emphasis should be placed on Iran providing unmanned aerial vehicles to Russia for use in Ukraine, as well as China aiding Russia by exporting various materials, including machine tools for tanks, propellants for missiles, intermediary goods used in producing gunpowder, explosives, and turbojet engines. Moreover, it has been reported that China provides geospatial intelligence, while North Korea supplies weapons for testing and ballistic missiles.

Conclusions: Although weapons proliferation among collaborating countries is not an unusual occurrence, the Axis of Upheaval appears to be diminishing the effectiveness of foreign policies imposed by the European Union and the United States, thereby contributing to the establishment of a new international order.

This paper attempts to emphasize the scale of the weapons proliferation among the Axis of Upheaval countries and how it has enabled Russia, Iran and North Korea to maintain their military potential.

Keywords: *Axis of Upheaval, weapons proliferation, sanctions, policy.*

2) Strengthening Peace, Security, and Prosperity: The Role of a Recent UN or Multilateral Operation

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Abstract: Since our emergence, the peace of world order was replaced by civil or global wars. Therefore, people were feared and wanted these things to change. For this to happen, the people created the United Nations, an ethical path to establish the protection of the population. All the 193 countries who take part in this try to maintain peace and security on a lively planet. UN succeed, over time, to create a powerful organization that helps people to progress. In other words, this organization builds the world we desire. The multilateral operations, supervised by the UN were affected by the pandemic, Coronavirus. Also, the wars that have taken place





recently, as well as other crises that have affected a large part of the population, have prompted the United Nations to take a stand and advocate for peace. This article shows the advantages and progress of this organization, to spotlight the importance of keeping this world on good terms.

Acknowledgements: Colonel Băncilă Mihail.

Keywords: *peace, equality, protection, prosperity, improvement.*

3) Winds of Change: The Lasting Imprint of the Vietnam War on Air Force Tactics, Strategies and Technology

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Introduction: A paradigmatic transformation in tactics, techniques, and technology resulted from a seismic shift in air force dynamics that occurred in the crucible of the Vietnam War (1955–1975). With great care, "Winds of Change: The Lasting Imprint of the Vietnam War on Air Force Tactics, Strategies and Technology" delves into this revolutionary period and reveals the tremendous effects lasting up to present-day wars and ongoing conflicts.

Methods and Results: This article traces the development of air force tactics across time, beginning with the early 1960s and the dominance of conventional dogfights. Operation Rolling Thunder (1965–1968) was a critical turning point in the tactical environment as persistent bombing campaigns forced a reevaluation of tactics. As a result, tactics became more subtle and asymmetric, reflecting the difficulties presented by the hostile terrain and elusive opponent, as demonstrated by operations such as Operation Bolo (1967), in which air forces were able to defeat North Vietnamese MiG aircraft by using deceitful tactics.

During this time, technological advancements also flourished simultaneously. Design and avionics advances were demonstrated with the advent of aircraft such as the F-4 Phantom II and the A-7 Corsair II. Systems for electronic warfare, most famously the Wild Weasel missions (1965–1973), demonstrated how technology could be integrated to overcome enemy air defenses.

The use of precision-guided weapons as the war went on, most demonstrated by the accomplishments of Operation Linebacker (1972), highlighted the development of air force capabilities. This article skillfully traverses the historical terrain to offer a comprehensive picture of how the Vietnam War turned into a testing ground for tactical and technological innovations, permanently altering air force doctrine in the process. "Winds of Change" allows readers to navigate through the histories of war, exposing the entwined tales of dates, incidents, and their lasting effects on the trajectory of modern air power.

Conclusions: This article succeeds in highlighting the events through which the Vietnam War revolutionized air power, including helicopter warfare, shaping modern military operations. Helicopters enabled rapid troop deployment, medical evacuations, and air assaults, tactics later refined in conflicts like the Gulf War and Afghanistan. Precision bombing strategies, seen in Linebacker II, paved the way for today's drone warfare, emphasizing targeted strikes with minimal risk to personnel. By examining these innovations, this article underscores the Vietnam War's lasting influence on contemporary warfare, demonstrating the continued need for adaptability, technological advancements, and air dominance in addressing modern military challenges.

Acknowledgements: *COL(AF.ret.)Assoc.Prof. Jănel TĂNASE, PhD -AFA"HC"*
Braşov.



Keywords: *Vietnam War; Air Force Evolution; Tactical Innovations; Technological Advancements; Asymmetric Warfare.*

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4) Considerations Regarding the Influence of the Tank on Combat Operations

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Introduction: The tank is one of the most influential military innovations, significantly impacting tactics and battle strategies from its introduction in World War I to the present day. This study analyzes the role of the tank in the evolution of military doctrines, highlighting both its operational advantages and vulnerabilities in modern combat scenarios.

Methods and Results: The research methodology is based on a comparative analysis of tank usage in major historical conflicts, from the German Blitzkrieg to recent wars in the Middle East. Additionally, the study examines the implications of recent technological developments, such as reactive armor, active protection systems, and the integration of artificial intelligence in armored vehicles.

The results indicate that, while the tank remains a key element of land warfare, its effectiveness depends on continuous adaptation to emerging threats, including advanced anti-tank weapons and hybrid warfare. The study concludes that the future of tanks will be shaped by digitalization, battlefield connectivity, and integration with drones and autonomous systems.

Conclusions: The analysis of the tank's influence on combat operations highlights its crucial role in modern warfare, as well as the challenges posed by the evolution of anti-tank weaponry and new military technologies. Despite its vulnerabilities, the tank continues to be a central component of ground operations, adapting through technological advancements such as active protection systems, artificial intelligence, and digital battle networks. The future of tank warfare will depend on the ability of nations to modernize and effectively integrate tanks into combined strategies alongside autonomous and aerial combat systems.

Acknowledgements: COL (ret) Assoc.Prof. Dumitru RADU.

Keywords: *tanks, military tactics, technological evolution, modern warfare, defense strategy.*

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5) An Analysis on a Possible Second Cold War

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Introduction: Considering current global events we can clearly see multiple similarities to the events of the Cold War . In this project I will present evidence suggesting the existence of a Second Cold War or whether the first one even end at all.

Methods and Results: There is a certain hypothesis that history repeats itself and a saying that "Those who didn't learn their history are doomed to repeat it" . Analyzing this last sentence actually reveals that history doesn't repeat itself but the mistakes people make , and not learning from your mistakes will force you to commit those mistakes again . We can apply this theory to current events as we compare them to events from last century and see what changed and what is the same . How political propaganda tactics and mass influence changed or if people are still easy to be persuaded or not . We'll have a look into whether proxy wars from last decade thought major military powers anything or nothing at all and how much do these conflicts weigh and affect the rest of the globe . At the end of this presentation we must obtain an idea over the state of global conflict between the military superpowers.

Conclusions: The Cold War either never ended or it did but there is another one starting if a second isn't already taking place and we can see that very clearly by repetition of events from the last century such as proxy wars , nuclear threats and rise of extremist political parties.

Acknowledgements: Col. BĂNCILĂ.

Keywords: *Cold War , proxy, propaganda , history , events , influence.*

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6) The International Politics Of Totalitarian Regimes: Expansion, Alliances And Global Impact

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Introduction: The totalitarian regimes of the 20th century had a profound impact on international relations, creating a world order marked by ideological confrontations, aggressive expansion, and strategic alliances driven by power interests. These regimes were characterized by the total centralization of authority, the use of propaganda for mobilization, and the justification of external aggression through radical ideologies, which led to a redefinition of diplomacy and conflict mechanisms on a global level.

This paper aims to examine the factors that contributed to the rise of totalitarian regimes, their foreign policy strategies, and the long-term effects on global order, through a comparative analysis of Nazi Germany, Fascist Italy, and the Soviet Union.

Methods and Results: The first part of the analysis focuses on the political, economic, and social context that facilitated the ascent of totalitarian regimes, highlighting the consequences of the First World War, the influence of the Treaty of Versailles, the Great Depression of 1929, and the instability of interwar democracies. To analyze how these regimes came to power, events such as the Beer Hall Putsch (1923) and the March on Rome (1922) will be examined, emphasizing the distinctions between violent and symbolic strategies used in the consolidation of totalitarian power.

The second part focuses on the foreign policy of totalitarian regimes, investigating how they resorted to aggressive diplomacy, the formation of strategic alliances, and the use of



international propaganda to fulfill their expansionist goals. The following will be analyzed: the Molotov-Ribbentrop Pact, involvement in the Spanish Civil War, aggressive diplomacy and territorial annexations such as the Anschluss, the occupation of the Sudetenland, and Soviet expansion in Eastern Europe.

Special attention will be given to the interactions between totalitarian states and Western democracies, emphasizing how appeasement policies facilitated the expansion of these regimes and indirectly contributed to the outbreak of the Second World War. The paper will also examine the transition of these regimes from strategic cooperation to open confrontation, highlighting the differences between Germany, Italy, and the Soviet Union in terms of geopolitical objectives and alliance strategies.

The final part of the paper explores the impact of totalitarian regimes on current international relations, showing how their strategies contributed to the division of Europe during the Cold War. It will also discuss the formation of international organizations meant to prevent similar conflicts (such as the UN, NATO, and the EU)

Conclusions: The rise of totalitarian regimes was closely tied to political instability, social fragmentation, and the collapse of democratic safeguards. Analyzing their ideological narratives and foreign policies allows for a deeper understanding of how authoritarianism takes root. These historical patterns remain relevant today, offering a cautionary lesson: the preservation of democratic institutions and civic vigilance are essential to preventing the resurgence of authoritarian rule.

Keywords: *dictatorship, political repression, totalitarianism, propaganda.*

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7) Operation Overlord

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Abstract: The Normandy landings on June 6, 1944, were a decisive event in World War II, marking the beginning of the Allied liberation of Western Europe. This large-scale military operation, part of Operation Overlord, aimed to open a second front in Europe and accelerate the defeat of Nazi Germany. Normandy was chosen as the landing site due to strategic advantages over other potential locations.

Methods and Results: To ensure the success of the landings, the Allies executed extensive deception, training, and logistical planning. Operation Bodyguard misled the Germans regarding the date and location of the attack, while large-scale training exercises prepared troops for combat.



The invasion required precise weather conditions, leading to a one-day delay. Despite strong German fortifications along the Atlantic Wall, Allied forces successfully landed on five beaches—Gold, Juno, Sword, Utah, and Omaha—securing a crucial foothold in France. Although Omaha Beach saw the heaviest casualties, the overall operation was a success, leading to rapid Allied advances.

D-Day was a pivotal moment in World War II, enabling the Allies to establish a foothold in France. By the end of August 1944, over 2,000,000 Allied troops had landed, leading to Germany's eventual defeat in May 1945. The success of Operation Overlord significantly weakened German defenses and forced them to fight on multiple fronts, hastening the war's end.

Acknowledgements: This document acknowledges the bravery and sacrifices of the soldiers who participated in the Normandy landings. Their efforts played a crucial role in securing freedom in Europe. Additionally, recognition is given to the strategic planning of Allied military leaders, whose coordination ensured the operation's success.

Keywords: *landings, Allies, beaches, front, World War II.*

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*Fig. 1. Omaha Beach,
Normandy*

8) The History and Evolution of Military Public Order and National Security Forces in Romania

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Introduction: Romania's historical, political, and social changes are reflected in the development of its military public order and national security systems. Romania's security institutions have consistently adjusted to new threats, starting with the Panduri, who were irregular military forces that upheld law and order in the early 19th century, and continuing with the current „Brigada Specială de Intervenție a Jandarmeriei”(en: Gendarmerie Special Brigade of Intervention), BSIJ for short, as the top tier special military unit of Ministry of Internal Affairs.

Methods and Results: The article focuses on revealing the evolution of Romania's public order forces over time, based on researching different normative acts issued by the authorities and acknowledged how these changes influenced the organisational and functional structure of the current time public order and national security organisations in Romania.

The Romanian Gendarmerie and Police was a key component in preserving rural security during the 19th and early 20th centuries, when law enforcement was a hybrid system combining both military and civilian forces. While the communist era saw a highly militarized internal security system, the interwar years saw attempts to modernize law enforcement through legal reforms. After the 1989 Revolution, Romania transitioned to a democratic structure, leading to the reformation of police and gendarmerie.

The analysis provides insight into the organizational, legal, and functional transformations of this history, underscoring the delicate balancing act between internal order



and public response to emergent security challenges. Formed during the early 19th century in Wallachia, the Panduri were some of the earliest organized efforts for internal security and public order; they carried out their activities as a militia. Their action was very important from the perspective of stabilizing the situation during political unrest.

The second half of the 19th century saw many reforms under the reign of Alexandru Ioan Cuza. These reforms brought about the professionalization of military public order forces, with the structured design of gendarmerie-type units modeled on those within Europe, using modern thinking in terms of the law state and internal security problems.

The interwar period saw stable progress in the direction of the creation of regional departments across Romania and the articulation of a legal basis by which to execute its functions. Still, in the period of communism, the military public order structures were thoroughly politicized structures. After 1989, when communism was finally overthrown, reforms were initiated within the Romanian security and public order systems, designed with a broad frame: depoliticization, modernization, and incorporation into European Union standards.

Within this setting, during 1999, the establishment of the BSIJ as a specialized unit marked a new state in this coherent evolution. It constitutes such a specialized, refined, and professionalized end within the Romanian framework of national security. BSIJ combats terrorism, high-risk interventions, and public order maintenance in critical arrangements. The historical journey presented in the article shows the dynamics of military forces of public order, a complicated and painful history that takes on admirably into the new national security structure.

Conclusions: The article reveals the evolution of public order forces over the past two centuries in Romania, the changes of different military structures of national security, explaining how these changes have acted under different regimes and how they influences our perspective over the role and attributes these military forces have in our society.

Keywords: *public order, national security, military forces history, special forces, police evolution.*

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9) Poland in the Face of Great Powers: Expansion, War, and Survival

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Introduction: Throughout its history, Poland has undergone periods of profound transformation, influenced by geopolitical and military factors that shaped its destiny. The Polish-Lithuanian Union (1569-1795) and the second World War (1939-1945) represent two





defining moments, characterized by expansion, armed conflicts and major territorial changes. The analysis of these periods is essential to understanding how Poland navigated through external challenges, and how its defense strategies influenced the evolution of the state.

Methods and Results: This research explores how the lessons of the past have been integrated into Poland's political and military decisions, highlighting the continuities and transformations in the strategic thinking of the Polish state. These analyzes are fundamental to understanding how Poland has navigated through two essential historical periods, facing major geopolitical and military challenges. In a landscape marked by the expansion of the great European powers, the alliance and defense strategies developed during the Polish-Lithuanian Union influenced how Poland reacted to 20th-century threats, including the Nazi and Soviet invasion. The study of these historical periods provides an insight into the continuities and transformations in Poland's foreign policy and military doctrine, highlighting the lessons applicable in the current geopolitical context, characterized by strategic reconfigurations and emerging risks.

Chapter I: The Polish-Lithuanian Union (1569-1795) – The Age of glory

In the late medieval period and the beginning of the modern era, the Polish-Lithuanian Union (1569-1795) stood out as one of the greatest and most influential powers of Europe. It was a unique alliance between the Kingdom of Poland and the Grand Duchy of Lithuania, also known as the Union of Lublin. [1] Through this union, the two states were integrated into a federation with a distinct political system, known as the Golden Freedom, having a major impact on European geopolitics, opposing the expansion of the Ottoman Empire [2], Russia and Sweden. Its innovative political structure—based on an elected monarch and a highly influential nobility—brought it both success and vulnerability.

This study examines the rise, apogee and decline of the Polish-Lithuanian Commonwealth.

Chapter II: World War II (1939-1945) – Poland between Hitler and Stalin

On September 1, 1939, Nazi Germany invaded Poland, triggering a devastating global conflict known as World War II. On September 17, the Soviet Union attacked Poland from the east, following the secret Ribbentrop-Molotov Pact. [3] Surrounded by two powerful enemies, Poland was divided into two, forcing the government to exile itself. Despite this, Poland did not stop fighting. Having the most active resistance movement in Europe at the time, it culminated in the Warsaw Uprising of 1944.

Chapter III:

Comparing the two periods, a striking contrast is revealed between the glory of the Polish-Lithuanian Union and the tragedy of Poland in World War II. In both cases, Poland was caught between the great powers and suffered from the lack of a centralized defense system. However, the nation has demonstrated remarkable resilience, and the struggle for freedom and sovereignty has remained constant.

The Polish-Lithuanian Union was an era of peak, with Poland being a great European power with a single political system and a strong army. During the war, Poland was invaded and divided between Germany and the Soviet Union, losing its independence and suffering devastating losses. [4]

At that time, Poland had a powerful nobility and an effective defense system. In contrast, in World War II, although it put up notable resistance, Poland was subject to the will of the two great powers.

Conclusions: In conclusion, the comparison between the Polish-Lithuanian Union and Poland in World War II reveals two crucial periods in the history of this nation. The Polish-Lithuanian Commonwealth, at its height, was a beacon of power and influence in Europe, with a feared army and strong political autonomy. [5] However, internal instability and external



pressures have broken its unity, leading to the collapse of this great nation. In opposition to Poland in World War II, where it was quickly crushed and divided between Nazi Germany and the Soviet Union [6], losing its independence and sovereignty. Although it led to heroic resistance, Poland was forced to submit to the will of the two great powers. After the war, its status as a satellite state of the Soviet Union highlighted the continuing difficulties in maintaining an autonomous national identity. These two periods illustrate the fragility of Poland, caught between dominant forces and engaged in a continuous struggle to preserve its dignity and independence.

Acknowledgements: Lect. Univ. Dr. SOPON Diana-Anelisse.

Keywords: *Geopolitical dynamics, transnational conflicts, strategic tactics, fragile sovereignty, territorial reconfigurations, historical and political interdependence.*

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10) The Main Differences Between Western and Russian Military Strategy and Doctrine

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Introduction: Military strategy is often considered to be the centerpiece of military science. It studies the specifics of planning for armed conflicts, engaging in combat, and attempts to reduce these many factors to a set of principles that govern all the interactions on the battlefield. Two major strategic systems prevail on the planet today, which may be described as the "Western" system, and the "Russian" system. Each system reflects and supports strengths and weaknesses in the underlying society.

Methods and Results: A few names stood out in history, influencing military strategies through their work and studies. The father of Western modern strategic studies, Carl von Clausewitz (1780– 1831), defined military strategy as "the employment of battles to gain the end of war" in his essay "Principles of War". These principles have been influential in developing the military approach to combat in the North Atlantic region.

At the opposite side of the world Sun Tzu (544–496 BC) is often considered as the father of Eastern military strategy, which differs from the Western by focusing more on asymmetric warfare (conflict in which belligerents' resources are uneven) and deception. "The Art of War" by Sun Tzu grew in popularity and saw practical use in Western society as well.

Based on different principles, both Western and Russian military doctrines have their unique approach to the modern art of war, with each doctrine having not only a major set of advantages, but drawbacks as well.

Modern Western military art is composed primarily of an amalgam of French, German, British, and American military systems. The Russians borrow from these systems as well, either through study or personal observation and form a unique product suited for the conditions that their war practitioners will encounter in combat. The system that is produced by the analysis provided by military art is known as doctrine.



Western military doctrine relies heavily on technology, the use of a highly trained and empowered NCO cadre (Non-commissioned officer), and superior information processing and dissemination to provide such a level of battlefield awareness that opponents cannot match.

The advantages that come with using this certain kind of strategy are utmost flexibility, extreme lethality, and a focus on removing the opponent's command, communications, control, and intelligence in order to paralyze and incapacitate rather than destroying their combat power directly (the ultimate goal being to minimize casualties in the process). Despite all these major benefits, Western military doctrine also has a set of flaws. Its drawbacks are high expense, a reliance on difficult-to-replace personnel, an enormous logistic train, and struggle in operating without high technology assets if depleted or destroyed.

On the other hand, unlike its Western counterpart, Russian military doctrine relies heavily on masses of troops and machinery that are disposable and easy to replace, a highly educated (albeit very small) officer corps, and pre-planned missions. This doctrine's benefits are the non-requirement of well-trained troops, it does not require a large logistic train, is under tight central control, and does not rely on a sophisticated C3I systems. These advantages also come with some considerable weaknesses such as inflexibility, a reliance on the shock effect of mass (with a significant cost in casualties, materials and resources), and overall inability to exploit unexpected success or respond to unexpected loss.

Conclusions: To conclude, there is no such thing as the best or the worst military strategy. Each military doctrine is strongly influenced by the personnel, technology, assets and resources that every country has at its disposal. History proved that the majority of armed conflicts are won by the more inspired side, not necessarily the larger one in terms of troops and military resources. Ideally all the studies on military strategy and doctrine would help to bring to an end wars worldwide, for all people to live together peacefully.

Keywords: *Military strategy, Military doctrine, Western, Russian.*

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11) The Doiran Defense Operation

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Introduction: The Doiran Defense Operation was one of the most significant military engagements of the Bulgarian Army during World War I. Fought between 1916 and 1918, it saw Bulgarian forces, led by General Vladimir Vazov, successfully repel repeated offensives by numerically superior British and Greek forces. This battle became a symbol of extraordinary military strategy and resilience, profoundly impacting the outcome of the Macedonian Front.



Methods and Results: The study analyzes three key battles in 1916, 1917, and 1918, emphasizing the defensive strategies employed by the Bulgarian forces. The research details the composition of the opposing armies, their military tactics, and the extensive use of artillery and fortifications. Despite being outnumbered and facing intense artillery bombardment, the Bulgarians managed to withstand multiple large-scale assaults, inflicting heavy casualties on the Allies. The final battle in September 1918 resulted in another decisive Bulgarian victory, yet the strategic situation forced Bulgaria to retreat due to breakthroughs on other fronts.



Fig. 1. Gen.
Vladimir Vazov

Conclusions: The Doiran Defensive Operation showcased exceptional Bulgarian military skill and determination. Although tactically successful, it could not alter Bulgaria's overall war trajectory, as the country capitulated shortly after the battle. The victory, however, played a crucial role in shaping Bulgaria's post-war negotiations, preventing complete occupation by neighboring states.

Acknowledgements: The authors acknowledge the contributions of historians and military analysts whose research has been invaluable in reconstructing the details of the Doiran battles..

Keywords: *Doiran Defensive Operation, World War I, Bulgarian Army, General Vladimir Vazov, military strategy, Macedonian Front.*

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12) Propaganda as a Strategic and Tactical Weapon: Who Controls the Truth in the Invisible War of Perceptions?

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Introduction: In an age where information is as powerful as military might, propaganda has become a strategic and tactical weapon capable of shaping global events. Governments, intelligence agencies, and private entities wage an invisible war for control over collective perception, using misinformation, psychological manipulation, and digital technologies to engineer reality itself. From influencing elections and fueling social unrest to rewriting historical narratives, propaganda operates on a battlefield where truth is fluid and perception is the ultimate prize.

Methods and Results: This paper delves into the mechanisms of modern propaganda, exposing the architects behind mass influence operations and the sophisticated tools they employ—AI-driven fake news, algorithmic bias, deepfake technology, and psychological warfare. It explores how media conglomerates, social platforms, and covert agencies serve as both weapons and battlegrounds in a war where narratives dictate power.

Conclusions: Yet, in a world saturated with manufactured realities, how can individuals and societies recognize and resist manipulation? By dissecting real-world case studies, emerging counter-strategies, and the ethical dilemmas of information warfare, this study unveils the shifting frontlines of propaganda. When truth itself becomes a contested space, the ultimate question arises: Who controls the narrative, and at what cost?

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Keywords: *Propaganda, Misinformation, Psychological manipulation, AI, Fake news, Information warfare, Narrative control.*





15. INTERCULTURAL COMMUNICATION AND MILITARY ETHICS

1) Information Warfare and Media Manipulation

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Introduction: Information warfare is an essential weapon of contemporary conflicts, used to influence both the perception of the civilian population and political decisions. The conflict between Russia and Ukraine serves as a clear example of the fact that disinformation plays a role as important as military operations. The case study will analyze the impact of disinformation and media manipulation in the Russian-Ukrainian war, describing the strategies used by both sides and their impact on public opinion. The objective of the paper is to find answers to the questions: "What is information warfare and media manipulation?"; "What were the methods used by both sides in disinformation and manipulation of the masses?"; and "What role did disinformation play in the Russian-Ukrainian war?"

Methods and Results: „Information warfare is an operation conducted in order to gain an information advantage over the opponent. It consists in controlling one's own information space, protecting access to one's own informations, while acquiring and using the opponent's information, destroying their information systems, and disrupting the information flow.” [1] In terms of media manipulation, this represents, according to the dictionary, „influencing public opinion through a set of means (press, radio, etc.) through which, without resorting to constraints, certain behaviors are imposed on it.” [2]

The Russo-Ukrainian war began on 24 February 2022, with the invasion of Ukraine by Russian troops, launched from Belarus to target Kiev, and from the northeast against the city of Kharkiv. However, this war did not stop at its conventional manifestation, but immediately included information warfare and the manipulation of masses through the media.

The research uses a mixed approach, combining qualitative content analysis and quantitative data collection. The methods applied include: media content analysis, social media monitoring and psychological operation.

A first aspect of the propaganda used by both sides was that of disinformation and fake news. Russia was that of promoting the war as a special military operation to protect the separatist regions of Donetsk and Lugansk, [3] but also the "denazification of Ukraine", while Ukraine tried to counter the propaganda by showcasing its military successes.

A second aspect was a significant increase in the activity of both accounts and trolls used to spread pro-Russian or pro-Ukrainian messages. Telegram and Twitter (actual X) were the main platforms where such tactics were intensively implemented. For example, a viral post by the Ukrainian Ministry of Defense on Twitter (actual X) featured a video of a destroyed Russian tank, with the message „Welcome to Ukraine – the place where invaders are turned into scrap metal”. [4] This post was massively redistributed, having a strong impact on both of national and international morale.

A third method involved psychological operations (PSYOPs) that used messages designed to demoralize troops and civilians. For example, Russia distributed fake video suggesting an imminent Ukrainian surrender, while Ukraine countered with emotional images of heroic resistance, such as a video of Ukrainian soldiers singing the national anthem in the trenches, widely shared on social media (Facebook). [5] The Russian strategy has focused on demoralizing the Ukrainian population and troops, as part of a broader psychological warfare



tactic designed to instill fear and insecurity. On the other hand, Ukraine's posting of content is intended to boost public morale and international support for Ukrainian cause.

Informational warfare and media manipulation has been a central tool in the Russian-Ukrainian conflict, particularly as part of Russia's hybrid warfare strategy. Here are some key aspects of its role: *shaping narratives* (Russian disinformation aimed to delegitimize Ukraine's government, portraying it as neo-Nazi or oppressive, and to justify Russia's actions as protective measures for Russian-speaking populations); *manipulating public opinion* (disinformation campaigns targeted both domestic and international audiences. Domestically, they bolstered support for the war by controlling narratives through state media. Internationally, they aimed to confuse and mislead about the conflict's realities.) and also, *undermining Ukraine's efforts* (false claims about Ukraine's military actions or intentions were used to discredit its efforts and to portray it as the aggressor).

Conclusions: The research objectively analyzed, with the help of news and social networks, the methods and impact that information warfare had in the Russian-Ukrainian war, the importance of the research lies both in raising awareness and understanding of the phenomena of media manipulation and information warfare, as well as in observing the tactics used by both countries.

Keywords: *mass-media; informational war; disinformation; propaganda.*

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2) Language Globalization: English Dominance vs. Multilingualism

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Introduction: Language serves as a vital tool for connecting people, sharing ideas, and shaping societies. In the era of globalization, English has emerged as the dominant global lingua franca, playing a crucial role in domains such as business, science, and diplomacy. This phenomenon, while facilitating international communication, also raises critical questions about the preservation of linguistic diversity and the sustainability of multilingualism in an increasingly interconnected world.

Methods and Results: English's rise to global prominence is rooted historically in the expansion of the British Empire and later reinforced by the economic and political influence of



the United States post-WWII. Today, its status is maintained through digital communication platforms, global business practices, and international scientific research. The dominance of English offers significant advantages, including enhanced international collaboration, improved employment opportunities, and greater access to global resources. However, this dominance concurrently poses severe threats to linguistic diversity, endangering thousands of languages, especially indigenous tongues, and risking the loss of cultural identity, history, and diversity.

In response, a growing advocacy for multilingualism seeks to balance these issues. Countries such as Canada, Switzerland, South Africa, and entities like the European Union promote multilingualism, recognizing the cognitive benefits, cultural preservation, and inclusive global interactions it fosters.

In the military domain, especially within alliances such as NATO, English serves as the primary language of operation, streamlining communication and enhancing effectiveness. Nonetheless, multilingual skills remain vital for intelligence, local interactions, and operations in linguistically diverse environments, emphasizing the continued relevance of multilingual capabilities.

Conclusions: The globalization of language, marked significantly by the dominance of English, represents a dual-faceted phenomenon. While enhancing global communication and economic integration, it simultaneously threatens linguistic diversity and cultural richness. Supporting multilingualism through balanced educational policies and technological tools.

Acknowledgements: Col. prof. univ. dr. ing. Marius-Valeriu CÎRMACI-MATEI.

Keywords: *language globalization, multilingualism, English dominance, linguistic diversity, cultural identity, international communication.*

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3) Intercultural Communication within Multinational Coalitions

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Introduction: This abstract is meant to present the subject of our presentation for the CERC. This presentation explores the subject “Intercultural Communication within multinational coalition”. The presentation explores the importance of intercultural communication in multinational coalitions, focusing on Romania’s role in European defense collaborations. Romania is an active member of NATO, the EU’s Common Security and Defense Policy, and hosts the Multinational Division South-East headquarters.

Methods and Results: The presentation will follow the following plan : a theoretical input that will highlight the importance of intercultural communication, examples (theory illustration), our personal experience on the subject and a conclusion.





Through our research it has been made clear that Intercultural communication within multinational coalitions in Europe is a critical factor for success in military, diplomatic, and organizational collaborations. Given the diverse cultural backgrounds of personnel from different nations, effective communication ensures cohesion, efficiency, and mission success.

Our main focus is **coalitions affiliated with Romania**.

Romania plays an active and growing role in multinational coalitions in Europe, particularly within **NATO, the European Union and regional defense initiatives**. Given its historical, cultural, and strategic position in Eastern Europe, Romania has developed strong intercultural communication capabilities to collaborate effectively with allies.

Romania is part of the following coalitions, which will be analyzed in our presentation:

- o **NATO Member (since 2004)**: Romania is fully integrated into NATO's command structure, participating in multinational exercises and peacekeeping missions.

- o **EU Common Security and Defense Policy (CSDP)**: Romania contributes to EU-led missions, demonstrating its ability to work within a multinational environment.

- o **Multinational Divisions & Units**: Romania hosts the **Multinational Division South-East (MND-SE)** headquarters in Bucharest, a critical hub for NATO's presence in the eastern Europe region.

We centered our attention on what place Romania occupied in those coalitions, what are their strengths and weaknesses and their reaction to the actual political tensions.

Conclusions: Romania is a **reliable and adaptable partner** in multinational coalitions, with strong language skills, cultural awareness, and operational experience. While challenges remain in bureaucratic efficiency and adapting to Western decision-making models, Romania's contributions to NATO, the EU, and regional coalitions highlight its growing role in European defense and security.

Acknowledgements: Moldoveanu Daniela.

Keywords: *collaborations, reliable, adaptable, multinational, coalition, defense initiative, Romania, defense cooperation, NATO, EU CSDP.*

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4) The Impact of AI in Modern Warfare

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Introduction: Artificial Intelligence (AI) involves creating computer systems capable of performing tasks that usually require human intelligence, such as decision-making, problem-solving, and pattern recognition. In modern warfare, AI is applied in areas like autonomous drones, battlefield monitoring, cyber operations, and data analysis. In conflicts such as the war in Ukraine, AI-driven drones assist with reconnaissance and targeted attacks, while machine learning processes provide satellite images and communication data to predict enemy actions. [1;2]





The main research question of this project is: “How does AI influence modern military strategy, decision making, and battlefield operations?”.

Methods and Results: This study examines various AI applications in Surveillance, and Reconnaissance (ISR), autonomous weaponry, and decision-making support systems. AI-driven drones enhance battlefield awareness by autonomously surveilling areas, detecting targets, and assessing threats using machine learning. These drones can adapt in real time, reducing human risk and increasing operational efficiency. [2;3]

Additionally, satellite-based AI assists intelligence gathering by analyzing large volumes of sensor data, improving situational awareness, and optimizing resource allocation. [5]

Furthermore, real-time threat detection, facilitated by AI algorithms, improves response times and minimizes delays in battlefield decision-making. AI's ability to process vast amounts of communication and reconnaissance data allows for enhanced early warning systems and countermeasure planning. However, predictive analytics enables military commanders to forecast enemy movements based on historical patterns and real-time data, enhancing strategic planning and force deployment. [1;5]

Autonomous weapon systems, such as AI-guided missiles and unmanned combat drones, demonstrate the potential for precision strikes and reduced collateral damage. However, these advancements also introduce challenges regarding human oversight and ethical considerations. The "human-in-the-loop" and "human-on-the-loop" models remain critical in ensuring responsible AI use and preventing unintended engagements. This study underscores the importance of regulatory frameworks to balance AI's military advantages with accountability and security concerns. [3;4]

Conclusions: AI significantly enhances military efficiency by automating reconnaissance, optimizing decision-making, and improving battlefield effectiveness. However, ethical concerns, such as the risk of AI errors and adversarial exploitation, remain critical challenges. This research highlights the necessity of balancing AI's military advantages with responsible deployment policies. [3;4]

Acknowledgements: We acknowledge the support from the staff of the MTA in conducting this research.

Keywords: *Artificial Intelligence, Modern Warfare, Autonomous Weapons, Predictive Analytics, Battlefield Management.*

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5) The Importance of Creativity and Imagination for an (Engineer) Officer

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Introduction: This abstract is meant to present the subject of our discussion. We will explore the significance of creativity and imagination within the role of an (engineer) officer. The presentation highlights how these qualities are pivotal to innovation, problem-solving, and leadership in engineering and military contexts. (Engineer) Officers play a crucial role in addressing complex technical challenges, designing infrastructure, and ensuring operational readiness under diverse conditions. Creativity empowers them to devise novel solutions, while imagination helps them anticipate and adapt to future needs. These attributes are essential for ensuring success in missions, fostering team collaboration, and advancing technological capabilities in defense operations.

Methods and Results: The presentation will follow this structure: a theoretical exploration of the role creativity and imagination play in engineering and leadership, real-world examples to illustrate these concepts, personal insights based on practical applications, and a conclusion summarizing the findings.

Through our analysis, it has become evident that creativity and imagination are pivotal for the success of engineer officers. These qualities enable officers to design innovative solutions for infrastructure challenges, adapt to dynamic military needs, and lead teams with vision and adaptability.

Our focus lies on demonstrating how creativity translates into tangible outcomes in military engineering contexts:

- **Problem-Solving Under Pressure:** Examples include rapid bridge construction in combat zones or devising new methods to secure key locations in hostile environments.
- **Technological Advancements:** Exploring the imagination behind developing and adapting engineering tools for modern defense needs.
- **Team Dynamics:** Showcasing how imaginative leadership inspires collaboration and fosters innovative thinking within teams.

We have centered our attention on how these traits not only enhance individual performance but also contribute to the collective efficiency and success of military operations.

Conclusions: Creativity and imagination are invaluable assets for engineer officers, enabling them to address challenges, innovate, and lead effectively in diverse scenarios. These qualities are not only fundamental for problem-solving but also critical for advancing engineering capabilities and adapting to dynamic military needs.

Engineer officers equipped with creative and imaginative thinking contribute significantly to mission success, team cohesion, and the development of sustainable solutions. While challenges may arise in fostering creativity within structured environments, the benefits of nurturing these attributes far outweigh the difficulties. By embracing creativity and imagination, engineer officers can continue to lead the way in shaping modern engineering and defense strategies.

Acknowledgements: Moldoveanu Daniela.

Keywords: *Creativity, Imagination, Engineer officer, Innovation, Problem-solving, Leadership, Adaptability, Technological advancement, Infrastructure, Strategic thinking.*



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6) The Use of Drones on the Modern Battlefield: Ethical and Legal Considerations

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Introduction: In today's modern day and age, the use of drones on the battlefield has raised a wide range of ethical and moral problems that require special attention. Thanks to the adoption of this technology, military forces around the globe have increased their military capabilities, resulting in a global debate in regard to humanitarian principles, regarding ethics and morality, in terms of the value of human life and justice in recent armed conflicts. At the core of the discussion is how drones have transformed the way war is waged, as can be seen by the fact that it distances drone operators from the damage inflicted, finally resulting in a new dynamic of power and responsibility for those who possess this military asset.

Methods and Results: In order to understand the ethical and legal challenges associated with the use of drones on the modern battlefield, this work focuses on a qualitative analysis consisting of academic sources, legal documents and other studied reports on this field.

The results show that, despite the great effectiveness of drones in reducing military casualties, their use generates ethical and legal dilemmas. The physical distances of operators from the battlefield influence the perception of the conflict, reducing the emotional impact attacks have on decision making. In addition, the existence of operational errors and intelligence failures jeopardize the principles of International Humanitarian Law, often resulting in the death of civilians.

Another unquestionable point is the psychological and social impact on the population that lives under constant surveillance by drones, increasing fear and insecurity and potentially fostering resentment and radicalization. Furthermore, the advancement of technology raises concerns about the possibility of fully autonomous drones, which could remove human agency from lethal decisions, violating the fundamental principles of human rights.

Conclusions: The use of drones in modern warfare has numerous strategic advantages but raises ethical and legal concerns. Their use challenges humanitarian principles, reduces accountability and increases the psychological impact on affected populations. To address these challenges, there is an utmost necessity for global dialogue and the implementation of stricter regulations to ensure the responsible and fair use of this technology.

Keywords: *Drones, Modern Warfare, Ethics, Technology.*

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7) How to Fight Stereotypes and Prejudices in the Army

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Introduction: Stereotypes and prejudices in the military present significant challenges, affecting unit cohesion, leadership effectiveness, and overall operational readiness. Biases related to ethnicity, gender, rank, and background can create divisions, weaken trust, and hinder teamwork among service members. Despite ongoing efforts to promote inclusivity, deeply ingrained prejudices persist within military structures worldwide. This study examines the origins of these biases, their impact on military effectiveness, and the measures taken to address them.

Methods and Results: Our research is based on case studies, military policies, and historical examples from various armed forces, analyzing how different nations have approached the fight against discrimination. Key strategies include diversity and inclusion training, equal opportunity policies, and leadership initiatives designed to challenge bias at both institutional and individual levels. Programs such as intercultural training, mentorship systems, and data-driven policy reforms have been implemented in numerous militaries to create more equitable and cohesive environments. Reports and studies indicate that inclusive military units demonstrate improved communication, stronger team dynamics, and greater adaptability in complex operational scenarios.

Conclusions: Diversity and inclusion are not just ethical imperatives but strategic necessities, enhancing both military effectiveness and global cooperation. A military force that actively works against prejudice is better equipped to function as a united, disciplined, and mission-ready organization in the modern world. While progress has been made, there is still a long way to go and combating stereotypes in the military requires continuous effort, particularly in enforcing policies, fostering awareness, and ensuring accountability at all levels of command.

Acknowledgements: Assoc.Prof. Daniela MOLDOVEANU, PhD.

Keywords: *Stereotypes, Prejudices, Military, Inclusivity, Teamwork, Leadership.*

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8) Beyond the Manual: How Culture Shapes Military Technical Understanding

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Introduction: Military IT concepts like digital forensics, network security, and computer operations are standardized in manuals, yet their meaning shifts with cultural and professional familiarity. This abstract is based on a two-week Erasmus exchange, where I worked with military students from Greece (cybersecurity), Bulgaria (logistics and cybersecurity), and Czechia (guns/armory). In our discussions, Czech students connected these terms to physical aspects like signal transmission and electricity, Greeks and some Bulgarians to equipment costs and selection criteria, and Bulgarian cybersecurity experts to transmission security and mathematics. This study, prepared for the Students' International Conference "CERC" 2025, explores these associations to reveal intercultural influences on technical understanding in multinational IT settings.

Methods and Results: During a two-week Erasmus program, I collaborated with colleagues from Greece, Bulgaria, and Czechia, each bringing perspectives from their specialties: cybersecurity, logistics, and guns/armory. Through informal discussions during joint activities, we explored three IT concepts—digital forensics, network security, and computer operations—noticing how they relied on familiar cultural examples to grasp them.

For digital forensics, Czechs related it to physical troubleshooting, like how electricity powers weapon systems in their armory experience. Greeks tied it to budgeting for forensic tools, drawing from cost-conscious equipment choices, while Bulgarian logisticians likened it to managing supplies, a familiar logistical task. Bulgarian cybersecurity experts saw it as a mathematical puzzle, akin to securing data in their training. For network security, Czechs focused on hardware reliability, such as signal transmission in field gear. Greeks and some Bulgarians compared it to cost-effective resource protection, like safeguarding supplies, while Bulgarian cybersecurity specialists linked it to mathematically secured transmissions, a concept familiar from their studies. For computer operations, Czechs connected it to powering armory systems, Greeks to balancing hardware costs, and Bulgarians split between practical repairs (logisticians) and computational logic (cybersecurity), each rooted in their everyday contexts.

These discussions showed that understanding often depended on relating technical terms to examples from their own cultures and specialties, revealing how background shapes comprehension beyond standard definitions.

Conclusions: This study highlights that military IT concepts are understood through cultural and professional familiarity—Czech physicality, Greek and Bulgarian cost concerns, and Bulgarian mathematical rigor—rather than just manual definitions. Most notably, over two weeks, it became clear that students needed culturally familiar examples to grasp these concepts effectively. This reliance on relatable contexts suggests that intercultural training, incorporating such examples, is essential for aligning technical understanding in multinational forces, ultimately enhancing operational unity across diverse perspectives.

Acknowledgements: I sincerely thank Christian MOLDOVEANU, my Erasmus coordinator, for his support during an enriching two-week Erasmus exchange, and Daniela MOLDOVEANU, my English teacher at the Military Technical Academy, for her invaluable guidance and motivation. I also express my gratitude to my colleagues from Greece, Bulgaria, and Czechia, as well as my Romanian peers, whose contributions and shared experiences were instrumental in shaping this study.

Keywords: *Intercultural communication, military IT concepts, digital forensics, network security, computer operations, cultural associations.*





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9) Conflict Management in the Army

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Introduction: Managing conflict is critical in operational environments, especially within military leadership circles. With stressful circumstances like military operations or international missions, conflicts tend to pop up organically because of hierarchy, culture, and even communication. This paper looks into the kinds of conflicts that exist within the military and ways of resolving them, paying special attention to cultural elements and the leaders' roles in resolving conflicts.

Methods and Results: We have our work based on theoretical approaches and case studies provided in a conflict management conference presentation. We categorize armed conflict as interpersonal, intergroup, and intercultural conflict and analyze their causal underpinnings, for example, role expectations, personality conflicts, and power dynamics.

Different conflict resolution styles are examined, including avoidance, accommodation, competition, compromise, and collaboration. We emphasize the impact of cultural origin on preferred conflict and communication styles, particularly in multinational operations like NATO or UN missions. The formal military chain of command can suppress open communication, increasing the likelihood of unresolved tensions.

Conflict management positively relies on leadership. Emotional intelligence training, mediation, and communications such as after-action review significantly reduce the incidence and intensity of conflict. Case analysis also indicates that culturally based miscommunications could be managed effectively through awareness training and structured communications.

Conclusions: Understanding the dynamics of armed conflict and application of culture-based and patterned solutions to control it is critical to success in operations. Those managers who facilitate openness, cross-cultural sensitivity, and anticipatory communication have the ability to turn conflict into a team building and learning opportunity.

Acknowledgements: We thank our academic supervisor for support and guidance during the preparation of this work.

Keywords: *Military conflict, intercultural communication, leadership, hierarchy, resolution strategies, multinational missions.*



10) Nonverbal Communication and Military Effectiveness

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Introduction: Nonverbal communication refers to the transmission of information without the use of spoken words. Instead, it relies on gestures, body language, facial expressions, and other physical cues to convey messages. This form of communication is essential in various fields, especially in situations where spoken language is not possible or practical.

Methods and Results: In many cases, nonverbal communication provides a solution for people with disabilities such as deafness or paralysis, allowing them to interact without relying on vocal sound. It is also crucial in environments where verbal communication is impossible, such as underwater during diving operations or in situations with high ambient noise, like industrial settings or factories. Additionally, nonverbal signals are often used in situations where distance hinders the effectiveness of verbal communication, such as signaling a boat from an island or across a vast area.

In the military, nonverbal communication is particularly important, as it is often used to navigate situations where silence, secrecy, or distance is required. The military understands the challenges outlined above and intentionally adopts nonverbal communication methods to maintain operational effectiveness. This includes conveying orders without speaking, signaling danger, or marking presence while avoiding detection. A prime example can be seen on the deck of an aircraft carrier, where movement instructions, danger signals, and presence indicators are communicated through hand gestures or flags to ensure clear understanding while minimizing the risk of detection or confusion. These silent communication techniques are integral to maintaining efficiency and safety in military operations.

Conclusions: In conclusion, nonverbal communication plays a vital role in various fields where spoken language is impractical or impossible. From aiding individuals with disabilities to facilitating communication in noisy or high-risk environments, its importance cannot be overstated. Particularly in military operations, where discretion and efficiency are crucial, nonverbal signals ensure clear and effective communication. Whether through gestures, body language, or visual cues, nonverbal communication remains an essential tool for conveying messages in diverse and challenging situations.

Acknowledgements: Prof. MOLDOVEANU Daniela.

Keywords: *Nonverbal communication, gestures, military, signals, efficiency.*

11) Military Ethics: Preserving the Essence of Humanity

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Introduction: This abstract is prepared for submission to the Students' International Conference “CERC” 2025 and aims to explore the ethical principles governing warfare. The study examines how military ethics regulate conflicts by balancing military necessity with the preservation of human dignity. It highlights the importance of Just War Theory, the application



of international humanitarian law, and the challenges posed by modern warfare technologies. The objective is to analyze how these ethical frameworks contribute to minimizing unnecessary suffering and maintaining fundamental human values, even in the context of war.

Methods and Results: This study is based on a literature review of key sources in Just War Theory, international humanitarian law, and modern military ethics. Primary references include Walzer (1977) and Orend (2006) on Just War Theory, the Geneva Conventions (1949) and the Rome Statute (1998) on international law, as well as contemporary works on emerging challenges such as autonomous warfare and cyber conflicts (Singer, 2009; Lucas, 2017).

The analysis focuses on ethical principles governing warfare and their practical implications in historical and modern conflicts.

Findings show that military ethics play a crucial role in limiting unnecessary suffering by enforcing *jus ad bellum* (justification for war) and *jus in bello* (ethical conduct in war). While international frameworks like the Geneva Conventions establish humanitarian protections, challenges such as asymmetric warfare and autonomous weapons create new ethical dilemmas.

The study highlights the ongoing relevance of military ethics in preserving human dignity despite evolving warfare strategies.

Conclusions: This study underscores the critical role of military ethics in regulating warfare and preserving human dignity. By applying Just War Theory and international humanitarian law, ethical frameworks help mitigate unnecessary suffering and ensure accountability in conflicts.

However, modern challenges such as autonomous weapons and cyber warfare require ongoing ethical and legal adaptation. Upholding these principles remains essential in maintaining the balance between military necessity and humanitarian values.

Keywords: *military ethics, Just War Theory, international humanitarian law, autonomous weapons, human dignity.*

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12) Gender Mainstreaming in the Military

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Introduction: Gender mainstreaming in the military is a policy approach aimed at integrating gender perspectives into all aspects of military structures, policies, and operations. The objective is to promote gender equality and enhance operational effectiveness by leveraging the diverse skills and perspectives of all service members.

Methods and Results: The research employs a mixed-method approach, combining qualitative and quantitative methods. The qualitative aspect includes policy analysis and interviews with military personnel, while the quantitative aspect involves statistical analysis of gender representation and performance metrics.



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Key findings indicate that gender mainstreaming contributes to improved decision-making, enhanced unit cohesion, and increased operational effectiveness. Case studies from NATO and UN peacekeeping missions demonstrate that gender-inclusive teams perform better in conflict resolution and community engagement. However, challenges such as institutional resistance, unconscious bias, and inadequate training hinder full integration.

Conclusions: Gender mainstreaming in the military enhances operational efficiency and promotes equality. While progress has been made, further efforts are needed to address structural barriers and foster a culture of inclusivity. Implementing targeted training programs and leadership support is crucial for the successful integration of gender perspectives in military institutions.

Keywords: *Gender, Military, Inclusion, Operational Effectiveness, Equality, Policy.*

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16. ENGLISH LANGUAGE AND CULTURE

1) The Bewitching Grimoire of English Folklore

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Introduction: Ever since the earth was created, people have been fascinated by what the planet could offer them. Starting from admiring the nature, the clouds, the animals, they were inspired to create stories, legends and beliefs in order to live in a magical and safer world. They desired to believe in something, even if it was not real, to tell stories based on their unique experiences and to be able to invent theories that could resonate with people and make them feel thrilled. Not only were these the reasons, but also humans are gentle creatures who love to dream, to aspire and to give themselves some sort of consolation.

Methods and Results: There is not a clear definition of English folklore due to the fact that it consists of a thick bundle of myths and legends of England, including mythical creatures, superstitions, beliefs, proverbs and folktales that have been passed down through various generations.[1] The vast majority of English people love sharing their folklore because they want to keep alive the invisible string between the past and the present that symbolizes continuity and change.[2]

Likewise, the legend of Robin Hood captivated humans entirely. According to the legend, Robin Hood was seen as a hero despite robbing and stealing from the rich and giving to the poor. Because of the courage he had in order to do justice in that period of time, he was extremely admired and praised by common folk. They were influenced to change their perspective about life, to fight for their rights and to never be afraid to stand up and speak up. But did he ever live or was he just a figment of imagination? Nevertheless, this legend remains one of the most beloved stories of English folklore because of its bravery and honor themes, making it a timeless tale.[3]

Another key thing to remember is that English people truly believe in superstitions in order to protect themselves from bad luck. For instance, they are afraid of walking underneath a ladder, breaking a mirror because mirrors are considered to be tools of the gods, spilling salt and if you do it accidentally you have to throw it over your shoulder, opening an umbrella indoors, putting new shoes on the table and seeing just one magpie.[4] Even if these are just a few of their superstitions, they are strongly believed in and respected, especially by older people.

Furthermore, witchcraft represented a major problem in Britain until 1563. Lots of poor women, especially the older ones, were persecuted because of their appearance or because they were believed they were working with the devil side by side. This era was also called "Witch fever" and women who were thought to be witches were put to various tests such as the swimming test. Their thumbs were tied to the opposite big toes and they were flung into the river, but if they floated they were innocent, otherwise they were considered to be guilty. In addition, witch hunting may still go on nowadays, so this belief has not entirely died out.[5]

Conclusions: Everything being put under the same umbrella, English folklore creates a fabulous realm of tales, legends and superstitions which makes people feel marvellous and offers them remarkable feelings. Not only it represents their culture, but also it defines their characters.

Acknowledgements: Many thanks to Mădălina Stănescu, PhD, for the guidance.

Keywords: *English Folklore, legend, superstitions, Robin Hood, witchcraft.*



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2) The Day Japan Awoke the Sleeping Giant

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Introduction: On December 7, 1941, the United States experienced a shocking event—the bombing of Pearl Harbor. This attack, carried out by the Imperial Japanese Navy, led the U.S. into World War II and changed global military strategies. It aimed to cripple American naval power but had unexpected long-term consequences for Japan. Understanding the factors that led to this attack is crucial for evaluating its historical significance and impact on future global events.

This presentation examines the complex motivations behind Japan's surprise attack, the precise execution of the assault, and the far-reaching aftermath of this historic event. Japan's aggressive expansion in Asia and the Pacific had led to growing tensions with Western powers, particularly the United States. As economic sanctions crippled Japan's access to essential resources such as oil, rubber, and steel, the Japanese leadership perceived war as unavoidable. Seeking to neutralize American military power before it could effectively respond, Japan launched a meticulously planned strike on Pearl Harbor, hoping to gain a strategic advantage and secure dominance in the Pacific.

The attack itself was carried out in two devastating waves, inflicting severe damage on the U.S. Pacific Fleet. Within a mere 90 minutes, over 2,400 Americans lost their lives, 21 ships were either sunk or damaged, and more than 300 aircraft were destroyed. The following day, the U.S. declared war on Japan, marking the country's official entry into World War II. This decision led to a full-scale mobilization of American industrial and military power, which would eventually shift the course of the war.

Methods and Results: Lots of online sources have been consulted in order to orchestrate the research paper, such as multiple articles and Wikipedia, and the suitable information has been selected.

Conclusions: As the war progressed, American industrial and military might turned the tide against Japan. Key battles, including the Battle of Midway, reversed Japan's early advantages and set the stage for its eventual defeat. Less than four years after Pearl Harbor, the war concluded with Japan's surrender following the atomic bombings of Hiroshima and Nagasaki in 1945. The consequences of the attack extended beyond military engagements, reshaping global alliances and influencing U.S. foreign policy for decades to come. The attack on Pearl Harbor served as a catalyst for America's emergence as a global superpower, shifting the nation's role in international affairs and solidifying its commitment to military readiness and strategic defense.



Acknowledgements: Senior Lecturer PhD Camelia Alibec.

Keywords: *Pearl Harbor, World War II, U.S. Pacific Fleet, Japan.*

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3) George Washington – Building the Foundation of a Nation

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Introduction: George Washington (1732-1799) is often called the “Father of His Country” and for a good reason. His life was a tapestry of leadership, resilience, and vision that helped shape the United States during its most fragile years. This paper takes a closer look at three key phases of Washington’s life: his early years and military beginnings, his pivotal role in the American Revolution, and his groundbreaking presidency. Born into a modest Virginia family, Washington’s early career as a surveyor and his experiences in the French and Indian War laid the groundwork for his future as a military leader. When the colonies rose against British rule, Washington was chosen to lead the Continental Army – a role that would test his strategic mind and unyielding determination. Despite facing overwhelming odds, Washington’s leadership during the Revolutionary War was nothing short of remarkable. From the harsh winter at Valley Forge to the decisive victory at Yorktown, he inspired his troops and outmaneuvered a far superior British force. After the war, Washington’s presidency set the tone for the new nation. He established critical precedents, like the two-term limit and the cabinet system, which remain pillars of American governance. Yet, his legacy is not without complexity. This paper also explores Washington’s relationship with slavery, a contradiction that challenges his image as a champion of liberty. By examining his life and achievements, this study highlights Washington’s enduring impact as a unifying figure and a symbol of the ideals that define the United States.

Methods and Results: We considered using open sources such as books, websites, blogs, and online journal articles in order to complete our research. We have the credence to say we have fulfilled our goal regarding the writing of this paper.

Conclusions: The life of George Washington is a great and wonderful one in which the outstanding qualities of leadership, perseverance, and concern for others’ welfare are considered virtues that he truly possessed. Throughout his unique existence, beginning from humble childhood times spent in rural Virginia to enormous responsibilities in the fields of war and politics, Washington pursued the cause of the liberty, self-government, and civic duty. Washington’s exemplary idealism and the perilous adversities represent one of the most important events in history. His leadership skills during the American Revolution, being the First President of the U.S., as well as his legacy as a symbol of the nation are the buildings blocks from which the title “Father of His Country” comes. Washington’s every deed and accomplishment represent real models for all generations and moreover, they have a further aim to be a reminder of the power of such moral concepts such as integrity, foresight, and the dedication to building justice and prosperity.

Washington was a leader who could manage the complexities of a very difficult era in which the nations’ interrelations more often led to confusion than to understanding, proving his astonishing leadership skills. During the American Revolution, he was able to display incredible problem-solving and strategic expertise that he used to weave a deeply disorganized,



undermanned, and yet fight-hungry colonial army ending with the dethronement of the British Empire. His skills to gather people, to motivate, and to be dynamic were crucial for the winning of the Independence of the U.S. Beyond the war zone, Washington put the most effort in bringing the people together to the idea of a single nation, its formation being based on the abolition of regional and political differences. His leadership derived not only from his deeds but his ability to inspire the confidence and trust of the people around him, which, in turn, helped the idea of liberty to be present in harsh conditions.

Even in retirement, Washington remained committed to public service and innovation. At Mount Vernon, he championed agricultural experimentation, land conservation, and advancements in farming techniques, demonstrating his forward-thinking approach and his dedication to contributing to the nation's progress in every way possible. (Ferling, 2009)

Today, Washington's life serves as a powerful reminder of the enduring impact of visionary leadership and the importance of prioritizing the greater welfare over personal ambition. His ability to rise above partisanship, to foster unity, and to lead with integrity provides timeless lessons for leaders in every field. More than two centuries after his death, Washington's example continues to inspire individuals worldwide to work toward a more just, prosperous, and equitable society. His life story remains a testament to the transformative power of hard work, honesty, and an unwavering commitment to the principles of liberty and democracy.

Acknowledgements: We would like to thank our coordinating professor, Dr. Brândușa-Oana Niculescu, for her valuable guidance. You provided us with the tools that we needed to choose the right direction and successfully complete this paper.

Keywords: *President, Revolutionary, Nation-building, Leadership, Legacy.*

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4) Special Operations Dogs

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Introduction: The continuous challenge of warfare has consistently posed a problem to modern society, between losing human lives and mass destruction, soldiers' morale can be a very sensible point when speaking about their mission success. Special operations dogs are vital assets in military and law enforcement missions due to their specialized capabilities. Man's best friend showed a warrior side since its early tame process. The cornerstone of their effectiveness is rooted in a meticulous breeding and selection process that emphasizes traits like intelligence, endurance, and a stable temperament. After being selected, these dogs undergo rigorous training that includes obedience, detection, tracking, and tactical skills, often mirroring the training methods utilized by special operations forces. This training involves getting used to high-pressure situations and specific tasks, such as airborne insertions and the detection of explosives. The operational contribution of these dogs is profound, as they improve mission success rates through detection of threats, tracking targets, and safeguarding forces, thereby enhancing the safety and efficiency of their teams. Their exceptional abilities and dependability render them essential in complex, high-risk operations, highlighting their strategic importance in contemporary warfare and security scenarios.

Methods and Results: We consider using open sources such as online journal articles, websites, blogs, and books in order to complete our research. We have the credence to say we have fulfilled our goal regarding the writing of this paper.

Conclusions: Special operations dogs exemplify the remarkable collaboration between innate animal instincts and human innovation. Their breeding is meticulously managed to cultivate optimal characteristics, while their selection process emphasizes temperament, health, and motivation. From the outset, these dogs are prepared for excellence. Their extensive military training refines their natural abilities, equipping them for the rigorous demands of high-stakes operations. Whether engaged in explosive detection, target tracking, or tactical support, these canines significantly bolster the effectiveness of their human partners. Their steadfast loyalty, versatility, and expertise render them invaluable assets, often influencing the outcomes of critical missions. Beyond saving numerous lives, special operations dogs symbolize the trust and cooperation that are essential to successful military collaborations.

Acknowledgements: We would like to thank our coordinating professor, Dr. Brândușa-Oana Niculescu, for her valuable guidance. You provided us with the tools that we needed to choose the right direction and successfully complete this paper.

Keywords: : *warfare, special operations dogs, breeding, training, abilities.*

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5) Jean Bart: The Literary Legacy of a Navy Officer

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Introduction: This paper explores the life and legacy of Jean Bart, born Eugeniu Botez, a distinguished Romanian writer and naval officer acclaimed for his literary works depicting maritime life and naval traditions. As a key figure in Romanian naval literature, his writings not only capture the spirit of the sea but also provide deep insights into maritime history, naval strategy, and the challenges faced by seafarers. Through his vivid storytelling and extensive knowledge of naval affairs, Jean Bart remains an enduring source of inspiration for both literary and maritime communities. In light of this, the Library of the Romanian Naval Academy plays a vital role in preserving and promoting Jean Bart's works, ensuring their continued relevance for future generations of maritime professionals.

Methods and Results: To conduct our research, we used data from the books, periodicals, journals, and articles found at the "Commander Eugeniu Botez" Library at the Romanian Naval Academy, together with some internet resources.

Conclusions: The research undertaken in this paper highlights the enduring relevance of Bart's writings. His stories continue to serve as a source of inspiration for generations, and the ongoing preservation of his works by institutions like the Library of the Romanian Naval Academy is crucial to maintaining their cultural and educational significance.

Acknowledgements: Lecturer PhD Corina SANDIUC.

Keywords: *Jean Bart, Eugeniu Botez, naval literature, maritime history.*

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6) Abraham Lincoln – the Leader Who Changed the World

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Introduction: In a nation that has produced remarkable leaders like George Washington, Thomas Jefferson, or Franklin D. Roosevelt, Abraham Lincoln stands tall among these giants. An honest lawyer with exceptional leadership qualities, he changed the course of the United States and left an indelible mark on world history. Lincoln emerged as a pivotal political figure of the 19th century, gaining prominence during his presidency. Known as “Honest Abe”, he faced the bloodiest conflict in the U.S. history, the Civil War, driven by a mission to preserve the territorial integrity of a young nation that had recently gained independence. Beyond this, he championed a noble cause: the abolition of slavery, a dark legacy that had marred humanity for centuries. Tragically, Lincoln's life was cut short before





he could fully witness the fruits of his efforts. However, the enduring legacy of “The Ancient One” continues to inspire generations.

Abraham Lincoln was born on February 12, 1809, in Kentucky into a poor family on America’s western frontier. His father was Thomas Lincoln, a simple farmer from Virginia who had a variety of other occupations to support his family, and his mother was Nancy Hanks Lincoln, who was a seamstress. Abraham Lincoln was the second of three children, with an older sister and a younger brother. The older sister Sarah Lincoln Grigsby died at the age of 21 along with her son from complications during pregnancy. Sadly, the future president's younger brother, Thomas Lincoln Jr, did not have a happier fate, dying just 3 days after birth from illness. Abraham Lincoln did not have an easy life, having struggled since he was a small child. From a poor boy from Kentucky to one of the most beloved American presidents in history, Abe had a long road ahead of him, but he managed to cross it thanks to his leadership qualities, perseverance, honesty and intelligence.

Methods and Results: We considered using open sources such as books, websites, blogs and online journal articles in order to complete our research. We have the credence to say we have fulfilled our goal regarding the writing of this paper.

Conclusions: Abraham Lincoln’s legacy is defined by his unwavering commitment to preserving the Union, promoting civil liberties, and shaping a progressive vision for the United States, and the roots of this vision can be traced back to his humble childhood. His early political career demonstrated his support for federal involvement in economic development and principled opposition to slavery, even when it was politically unpopular. As president, his leadership during the Civil War not only saved the Union but redefined its purpose, transforming the conflict into a struggle for unity and the abolition of slavery. His visionary policies catalyzed economic growth and established frameworks for national progress. His devotion to democratic principles has resonated through generations as a call to liberty, equality, and unity. Even after his death, Lincoln's influence grew, becoming a symbol of resilience, moral leadership and the enduring potential of democracy.

Acknowledgements: We would like to thank our coordinating professor, Dr. Brândușa-Oana Niculescu, for her valuable guidance. You provided us with the tools that we needed to choose the right direction and successfully complete this paper.

Keywords: *President, Civil War, Slavery, Leadership Qualities, Legacy.*

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7) Richard Winters – What Leadership Should Be

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Introduction: *Major Richard "Dick" Winters, the commander of Easy Company (101st Airborne Division) during WWII, remained an excellent example of what leadership should be. Through his discipline, courage and composure, always maintaining the initiative during military operations, and his command act based on personal example, he quickly got the recognition and trust of his men, but most important he was inspiring assurance, the one thing that his men needed the most in those moments of pure uncertainty. Winters' focus on teamwork and integrity transformed Easy Company into one of the most effective units of the war. His leadership serves as a timeless reminder of how one man can coordinate others into achieving extraordinary results in the most demanding circumstances. He was more than a leader for those who needed him, he was an example to follow, he shown others the way to victory.*

Leadership is often defined by the decisions made and the actions taken in moments of profound challenge and uncertainty. Major Richard Winters (1918-2011), a paragon of selfless leadership, rose to prominence during one of history's most pivotal conflicts, World War II, as a commanding officer of the Easy Company in the 506th Parachute Infantry Regiment of 101st Airborne Division. Winters demonstrated that effective leadership is not about issuing orders but about earning trust, respect, and loyalty by leading through action. From preparing his men for the trials of D-Day to personally spearheading critical missions, he consistently placed himself at the forefront of danger, embodying the principles he asked of his soldiers. His actions the night before the D-Day invasion stand as a testament to his meticulous planning, unwavering resolve, and deep sense of responsibility for his men. Later, he led his men through the grueling campaigns of Operation Market Garden and the Battle of the Bulge. Winters displayed exemplary leadership through his ability to serve others selflessly, to lead from the front, and to remain a steady, decisive figure in the chaos of war. His story offers valuable lessons on how courage and character can transform ordinary individuals into extraordinary heroes when history demands it most.

Born in Pennsylvania, Winters joined the Army in 1941 and was soon selected for the Officer Candidate School. His leadership, tactical brilliance, and dedication to his soldiers earned him the Distinguished Service Cross Bronze Star, Purple Heart and other honors. After the war, Winters pursued a business career and lived a quiet life until his story gained wider recognition through Stephen Ambrose's *Band of Brothers* and its HBO adaptation. He remains an enduring symbol of courage and exemplary leadership.

Methods and Results: We considered using open sources such as books, websites, blogs and online journal articles in order to complete our research. We have the credence to say we have fulfilled our goal regarding the writing of this paper.

Conclusions: Richard Winters' leadership throughout his military career exemplified the core values of service, sacrifice, and discipline, which shaped him into one of the most respected leaders, a legacy that continues to serve as a model in military history. From his time at Camp Toccoa to his actions during WWII, Winters consistently placed the welfare of his men above his own, demonstrating an unwavering commitment to their success. His sacrifice extended beyond personal comfort – he often exposed himself to danger to ensure the success of mission, earning trust and loyalty from his men. This selflessness was foundational in transforming the Easy Company into a cohesive and formidable unit. His story offers valuable lessons on how courage and character can transform ordinary individuals into extraordinary heroes when history demands it most. "If you're a leader, you lead the way. Not just on the easy



ones. You take the tough ones too.” This quote perfectly demonstrates not only the superior soldier that he was, but also the man and the qualities underneath. This was a leader that did not give an order for something that he would not do himself. This was a man that for every report he filed as the Commander of Easy Company, he did not write, “I did....” when talking about actions and maneuvers. It was always “we”. He worked with his men as a team.

Acknowledgements: We would like to thank our coordinating professor, Dr. Brândușa-Oana Niculescu, for her valuable guidance. You provided us with the tools that we needed to choose the right direction and successfully complete this paper.

Keywords: *leadership, “Follow Me!”, WWII, 101st Airborne, American military culture..*

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8) In Search of Equilibrium

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Abstract: Existentialism is a complex and multifaceted philosophical movement that explores the nature of human existence, freedom, and meaning. It encompasses a range of perspectives, from secular to religious, and includes concepts such as “existence precedes essence” and “radical freedom.” Defined by its focus on the concreteness and problematic nature of existence, existentialism challenges individuals to confront the absurdity of life and seek their own sense of purpose.

This paper investigates these existential dilemmas, questioning what drives human perseverance, the paradox of purpose, and the struggle against entropy. This paper critically examines the illusion of progress, the subjectivity of perception, and the overwhelming nature of modern information, while also exploring the impact of artificial intelligence on the future of work. Drawing from existentialist thought, thermodynamics, and philosophical discussions on freedom and choice, it argues that while life may lack inherent meaning, equilibrium can be found acceptance of the absurd.

Keywords: *Existentialism, Hope, Artificial Intelligence, Entropy.*

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9) USS Forrestal: Lesson Learned

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Abstract: The USS Forrestal (CV-59) was the United States Navy's first supercarrier and played a crucial role in naval aviation history. However, the vessel is most notably remembered for the catastrophic fire that occurred on July 29, 1967, during operations in the Gulf of Tonkin. This paper examines the causes, impact, and lessons learned from the incident, which remains one of the most devastating accidents in U.S. naval history. The primary objective of this paper is to analyze the sequence of events, technical failures, and human factors that contributed to the disaster and to draw some conclusions of lesson learned.

The analysis is based on official reports, firsthand accounts, and technical evaluations of the USS Forrestal fire. The accident began when an electrical anomaly caused an uncommanded launch of a Zuni rocket from an F-4 Phantom II, striking an armed A-4 Skyhawk on the flight deck. The impact led to a series of explosions, igniting a massive fire that resulted in the deaths of 134 sailors and extensive damage to the carrier. Firefighting efforts were severely hindered by outdated safety protocols and the presence of highly flammable ordnance. This study highlights the procedural failures, structural vulnerabilities, and the heroism of the crew during the crisis.

The USS Forrestal disaster led to significant reforms in naval safety procedures, firefighting techniques, and weapons handling protocols aboard aircraft carriers. The lessons learned from this incident continue to shape modern naval aviation safety standards. By understanding these failures, future naval operations can be made safer, preventing similar tragedies. I would like to acknowledge my coordinator at the Romanian Naval Academy for guidance and support in the development of this research.

Keywords: *USS Forrestal, aircraft carrier fire, naval disaster, safety reforms, Zuni rocket, Gulf of Tonkin.*

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10) Dwight D. Eisenhower: from Modest Origins to Exceptional Leadership

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Introduction: This paper explores the life and legacy of Dwight D. Eisenhower, a prominent figure in 20th-century history who shaped both military and political landscapes. It examines his rise from a modest upbringing to becoming a distinguished military leader during World War II, ultimately leading the Allied forces to victory. It also explores Eisenhower's transition from military service to the presidency, focusing on his governance during the Cold War, his policies on domestic growth, and his approach to international diplomacy. The study reflects on how his leadership principles, emphasizing unity, resilience, and strategic thinking, left a profound mark on Western society, global relations, and contemporary leadership styles.

Dwight David Eisenhower, the 34th President of the United States, is remembered as both a military hero and a transformative leader who shaped the course of national and global history. Born in 1890 in Texas and raised in Kansas, Eisenhower's humble beginnings instilled in him a strong work ethic and a deep sense of duty. His military career was marked by extraordinary achievements, culminating in his role as Supreme Commander of Allied Forces in Europe during World War II. Eisenhower's leadership during the D-Day invasion and subsequent Allied victories in Europe solidified his reputation as a master strategist and a unifying force. His reforms and commitment to duty, leadership, and service to freedom-loving people around the world reflected a powerful leader and an impactful figure in his decade.

Methods and Results: We utilized open sources, including books, websites, and online journal articles, to conduct our research. We confidently affirm that we have successfully achieved our objective in writing this paper.

Conclusions: Dwight D. Eisenhower's life and legacy exemplifies the ideals of leadership, resilience, and service. From his humble beginnings in Kansas to his role as a global leader, Eisenhower navigated challenges and hardships with determination and outmost care. His military strategies during World War II, especially his coordination with global leaders like Winston Churchill, showcased his diplomatic skills and strategic expertise. His presidency further demonstrated his commitment to national growth through transformative infrastructure projects and impactful foreign policy. Eisenhower's lasting influence on military strategy, national infrastructure, civil rights, and international diplomacy continues to shape the modern world, solidifying his place as one of America's most respected, greatest and impactful military leaders.

In conclusion, Eisenhower's presidency reflected his military background in its disciplined approach to leadership, diplomacy, and crisis management. His transition from general to president demonstrated his ability to adapt and lead in both military and civilian spheres, leaving a lasting impact on American politics and global affairs.

Acknowledgements: We would like to thank our coordinating professor, Assoc. Prof. Brândușa-Oana Niculescu, PhD, for her invaluable guidance and expertise in the field.

Keywords: *personal life, military career, leadership, modesty, politics.*

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11) String Theory: The Connection between Science, Culture and Imagination

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Introduction: String theory is considered to be one of the most intriguing and complex ideas in modern physics, proposing a universe that transcends our visible dimensions. According to this theory, which was developed in the late 1960s by scientists such as Leonard Susskind and Gabriele Veneziano, fundamental particles are small points and one-dimensional strings that vibrate in dimensions that are hidden from our familiar three-dimensional space and time [1].

This paper comes to clarify the intricacies and philosophical string theory consequences, especially its cultural connections, as evidenced in British scientific advancements and representations in science fiction movies. By exploring this theory, we can identify significant changes in how people perceive reality, space, time, and matter [2].

Methods and Results: This paper investigates scientific databases, articles, and reliable online materials, focusing on the contributions of British physicists such as Stephen Hawking, Michael Green, and Brian Cox. Their work has played a crucial role in shaping contemporary physics, especially quantum gravity and cosmological theories [3].

Additionally, the popular culture analysis illustrates how string theory and related concepts like black holes, wormholes, and multidimensional realities have influenced iconic films, particularly Christopher Nolan's "Interstellar" (2014). This movie weaves together complex scientific ideas from string theory, such as higher dimensions and the "bulk", highlighting the profound effect these theoretical notions have on people's imagination and cultural expressions [4].

Conclusions: It can be concluded that string theory has evolved from just a scientific idea to a significant part of our culture. It represents much more than an advanced scientific idea; it encapsulates humanity's persistent quest for deeper understanding, truth, and meaning in a constantly increasing universe.

Acknowledgements: Many thanks to Mădălina Stănescu, PhD, for her invaluable guidance throughout this research.

Keywords: *string theory, multidimensional universe, cosmology, science fiction, evolution.*

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12) British Colonization of the Americas

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Introduction: The British colonization of America began in the early 17th century, motivated by economic expansion, religious freedom, and territorial ambitions. This process led to the establishment of thirteen colonies along the eastern coast of North America, which played a crucial role in shaping the political, economic, and social dynamics of the region.

Methods and Results: The analysis of British colonization focuses on historical records, economic reports, and sociopolitical developments. The colonies were founded under different charters and governance structures, evolving from Crown-controlled territories to semi-autonomous entities with increasing self-rule. Trade, agriculture, and the exploitation of natural resources significantly contributed to economic prosperity, particularly in the southern colonies where plantation economies depended on enslaved labor. Relations with Indigenous peoples were marked by both cooperation and conflict, as expansion led to territorial disputes and violent confrontations. Furthermore, growing discontent with British taxation policies and governance restrictions culminated in the American Revolution (1775–1783), leading to the independence of the United States.

Conclusions: The British colonization of America left a lasting impact on the region, influencing its political institutions, economic systems, and cultural identity. The governance models and legal frameworks established during this period served as a foundation for the future development of the United States. Additionally, the economic structures introduced by British settlers, particularly in agriculture and trade, continued to shape American society long after independence.

Acknowledgements: We acknowledge the support and guidance of Sopon Diana.

Keywords: *Colonization, British Empire, America, Economy, Governance, Revolution.*

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13) Naval Warfare: Movies vs. Reality

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Introduction: Naval warfare has been a crucial aspect of military history, with significant battles shaping global conflicts. Films such as *Greyhound* (2020) and *Midway* (2019) attempt to depict these battles, yet they often include dramatic embellishments. This study evaluates the accuracy of these films compared to historical events, focusing on their representation of tactics, technology, and combat realism.

Methods and Results: A comparative analysis was conducted by examining both films against historical records from the Battle of the Atlantic and the Battle of Midway. The evaluation considered criteria such as ship design, battle tactics, command decisions, and enemy engagement.



Greyhound: Based on C.S. Forester's novel "The Good Shepherd", the film accurately portrays the intensity of World War II convoy escort missions. However, dramatic elements – such as German U-boats taunting Allied forces over the radio – lack historical evidence.

Midway: The film closely follows real events, particularly the strategies and key moments of the battle. While character portrayals and decision-making sequences are largely accurate, certain interactions and dialogue were dramatized for storytelling purposes.

Conclusions: Both *Greyhound* and *Midway* provide compelling narratives that introduce audiences to critical moments in naval history. However, while *Midway* maintains a stronger commitment to historical accuracy, *Greyhound* takes creative liberties in character interactions and battle portrayals. Viewers should recognize the entertainment-driven embellishments in such films and supplement them with historical research for a deeper understanding.

Acknowledgements: PhD, Kaiter Edith-Hilde, Senior Lecturer.

Keywords: *Naval warfare, military history, war films, historical accuracy.*

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14) Extraordinary Until Proven Otherwise

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Introduction: For as long as humans have gazed at the stars, we have wondered whether we are alone in the universe. The sheer number of potentially habitable planets suggests that intelligent life should exist beyond Earth, yet we have found no clear evidence—this contradiction lies at the heart of the Fermi Paradox. At the same time, the Kardashev Scale provides a framework for measuring the technological advancement of civilizations, yet we see no signs of highly developed extraterrestrial societies.

Beyond scientific theories, history is filled with events that have fueled speculation and conspiracy. The Roswell Incident, the USS Nimitz UFO encounters, and the Battle of Los Angeles have all sparked debates about government cover-ups and extraterrestrial visitations. While some claim these incidents provide proof of alien contact, others argue they are misinterpretations of earthly phenomena.

Methods and Results: This paper seeks to explore these fascinating mysteries, separating fact from fiction by examining both scientific perspectives and cultural narratives. By analyzing paradoxes, alleged encounters, and cosmic anomalies, it aims to provide a balanced perspective on our search for extraterrestrial intelligence—and what it reveals about our own place in the universe.

Battle of Los Angeles: Conspiracy theories surrounding the Battle of Los Angeles during World War II, where American military forces engaged unidentified objects over the city in 1942, persist due to conflicting interpretations, with some alleging government cover-ups of extraterrestrial encounters or staged events to manipulate public opinion, despite the lack of concrete evidence supporting these claims, keeping the incident shrouded in mystery and subject to speculative discussions.

Roswell Incident: The Roswell Incident of 1947 involves conflicting reports from the United States Army regarding the recovery of either a UFO or a weather balloon near Roswell, New Mexico, sparking conspiracy theories about extraterrestrial contact and government cover-ups.



Despite speculation and conspiracy theories, there is a lack of solid evidence supporting the hypothesis that the Roswell Incident involved encounters with extraterrestrial beings, leading to ongoing controversy within the realms of unidentified flying objects and conspiracy theories

USS Nimitz: Alleged encounters with unidentified flying objects (UFOs) involving events associated with the USS Nimitz Fleet have been the subject of limited disclosure and questionable reports, contributing to ongoing speculation and debate.

The primary incident linked to the USS Nimitz occurred in 2004, when fighter pilots reported encountering an unidentified flying object off the coast of California, describing its capabilities as beyond known technology, with subsequent media attention and public scrutiny fueled by associated videos depicting anomalous aerial phenomena.

Conclusions: The search for extraterrestrial intelligence remains one of humanity's greatest mysteries, blending scientific inquiry with cultural fascination. The Fermi Paradox highlights the contradiction between the high probability of alien life and the lack of observable evidence, while the Kardashev Scale offers a framework for understanding potential civilizations, none of which we have yet detected. These unanswered questions continue to challenge our understanding of the universe and our own technological limitations.

At the same time, historical incidents such as the Roswell Incident, the USS Nimitz UFO encounters, and the Battle of Los Angeles reveal how uncertainty and speculation shape public perceptions of alien life. While no conclusive proof of extraterrestrial contact has been found, these events have fueled widespread interest, government investigations, and ongoing debates about what might be hidden from public knowledge.

Ultimately, the pursuit of extraterrestrial life is as much about understanding ourselves as it is about discovering others. Whether through scientific research, technological advancement, or cultural narratives, our search for the unknown reflects a deep-rooted curiosity and a desire to find our place in the cosmos. Until definitive evidence emerges, we remain explorers of both the universe and our own imagination, continuously questioning what lies beyond our world.

Acknowledgements: Lect.Univ.Dr. SOPON Diana-Annelisse.

Keywords: *Battle of Los Angeles, Conspiracy Theories, Extraterrestrial Intelligence, Fermi Paradox, Government Cover-ups.*

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15) Is a Byte More Powerful than a Bullet? The Impact of Computers in Modern Warfare

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Introduction: Ever since the first mechanical computers helped the armies of the world decrypt enemy communications and plans, the power of a machine that could compute raw data into useful information has seen an exponential increase, both in a computational sense and a practical sense. With a quickly evolving toolset and range of use cases, one can ask: Is a single byte becoming more powerful than a bullet? This paper aims to explore this question by examining both the historical evolution of computers and their impact not only on modern conflicts but on the everyday lives of people around the world. We also emphasize the crucial importance of being educated in filtering information, especially in an era where the overwhelming flow of information poses significant challenges in discerning truth from manipulation. As technological advancements accelerate, state and non-state actors increasingly exploit information warfare to destabilize nations and manipulate public opinion. Thus, educating the public in critical information filtration has become crucial not only for individual autonomy but also for national security.

Methods and Results: While writing this paper, we thought it necessary to first and foremost take a chronological approach to the technological advancements, that influenced the computing field, and the most representative events and cases in which computers played an essential role. By taking information from websites, online encyclopedias, articles and, for more recent events, news and analyses on what is happening in the international space, we believe that we furthered the aforementioned goal of offering a possible answer to the question of whether or not 1s and 0s are in the process of outweighing metal and gunpowder in a world that is becoming ever more tensioned and uncertain.

Conclusions: In conclusion, as the line between the digital and the physical space has passed beyond the phase of being blurred, computers, the internet and modern electronics have become intertwined not only with our way of life, but with critical infrastructures and services within nation states and their governments. With the convenience and utility, they have brought, these technological advancements have also introduced many vulnerabilities and security concerns for everyone and everything that enjoys their features. Militaries around the world now face much more difficulty both in hiding from their adversaries and in protecting critical information on which many a soldiers' lives depend on. At the same time, the dangers of warfare, which has expanded into the cyber realm, have reached a point in which they spill over into civilian areas and do major damage without a single fire shot or response from the victim of the attack. From hospitals that are crippled without their informational systems and databases to whole electrical power supply systems being shut down and public opinion being swayed by opaque algorithms and misinformation, bytes have laid out a fertile ground for the rapid expansion of a much more aggressive and dangerous type of hybrid warfare. The ability to critically evaluate and filter information is essential for protecting societies from manipulation. Strengthening information literacy is vital to safeguard democratic institutions and national security, ensuring that technology is used to advance, not deceive.

Acknowledgements: We would like to thank our professor, Corina Mărculescu, PhD, for her guidance and the help that she has provided us with.

Keywords: *Computers, byte, security, military, information warfare.*

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16) Teaching English Through Pop Culture: Bridging the Gap with Students

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Introduction: The phenomenon of generation gap has been a noticeable issue since the beginning of times, a problem that is still not remotely close to being overcome. Despite the fact that different generations will always have different habits and beliefs, there should be no habit of complaining about one another. On the contrary, people should try to bridge the gap brick by brick. Through this paper we aim to bring forward one of those bricks by introducing methods of teaching English which are newer, more appealing and closer to the younger generation.

Methods and Results: It is safe to state that, for nowadays students, classes can become boring and unattractive extremely frequently, especially when the amount of rules and theoretical concepts seems overwhelming. It is also said that the youth have their own language. Why not try to teach them English in their own language?

Both English language and young people's interest are ever-present in domains such as music, television, cinematography and social media content. [2] We believe that it would be beneficial for teachers to embrace the idea of integrating into their lessons references to popular songs, movies or TV shows, current social media trends, or even memes. The first category could serve as a support for the vocabulary lessons, as they all cover a wide range of topics. It is easier for students to memorize new words from a popular scene of a series or the lyrics of a song they hear on the radio daily, rather than from a list on a piece of paper. Grammar should not be left behind either. The endless tables filled with rules whose only fun is their colors could be turned into memes [1], a visual element that students interact with on a daily basis and which they find amusing, thus encouraging them to pay more attention in class and even spend additional time studying.

Conclusions: The purpose of these new approaches is to bring studying closer to the students' usual way of spending their free time, distancing the idea of study from an unpleasant, boring or overwhelming activity and simultaneously strengthening the teacher-student relationship.

Acknowledgements: We would like to express our gratitude to our English teacher, Mădălina Stănescu, for inspiring and guiding us into writing this paper..

Keywords: *language learning, pop culture, teaching methods, English language.*

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17) Henry VII – the King Who Shaped England's Religious and Military Destiny

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Introduction: Henry VIII was born on June 28, 1491, and was the second son and the third child of King Henry VII and his queen, Elizabeth of York. It was his older brother Arthur who, as the eldest male child, was set to inherit the crown on the death of their father. However, being born the second son had its advantages. While Arthur was groomed for kingship right from the start, Henry enjoyed a more informal childhood and was allowed more freedom. He grew up with his sister Margaret in the royal nursery at Eltham, where they were soon briefly joined by three more sisters and brother, of whom only one, Mary, survived childhood. Henry VIII's reign was marked by a break with Rome and the founding of the Church of England, as well as costly military campaigns. He modernized the army and navy, and his economic reforms by dissolving the monasteries profoundly changed England. (Elgin, 2020)

Methods and Results: We considered using open sources such as books, websites, blogs and online journal articles in order to complete our research. We have the credence to say we have fulfilled our goal regarding the writing of this paper.

Conclusions: Henry VIII played a crucial role in the development of the English navy, transforming it into a powerful and professional force. He established a permanent fleet, built new warships, and invested in key naval infrastructure. His reforms and focus on naval expansion not only strengthened England's military capabilities but also laid the foundation for the country's future as a dominant maritime power. Through these efforts, Henry VIII's reign marked a significant turning point in the history of naval warfare and England's influence on the world stage.

In conclusion, Henry VIII's reign marked a transformative era in English history, marked by military innovation, political consolidation, and religious upheaval. He modernized the army and navy, built coastal defenses, and established England as a future maritime power. Breaking with Rome to create the Church of England united political and religious authority under the Crown, while wealth from dissolved monasteries funded his ambitious campaigns. Despite financial strain and religious division, his leadership reshaped England's identity, solidifying the Tudor dynasty and laying the foundation for the nation's rise as a formidable power.

Acknowledgements: We would like to thank our coordinating professor, Dr. Brândușa-Oana Niculescu, for her valuable guidance. You provided us with the tools that we needed to choose the right direction and successfully complete this paper.

Keywords: *Tudor Monarchy, Religious Transformation, Military Power, Military Reform, Political Consolidation.*

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18) Unraveling Guy Fawkes Night and Focul lui Sumedru Through Flames of History

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Introduction: This paper explores the cultural significance and historical roots of two fire-based traditions: Guy Fawkes Night, celebrated annually on November 5th in the United Kingdom, and Focul lui Sumedru, observed on October 25th in rural Romania. Both events center around bonfires and communal gatherings, yet they reflect distinct historical narratives and social purposes. The objective of this study is to compare these traditions in terms of their origins, symbolism, and modern adaptations, shedding light on how fire serves as a unifying element across diverse cultural contexts. Submitted for the Students' International Conference "CERC" 2025, this abstract examines the interplay between historical memory and contemporary celebration.

Methods and Results: The research employs a comparative historical analysis, for Guy Fawkes Night, the study traces its origins to the failed Gunpowder Plot of 1605, where effigies of Guy Fawkes are burned to commemorate the preservation of the monarchy, symbolizing national unity and anti-Catholic sentiment in its early years. In contrast, Focul lui Sumedru, linked to the Orthodox Saint Dimitrie (Sumedru), has pre-Christian roots tied to pastoral life and seasonal renewal, with bonfires lit to mark the end of autumn and ward off evil spirits.

The comparison highlights that fire acts as a versatile symbol, embodying rebellion and survival in the UK, and purification and continuity in Romania. Despite their divergent historical triggers—political conspiracy versus seasonal folklore—both traditions foster community cohesion through shared rituals. However, Guy Fawkes Night's commercialization contrasts with Focul lui Sumedru's localized authenticity, suggesting different trajectories for cultural preservation in the face of globalization.

Conclusions: This study underscores the adaptability of fire-based traditions across time and space.

Acknowledgements: Guy Fawkes Night, Focul lui Sumedru, bonfire traditions, cultural comparison, historical symbolism, community rituals.

Keywords: *Urban warfare, situational awareness, casualty reduction, operational effectiveness, soldier monitoring, augmented reality, autonomous systems, psychophysiology.*

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19) English in Warfare: A Global Standard for Defense and Technology

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Introduction: Effective communication is essential in military operations, where accuracy can significantly influence mission outcomes. Over time, English has established itself as the global standard for military communication, being widely utilized by entities such as NATO, the United Nations (UN), and various multinational defense alliances. This paper seeks to explore the rise of English as the primary language in defense communication, assess its significance in contemporary military technologies such as artificial intelligence, cybersecurity, and autonomous systems, and identify the challenges it poses, including language barriers in multinational missions and biases inherent in AI-driven military technologies. Furthermore, it will investigate the future role of English in military settings, especially considering the advent of new technologies, and evaluate its ongoing importance in global defense and security collaboration. By pursuing these aims, the paper will analyze the lasting influence of English on the evolution of modern warfare and international peacekeeping efforts.

Methods and Results: This research employs a descriptive and analytical methodology, concentrating on existing literature, a case study, and statistical information to explore the significance of English in military communication and technology. The investigation examines the historical background of English as the prevailing language in defense, tracing its ascent through military alliances and international collaborations. Furthermore, it reviews data from contemporary studies on military technology, encompassing artificial intelligence, cybersecurity, and autonomous systems, to comprehend the role of English in these domains. [1][2][3]

In cybersecurity, **English** dominates (99%) in several key areas:

- **Ethical Hacking:** Tools, documentation, and certifications are primarily in English.
- **Red Teaming / Blue Teaming:** Collaboration and resources are almost all in English.
- **Malware Analysis & Reverse Engineering:** Research papers, tools, and forums use English.
- **Security Research:** Most academic papers and technical reports are in English.
- **DevSecOps:** Most tools and documentation are in English.

Some statistics from the point of view of innovation in the technology trend:

- Over 70% of defense-related AI technologies are programmed using English-based coding languages.
- Approximately 80% of military cybersecurity protocols use English-language algorithms for data analysis and threat detection.
- Over 85% of cybersecurity protocols used by multinational defense organizations rely on English-based encryption and communication systems.
- Real-time operational communication for military autonomous systems is 95% in English, even in multinational missions involving non-English speaking countries.



Overall, while other languages may be useful in specific regions, **English** is the universal language in these fields.

The results reveal that English is widely acknowledged as the principal language for military operations, playing a crucial role in international defense coordination and military technology. The research underscores the necessity of English in the development and functioning of AI-driven military systems, with the majority of defense-related programming, cybersecurity measures, and autonomous technologies utilizing English as their primary language. Nonetheless, challenges persist, such as linguistic obstacles in multinational military operations and the risk of bias in AI technologies stemming from their dependence on English-language data. The findings also indicate that while English is expected to maintain its dominance in military communication, advancements in real-time translation technology may alleviate some of these linguistic issues in the future.



Fig. 1. Case Study of the reasons [4]

Conclusions: In this paper, it has been examined the crucial role of **English** as the global standard in warfare, defense, and technology. The analysis revealed several key points regarding its widespread use and significance:

- a) **Technological Progress and Military Development:** The swift advancement of technology, particularly in the realms of cybersecurity, artificial intelligence, and defense systems, has solidified English as the predominant language. Essential scientific studies, military documentation, and development guidelines are predominantly released in English, rendering it an indispensable resource for experts in defense technology and research.
- b) **Global Alliances and Diplomacy:** Proficiency in English is crucial within the realms of diplomacy and international relations, particularly in military alliances like NATO and numerous bilateral agreements that necessitate precise and effective communication. Language acts as a conduit, allowing nations to engage in discussions regarding defense strategies, exchange intelligence, and establish collaborative defense structures.
- c) **Cybersecurity and Information Warfare:** With the increasing significance of cyber warfare in contemporary conflicts, English continues to be the primary language for both cyber defense and offensive strategies. A substantial portion of cybersecurity tools, research, and threat intelligence is available in English, rendering it essential for practitioners in this domain.

Acknowledgements: This study was conducted under the guidance of teaching coordinator Elena Matei.

Keywords: *English, technology, international, statistics, trends.*

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20) The Impact of Mindset on Leadership Behavior: Lessons from Abraham Lincoln

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Introduction: Mindset plays a pivotal role in shaping leadership behavior. Leaders with a growth mindset embrace challenges, viewing them as opportunities for learning and development. This mindset fosters resilience, creativity, and the ability to adapt, which are crucial qualities for effective leadership. On the other hand, a fixed mindset can limit a leader's potential, making them more risk-averse and less open to change, which can negatively impact decision-making and team dynamics.

Abraham Lincoln serves as a prime example of how mindset influences leadership. During the American Civil War, Lincoln faced significant obstacles, including political divisions, military struggles, and public criticism. His growth mindset allowed him to learn from mistakes, adapt his strategies, and ultimately make decisions that helped preserve the Union. Lincoln's willingness to shift his approach, such as his evolving stance on emancipation, demonstrated his ability to evolve based on new information and circumstances. His open-mindedness and persistence inspired his followers, proving that a leader's mindset is essential in guiding others through difficult times and achieving transformative change.

Keywords: *growth mindset, leadership behavior, resilience, decision-making, Abraham Lincoln.*



17. FRENCH CULTURE, CIVILISATION AND MILITARY ETHICS

1) L'essor des drones Bayraktar TB2 dans les opérations militaires modernes

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Introduction: Ces dernières années, l'utilisation des drones et des technologies autonomes dans les forces armées est devenue de plus en plus importante. L'armée roumaine ne fait pas exception à cette tendance mondiale et a commencé à intégrer des drones de pointe pour la reconnaissance, la surveillance, l'attaque et la défense. Parmi les exemples les plus pertinents de drones utilisés par la Roumanie, il y a le Bayraktar TB2, un système de combat aérien très efficace, et les drones développés par l'industrie locale, qui jouent un rôle clé dans les missions de surveillance et les opérations spéciales. Ces innovations contribuent à la modernisation et à l'amélioration de l'efficacité des forces armées roumaines, ce qui leur confère un avantage stratégique sur le champ de bataille.

Méthodes et résultats: Le Bayraktar TB2 est un drone de combat développé par la société turque Baykar Technologies. Conçu pour la reconnaissance, la surveillance et l'attaque, cet UAV se distingue par sa grande précision et son efficacité sur le champ de bataille. Il possède une autonomie remarquable, pouvant voler jusqu'à 27 heures sans ravitaillement, ce qui lui permet de mener des missions prolongées. Son rayon d'action dépasse 150 km, offrant ainsi une couverture étendue du terrain. Grâce à son armement avancé, il peut transporter et lancer des missiles guidés MAM-L et MAM-C, augmentant sa capacité d'attaque de cibles stratégiques. Il est également doté de capteurs sophistiqués, incluant des caméras électro-optiques et infrarouges, garantissant une reconnaissance précise dans toutes les conditions de visibilité. Son intelligence artificielle embarquée lui permet d'effectuer des missions de manière totalement autonome, sans intervention humaine directe, tout en offrant la possibilité d'un contrôle à distance si nécessaire.

La Roumanie a intégré le Bayraktar TB2 dans son arsenal militaire pour renforcer ses capacités de reconnaissance et de frappe à distance.

Pour la Roumanie, ce drone représente une solution moderne et rentable pour améliorer la défense aérienne et optimiser les capacités de frappe à distance. En parallèle, la Roumanie développe ses propres systèmes de drones militaires, visant à renforcer son autonomie technologique et à réduire sa dépendance aux importations d'équipements étrangers. Cette initiative permet non seulement de réduire les coûts, mais aussi d'adapter les UAV aux besoins spécifiques de l'armée roumaine et des missions de l'OTAN.

Conclusions: L'intégration des drones et des technologies autonomes dans l'armée roumaine est une étape cruciale dans le processus de modernisation des forces armées. Le Bayraktar TB2 constitue une solution efficace pour la reconnaissance et l'attaque, et a déjà démontré ses capacités dans des conflits réels. Parallèlement, le développement d'une industrie locale des drones permet à la Roumanie de renforcer son autonomie technologique et d'adapter ses capacités militaires aux défis modernes. À l'avenir, l'utilisation des drones continuera à jouer un rôle essentiel dans la défense nationale, renforçant la position de la Roumanie en tant que partenaire stratégique au sein de l'OTAN et des alliances internationales.

Remerciements: maître de conf. Andreea Preda.

Mots-clés: *Urban warfare, situational awareness, casualty reduction, operational effectiveness, soldier monitoring, augmented reality, autonomous systems, psychophysiology.*



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2) Le syndrome de Paris: quand le rêve vire au choc

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Introduction: Le syndrome de Paris est un phénomène psychologique qui affecte principalement les touristes, en particulier ceux d'origine japonaise, lorsqu'ils visitent la capitale française. Il se caractérise par un sentiment de désillusion intense causé par l'écart entre l'image idéalisée de Paris véhiculée par les médias et la réalité du terrain.

Ce trouble met en lumière la confrontation entre l'idéal et la réalité, soulevant des questions sur notre perception du monde et les attentes culturelles façonnées par l'imaginaire collectif. Cette étude vise à explorer les origines du syndrome de Paris, ses manifestations et son impact psychologique sur les individus qui en souffrent.

Méthodes et résultats: L'analyse repose sur une approche comparative entre la perception idéalisée de Paris et la réalité vécue par les visiteurs affectés par ce syndrome. Nous avons identifié plusieurs facteurs contribuant à cette désillusion:

L'illusion médiatique et culturelle. Paris est souvent présenté dans les films, la littérature et les guides touristiques comme une ville romantique, élégante et sophistiquée. Les touristes s'attendent à un environnement harmonieux, où la beauté architecturale, l'accueil chaleureux et l'ambiance bohème se mêlent à la perfection. Or, la réalité peut s'avérer bien différente. Il y a aussi d'autres facteurs comme l'affluence touristique et congestion urbaine, les problèmes sociaux (mendicité, grèves, insécurité) ou les attitudes perçues comme froides ou distantes de certains habitants.

L'impact psychologique et les symptômes. Les visiteurs souffrant du syndrome de Paris peuvent présenter des symptômes tels que : désorientation et choc culturel (difficulté à accepter la disparité entre leurs attentes et la réalité) ; anxiété et détresse émotionnelle (sentiment de trahison et frustration) et troubles physiques (vertiges, palpitations, insomnie).

Facteurs culturels et vulnérabilité. Les touristes japonais semblent être les plus touchés par ce syndrome. Plusieurs raisons expliquent cette sensibilité accrue à cause d'une attente culturelle élevée liée à l'image romantique de la France véhiculée dans les médias japonais. Une autre cause peut être la différence marquée dans les normes sociales : au Japon, l'amabilité et la politesse sont omniprésentes, tandis que la culture parisienne peut être perçue comme plus directe, voire distante. Enfin, la barrière linguistique rend l'expérience encore plus difficile.

Conclusions: Le syndrome de Paris illustre la puissance des illusions collectives et leur impact sur notre perception du monde. Il met en évidence la difficulté d'accepter une réalité qui ne correspond pas aux attentes construites par la culture et les médias.



La désillusion n'est pas uniquement un phénomène touristique : elle peut se retrouver dans de nombreux aspects de la vie, des relations personnelles aux ambitions professionnelles.

Être conscient de ces dynamiques nous permet d'adopter un regard plus critique et réaliste sur nos expériences, nous aidant ainsi à mieux naviguer dans la complexité de notre monde moderne.

Remerciements: maître de conf. Andreea Preda.

Mots clés: *syndrome de Paris, désillusion, choc culturel, attentes, tourisme.*

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3) Bâtiments bizarres de France

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Introduction: La France, riche d'un patrimoine architectural impressionnant, abrite de nombreux édifices qui sortent de l'ordinaire par leur conception, leur fonctionnalité ou leur esthétique. Ces bâtiments, qu'ils soient modernes, historiques ou disparus, reflètent une approche unique de l'architecture et de l'innovation. Ce projet vise à explorer quelques-uns des bâtiments les plus insolites de France en mettant en avant leur conception, leur histoire et leur impact culturel.

Méthodes et résultats: Nous présenterons une brève histoire de la construction de chaque bâtiment, en mettant en avant les architectes ou artistes principaux qui ont façonné leur conception. Nous analyserons également leur évolution jusqu'à présent et leur impact sur le paysage culturel et architectural français.

1. Le Palais Idéal du Facteur Cheval, situé à Hauterives
2. La Maison Picassiette, située à Chartres
3. La Bibliothèque Louis Nucéra (Tête Carrée), implantée à Nice
4. La Maison Bulle de Pierre Cardin aussi connue sous le nom de Palais Bulles, située à Théoule-sur-Mer
5. Les Machines de l'île, situées à Nantes et inspirées de l'univers de Jules Verne et de l'imagination de Léonard de Vinci
6. La Bastille de Paris (détruite)
7. Le Phare de Cordouan, construit entre 1584 et 1611
8. Le Mur des Canuts, situé à Lyon

Conclusions: L'architecture française ne se limite pas à ses monuments historiques et classiques. Des constructions comme le Palais Idéal du Facteur Cheval, la Maison Picassiette ou encore les Machines de l'île illustrent la créativité et l'audace des architectes et artistes qui ont voulu repousser les limites du conventionnel. D'autres bâtiments, comme la Bastille, bien que disparus, ont joué un rôle clé dans l'histoire. Ces structures reflètent non seulement des techniques architecturales innovantes, mais aussi une vision artistique et culturelle qui continue d'inspirer et de fasciner le monde entier.

Remerciements: maître de conf. Andreea Preda.

Mots clés: *bâtiment, bizarre, artiste, architecture, culture.*



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4) L'idée créative et la dystopie dans 1984 de George Orwell

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Introduction: Notre présentation explore la manière dont George Orwell conçoit et développe l'idée créative dans son roman dystopique 1984. L'œuvre, publiée en 1949, dépeint une société totalitaire où la surveillance, la manipulation de l'information et la restriction de la pensée critique sont omniprésentes.

Le récit suit Winston Smith, un individu qui remet en question le régime oppressif du Parti dirigé par Big Brother. À travers 1984, Orwell illustre les dangers d'un contrôle total sur la pensée humaine, en utilisant une créativité unique pour concevoir un univers où la liberté individuelle est totalement anéantie.

Méthodes et résultats: Orwell construit une dystopie immersive à travers plusieurs techniques:

- Novlangue : Un langage simplifié conçu pour limiter la pensée critique;
- Surveillance constante : Le Télécran contrôle chaque mouvement des citoyens;
- Révision de l'histoire : Winston falsifie les archives pour que le Parti ait toujours raison;
- Psychologie de la peur : La torture et l'intimidation brisent toute opposition;
- Doublepensée : Accepter simultanément deux idées contradictoires renforce la soumission au régime.

Ces méthodes illustrent comment la propagande et la répression peuvent anéantir toute résistance intellectuelle et psychologique.

Conclusions: L'œuvre 1984 de George Orwell demeure l'une des critiques les plus percutantes du totalitarisme. Sa pertinence dans la société moderne est indéniable, car elle met en garde contre les dérives autoritaires, la manipulation médiatique et la surveillance excessive.

En combinant une imagination dystopique avec des concepts politiques et philosophiques profonds, Orwell ne se contente pas d'alerter son lectorat, mais le pousse à une réflexion critique sur la liberté et la vérité dans nos sociétés contemporaines.

Remerciements: maître de conf. Andreea Preda.

Mots clés: *Dystopie, totalitarisme, surveillance, manipulation, liberté.*

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5) L'influence de la cathédrale de Notre-Dame de Paris sur la culture française

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Introduction: Notre présentation explore l'importance de la Cathédrale de Notre-Dame de Paris, soulignant son rôle en tant que symbole puissant de l'histoire et de l'identité françaises.

Méthodes et résultats: Depuis près de neuf siècles, elle a vu défiler des événements majeurs, du couronnement de Napoléon à la libération de Paris en 1944. Son architecture gothique, avec ses célèbres gargouilles et vitraux, fascine les visiteurs du monde entier et a inspiré de nombreux artistes. La musique résonne aussi dans ses murs depuis des siècles, portée par ses grandes orgues qui ont influencé des compositeurs comme Louis Vierne et Olivier Messiaen. Chaque année, des millions de touristes et de croyants franchissent les portes de la Cathédrale de Notre-Dame de Paris, attirés par sa beauté et sa spiritualité. L'incendie de 2019 a profondément marqué les esprits, mais aussi renforcé l'attachement des Français à ce chef-d'œuvre. Aujourd'hui, sa restauration symbolise un renouveau, prouvant que Notre-Dame n'est pas seulement une cathédrale, mais un véritable trésor du patrimoine culturel européen.

Conclusions: La Cathédrale de Notre-Dame de Paris demeure un symbole incontesté de l'histoire, de l'identité et de la culture françaises. Son architecture gothique unique, son rôle central dans les événements historiques et son influence sur la musique et l'art témoignent de son importance à travers les siècles. La restauration de la cathédrale est non seulement un acte de préservation du patrimoine, mais aussi un symbole d'espoir et de résilience. Aujourd'hui, Notre-Dame reste un lieu de spiritualité, d'admiration et d'inspiration, et continue de jouer un rôle majeur dans la culture européenne.

Remerciements: Corina SANDIUC.

Mots clés: *Notre-Dame de Paris, culture française, histoire, art.*

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6) Suis-je honnête avec moi-même ? « Illusions perdues » de la vie quotidienne

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Introduction: L'œuvre « Illusions perdues » d'Honoré de Balzac explore la désillusion et le contraste entre les aspirations idéalisées et la réalité impitoyable. De la même manière, notre vie quotidienne est ponctuée d'illusions que nous entretenons sur nous-mêmes, sur les autres et sur le monde qui nous entoure.

Cette réflexion interroge notre honnêteté envers nous-mêmes : sommes-nous conscients des illusions qui façonnent notre perception du réel? Le but de cette présentation est d'examiner comment les mécanismes décrits par Balzac résonnent avec les désillusions contemporaines et de mieux comprendre les dynamiques de l'auto-illusion dans notre société.

Méthodes et résultats: L'analyse repose sur une approche comparative entre « Illusions perdues » et des exemples de la vie quotidienne où les individus se confrontent à leurs propres illusions. Balzac illustre notamment à travers le parcours de Lucien de Rubempré



l'ascension et la chute d'un jeune homme aveuglé par ses ambitions et ses rêves. Cette dynamique se retrouve dans de nombreux aspects de notre société moderne:

1. *Illusions professionnelles*: À l'instar de Lucien, nombreux sont ceux qui nourrissent des espoirs démesurés sur leur carrière, influencés par des discours méritocratiques ou des promesses d'ascension rapide. Cependant, la réalité du marché du travail, marquée par la compétition et les inégalités, engendre souvent des désillusions amères;
2. *Illusions relationnelles*: L'idéalisation des relations amoureuses ou amicales est un autre exemple de ces illusions. Balzac montre comment les personnages sont dupés par leurs propres attentes et par les jeux de pouvoir inhérents aux interactions sociales, un phénomène encore exacerbé aujourd'hui par les réseaux sociaux et les représentations idéalisées des relations humaines;
3. *Illusions médiatiques et culturelles*: Dans « Illusions perdues », la presse joue un rôle central dans la manipulation des opinions et la fabrication du succès. Aujourd'hui, ce mécanisme est amplifié par la culture numérique et l'omniprésence des médias, qui participent à la construction d'une réalité biaisée et parfois trompeuse.

Cette étude met en lumière la permanence des dynamiques d'auto-illusion et leur impact sur notre quotidien. Elle souligne également le rôle de la lucidité et du discernement dans notre rapport au monde.

Conclusions: L'analyse « d'Illusions perdues » nous permet de comprendre comment les illusions personnelles et collectives influencent notre vision du monde. La confrontation entre les idéaux et la réalité est un défi constant, et être honnête avec soi-même implique une remise en question de nos croyances et de nos attentes. En identifiant les mécanismes d'auto-illusion, nous pouvons développer un regard plus critique et nuancé sur notre propre existence et ainsi mieux naviguer dans les complexités de la vie quotidienne.

Remerciements: maître de conf. Andreea Preda.

Mots clés: Balzac, *Illusions perdues*, société, ambition, lucidité.

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7) Projets impressionnants de France

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Introduction: La France est reconnue pour ses réalisations architecturales et d'ingénierie qui témoignent de son riche passé et de son innovation constante. Certaines constructions, qu'elles soient historiques ou modernes, illustrent le génie technique et artistique du pays. Ce projet explore cinq édifices remarquables : le Viaduc de Millau, la Tour Eiffel, le Musée du Louvre-Lens, l'Abbaye du Mont Saint-Michel et le Château de Chambord. Chacun de ces projets représente un défi architectural et un héritage culturel qui continue d'influencer le monde contemporain.

Méthodes et résultats: Nous avons analysé ces constructions en nous basant sur plusieurs critères : le contexte historique et la nécessité du projet, les défis techniques et architecturaux et l'impact culturel et économique

Dans le projet, nous analyserons les constructions suivantes :





1. Le viaduc de Millau

Ce pont, inauguré en 2004 et conçu par Norman Foster et Michel Virlogeux, détient le record du pont routier le plus haut du monde (343 mètres). Il a révolutionné le transport dans le sud de la France et demeure une prouesse d'ingénierie moderne.

2. La tour Eiffel

Construite en 1889 par Gustave Eiffel, cette structure métallique était initialement controversée mais est devenue un symbole mondial de la France. Elle représente une avancée majeure dans l'utilisation du fer dans la construction.

3. Le musée du Louvre-Lens

Inauguré en 2012, il est une extension moderne du Musée du Louvre et se distingue par son architecture minimaliste en verre et aluminium. Il favorise l'accès à l'art dans une région post-industrielle.

4. L'abbaye du Mont Saint-Michel

Construite entre le VIII^e et le XV^e siècle, cette abbaye gothique, perchée sur un îlot rocheux en Normandie, est un exploit d'ingénierie médiévale et un lieu de pèlerinage incontournable.

5. Le château de Chambord

Construit au XVI^e siècle, ce chef-d'œuvre de la Renaissance française est célèbre pour son escalier à double révolution, attribué à Léonard de Vinci. Il témoigne du pouvoir et de la vision artistique de François I^{er}.

Conclusions: Ces projets illustrent la capacité de la France à innover tout en préservant son patrimoine. Qu'ils soient anciens ou récents, ces édifices continuent d'attirer des millions de visiteurs et influencent l'architecture contemporaine. L'étude de ces constructions nous permet de mieux comprendre l'évolution des techniques de construction et l'importance du patrimoine culturel.

Remerciements: maître de conf. Andreea Preda.

Mots clés: architecture, ingénierie, patrimoine, innovation, France.

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8) Mythes et légendes dans la littérature roumaine : entre tradition et modernité

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Introduction: Les mythes et légendes sont des éléments fondamentaux de toute culture, transmettant des valeurs, des croyances et des explications sur l'origine du monde. Dans la littérature roumaine, ces récits ont joué un rôle essentiel, influençant non seulement l'imaginaire collectif, mais aussi les œuvres littéraires modernes.

Cette présentation explore la manière dont les mythes et légendes roumains ont traversé les siècles, s'adaptant aux réalités contemporaines. Nous examinerons comment ces récits



continuent de façonner l'identité nationale et influencent encore la littérature et la culture populaires d'aujourd'hui.

Méthodes et résultats: L'analyse repose sur une approche comparative entre les mythes et légendes traditionnels et leur interprétation dans la littérature et la culture roumaine moderne. Les catégories que nous aborderons sont les suivantes :

1. **Mythes anthropogoniques** – Ils présentent la naissance et la formation de l'homme.
 - Ex : le mythe de Făt-Frumos.
2. **Mythes héroïques** – Ils illustrent les exploits de bravoure des héros légendaires.
 - Ex : le mythe de Traian et Dochia, la légende de Ștefan cel Mare.
3. **Mythes religieux** – Ils traitent des sujets liés aux croyances populaires et à la divinité.
 - Ex : le mythe de Miorița, qui contient des éléments de résignation et de spiritualité.
4. **Mythes de la mort et de l'au-delà** – Ils expliquent la vision du peuple sur la vie après la mort.
 - Ex : le mythe de « Zburătorul », qui représente un esprit troublant les jeunes filles non mariées.

Le renouveau des croyances populaires à travers les récits urbains et notre recherche montrent que les mythes et légendes, bien qu'anciens, restent pertinents et adaptables aux réalités modernes. Ils servent non seulement de références culturelles, mais aussi d'outils pour comprendre l'évolution de la société roumaine.

L'impact du folklore dans la littérature roumaine contemporaine se retrouve chez des auteurs tels que Mircea Eliade, Vasile Voiculescu, etc.

Conclusions: Les mythes et légendes de la littérature roumaine constituent un patrimoine culturel inestimable. Leur persistance dans la littérature et l'imaginaire collectif prouve leur capacité d'adaptation aux nouvelles réalités. Comprendre ces récits nous permet de mieux appréhender notre passé, mais aussi d'interroger notre identité dans le présent.

En reconnaissant la place des mythes dans la culture contemporaine, nous pouvons développer un regard plus critique sur les récits qui façonnent nos croyances et notre vision du monde.

Remerciements: maître de conf. Andreea Preda.

Mots clés: *mythes roumains, légendes, folklore, littérature, identité culturelle.*

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9) L'intelligence artificielle et la musique au service des personnes malades

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Introduction: La musique a toujours été une source de réconfort et d'émotion pour l'humanité. Depuis des siècles, elle accompagne les moments de joie et de tristesse. Aujourd'hui, grâce à l'intelligence artificielle (IA), la musique devient un outil thérapeutique puissant pour les personnes malades.

Méthodes et résultats: L'IA a révolutionné plusieurs domaines, y compris la médecine et la musique. Des algorithmes sophistiqués peuvent analyser les émotions d'un patient et générer des mélodies adaptées à son état psychologique. Par exemple, des applications comme « AI Music Therapy » utilisent l'IA pour créer des playlists personnalisées qui aident les patients atteints de stress, d'anxiété ou de maladies neurodégénératives.



Dans les hôpitaux, la musicothérapie assistée par l'IA est de plus en plus utilisée. Des études ont montré que la musique générée par l'IA réduit la douleur et améliore le bien-être des patients. Il serait formidable si ces technologies devenaient accessibles à un plus grand nombre de personnes.

Si l'IA avait existé plus tôt, de nombreux patients auraient pu bénéficier d'un traitement plus humain et personnalisé. Dans l'avenir, elle pourra peut-être composer des morceaux uniques pour chaque individu, en fonction de son état de santé. De plus, on prévoit que l'IA et la musique deviendront des éléments essentiels des soins médicaux.

Conclusions: En conclusion, l'intelligence artificielle et la musique ouvrent de nouvelles perspectives pour le traitement des maladies. Grâce à ces avancées, il sera possible d'améliorer la qualité de vie de nombreux patients. Il ne fait aucun doute que cette révolution musicale et technologique continuera à progresser et à surprendre le monde.

Remerciements: maître de conf. Andreea Preda.

Mots clés: *Intelligence artificielle, musique, thérapie, bien-être, innovation, médecine, émotions, futur.*

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10) Insuccès en ingénierie civil

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Introduction: Cette présentation explore certains des plus grands et célèbres insuccès en ingénierie, qui ont eu un impact significatif sur le domaine de l'ingénierie civile. De l'effondrement spectaculaire du pont Tacoma Narrows aux erreurs de conception du bâtiment Walkie-Talkie à Londres, en passant par les incidents récents à Shanghai, chacun de ces cas met en évidence l'importance d'une planification rigoureuse, d'une évaluation correcte des risques et de tests minutieux. Ces erreurs ne sont pas seulement des leçons pénibles, mais aussi des jalons essentiels qui ont conduit à des progrès significatifs en ingénierie et en construction. La présentation vise à souligner le rôle fondamental des enseignements tirés des erreurs du passé, contribuant ainsi à la création de normes de sécurité plus strictes et à l'amélioration des processus de conception et de construction dans le monde entier.

Méthodes et résultats: La présentation proposée se concentre sur l'analyse de certains échecs majeurs en ingénierie, ayant eu un impact significatif sur l'industrie de la construction et ayant contribué à des changements essentiels dans les approches techniques et de sécurité de ce domaine. Les échecs structurels, les défauts de conception, les erreurs en construction et les excavations non sécurisées sont des situations significatives de l'importance d'un calcul minutieux, de tests appropriés et de l'évaluation des risques dans un projet de construction.

À travers l'analyse de ces événements, les causes et les conséquences de chaque erreur seront abordées, ainsi que les leçons apprises qui ont été appliquées pour prévenir des incidents similaires à l'avenir. De plus, l'accent sera mis sur la manière dont ces événements ont conduit à des réglementations plus strictes et à l'évolution des normes en génie civil. Bien que certaines de ces erreurs aient eu des effets dévastateurs, elles ont ouvert la voie à des innovations



essentielles dans le domaine, améliorant la sécurité et l'efficacité dans la conception des structures modernes.

Le résumé de ce travail cherche à souligner l'importance d'apprendre des erreurs du passé, démontrant qu'à travers les erreurs, nous pouvons parvenir à des solutions plus sûres et plus efficaces. Il sera également question de l'importance de trouver un équilibre entre l'innovation et la responsabilité, afin que les projets de construction puissent évoluer de manière durable et répondre aux exigences de la société contemporaine.

Conclusions: L'analyse des échecs majeurs en ingénierie met en évidence l'importance d'une planification rigoureuse et d'une évaluation correcte des risques dans la construction. Bien que dévastateurs, ces événements ont contribué à l'amélioration des normes de sécurité et des réglementations en génie civil. Les leçons tirées ont permis de créer des solutions plus sûres et plus efficaces, montrant que l'innovation doit aller de pair avec la responsabilité.

L'équilibre entre innovation et sécurité est essentiel, comme le montre l'impact de ces incidents sur les pratiques de conception et les réglementations internationales. Ces erreurs ont ouvert la voie au progrès, prouvant qu'en apprenant du passé, nous pouvons construire un avenir plus sûr et durable, répondant aux besoins de la société sans compromettre la sécurité ou l'efficacité.

Remerciements: maître de conf. Andreea Preda.

Mots clés: *Erreurs d'ingénierie, insuccès structurels, leçons des échecs, sécurité des constructions, enseignements des effondrements.*

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11) Suis-je étranger à moi-même ? Une lecture existentielle de L'Étranger d'Albert Camus

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Introduction: Dans son roman L'Étranger, Albert Camus explore l'absurdité de l'existence à travers le personnage de Meursault, un homme détaché des conventions sociales et des émotions attendues. Son indifférence face à la mort de sa mère et son absence de réaction aux événements de la vie le placent en marge de la société, faisant de lui un « étranger » au monde qui l'entoure.

Ce roman soulève des questions fondamentales sur le sens de la vie, la liberté individuelle et l'absurde. Cette étude vise à examiner comment L'Étranger illustre la philosophie de l'absurde selon Camus et met en lumière la confrontation entre l'individu et un monde dépourvu de sens.

Méthodes et résultats: L'analyse repose sur une approche comparative entre la pensée existentialiste et le parcours de Meursault. Plusieurs thèmes clés émergent de cette réflexion :

1. L'absurde et l'indifférence de Meursault : Dès le début du roman, l'attitude de Meursault face à la mort de sa mère choque le lecteur : il ne pleure pas, ne montre aucun chagrin et semble plus préoccupé par des détails matériels que par l'événement lui-même. Ce détachement traduit une absence d'adhésion aux normes émotionnelles imposées par la société. Cette indifférence s'observe également dans sa relation avec Marie, qu'il accepte



d'épouser sans éprouver d'amour profond, ou encore dans son rapport à la violence lorsqu'il tue un homme sans véritable intention, comme mû par une fatalité extérieure.

2. La justice et le rejet de l'individu par la société :Le procès de Meursault illustre comment la société juge non seulement les actes d'un individu, mais aussi son comportement et son adhésion aux conventions sociales. Il n'est pas condamné uniquement pour son crime, mais aussi pour son manque d'émotion et son refus d'exprimer du remords.Ce rejet par la société met en lumière la nécessité de conformité dans un monde où l'absurde n'est pas accepté. Meursault, en refusant de jouer le jeu des apparences, devient un étranger aux yeux des autres.

3. L'acceptation de l'absurde et la liberté ultime :Dans la dernière partie du roman, Meursault accepte pleinement l'absurde et trouve une forme de liberté dans l'indifférence au jugement du monde. Il comprend que la vie est dénuée de sens objectif et qu'il ne sert à rien de chercher des explications rationnelles ou des justifications morales.

Cette révélation culmine dans la célèbre phrase finale où il souhaite être accueilli par « des cris de haine » le jour de son exécution. En acceptant son destin sans illusion, il atteint une forme d'harmonie avec l'absurde.

Conclusions: L'Étranger est un roman qui remet en question nos certitudes et nos attentes face à la vie et à la mort. Camus y développe une réflexion sur la condition humaine, où l'absurde devient à la fois un fardeau et une source de libération.Le parcours de Meursault nous invite à nous interroger sur notre propre rapport au monde: sommes-nous prêts à accepter l'absurde, ou préférons-nous nous réfugier dans des illusions rassurantes?

Remerciements: maître de conf. Andreea Preda.

Mots clés: Camus, absurde, existentialisme, justice, liberté.

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12) Les grands chefs de la cuisine française et la gastronomie traditionnelle

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Introduction: La cuisine française est reconnue mondialement pour son excellence et son raffinement. Elle repose sur des techniques culinaires précises et une tradition gastronomique riche. De nombreux chefs français ont marqué l'histoire de la gastronomie en révolutionnant les arts culinaires et en exportant leur savoir-faire à travers le monde. L'objectif de cette présentation est de mettre en avant les plus grands chefs français et leur influence sur la cuisine internationale, tout en abordant quelques plats traditionnels français emblématiques.

Méthodes et résultats: La cuisine française doit une grande partie de sa renommée à des chefs visionnaires qui ont su allier tradition et innovation. Notre approche vise à les présenter brièvement, en soulignant leur impact sur l'évolution de la cuisine française et mondiale.

Parmi eux, Auguste Escoffier, souvent considéré comme le « roi des cuisiniers et le cuisinier des rois », a joué un rôle décisif en modernisant l'organisation des cuisines professionnelles. Son introduction du système de brigade a rationalisé le travail en cuisine et ses nombreuses codifications de recettes continuent d'influencer la gastronomie mondiale.

Paul Bocuse, figure emblématique de la « nouvelle cuisine », a révolutionné l'approche culinaire en mettant l'accent sur la légèreté, la fraîcheur des ingrédients et une présentation soignée. Son restaurant, l'Auberge du Pont de Collonges, est aujourd'hui une institution.



Joël Robuchon, le chef le plus étoilé du monde, a su parfaire les recettes classiques et créer des restaurants dans le monde entier, de Paris à Tokyo, tout en transmettant un savoir-faire exigeant.

D'autres grands noms comme Alain Ducasse et Anne-Sophie Pic continuent d'innover tout en préservant l'authenticité de la cuisine française.

La richesse de cette cuisine se reflète également dans ses plats traditionnels. Le coq au vin, par exemple, illustre parfaitement l'art de mijoter des aliments pour en extraire toute la saveur. La bouillabaisse, cette fameuse soupe de poisson marseillaise, est un témoignage du lien entre la cuisine et les régions. Le bœuf bourguignon, longuement mijoté dans une sauce au vin rouge, et le cassoulet, spécialité du sud-ouest à base de haricots blancs et de viande, sont autant d'exemples de plats ancrés dans la culture gastronomique française. En dessert, les crêpes et la tarte Tatin viennent clore un repas sur une note sucrée, représentant à elles seules l'héritage culinaire du pays.

Conclusions: La cuisine française doit sa réputation à ses chefs innovants et talentueux qui ont su préserver les traditions tout en les modernisant. Leur influence s'étend bien au-delà des frontières françaises, avec des restaurants et des techniques adoptées dans le monde entier. La richesse des plats traditionnels illustre parfaitement cette excellence gastronomique.

Remerciements: maître de conf. Andreea Preda.

Mots clés: *Gastronomie française, chefs cuisiniers, tradition, innovation, haute cuisine, plats emblématiques.*

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13) Gabrielle Chanel. L'écho de sa influence sur l'identité culturelle française

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Introduction: Coco Chanel a redéfini l'élégance française et a joué un rôle clé dans l'établissement de Paris comme capitale mondiale de la mode. Grâce à une approche révolutionnaire basée sur la simplicité, la fonctionnalité et le raffinement, elle a transformé la perception du luxe en affirmant que « la simplicité est la clé de l'élégance. »

Ainsi, nous analysons la manière dont les créations de Coco Chanel ont influencé l'identité culturelle française, tant à travers l'esthétique vestimentaire qu'elle a promue que par ses relations avec les figures culturelles de la période de l'entre-deux-guerres.

Méthodes et résultats: Les transformations qu'elle a apportées à la mode et à la culture françaises ont renforcé le statut de Paris en tant que centre du raffinement. En abandonnant les corsets et les structures vestimentaires rigides, Chanel a introduit une silhouette féminine plus fluide et confortable, inspirée du vestiaire masculin.

À une époque où l'opulence dominait, elle a redéfini le concept du luxe en mettant l'accent sur la qualité des matériaux et des coupes plutôt que sur l'ornementation excessive. Cette philosophie s'est également reflétée dans le monde de la parfumerie avec l'iconique Chanel No. 5, symbole d'une élégance discrète.

Ses relations avec les artistes et intellectuels de son époque ont contribué à positionner la mode comme un élément central de la culture française. Ses collaborations avec Jean Cocteau, Pablo Picasso et Igor Stravinsky ont favorisé un dialogue entre la mode, l'art et la littérature, faisant du style Chanel une expression de la modernité. Son influence sur le design



vestimentaire a dépassé le cadre de la haute couture, s'étendant à la réinterprétation de pièces inspirées des uniformes marins et à l'usage d'une palette chromatique neutre, associée à la fonctionnalité et à la sobriété.

Conclusions: L'influence de Coco Chanel sur l'identité culturelle française demeure profonde et actuelle. En révolutionnant la mode et en redéfinissant le luxe, elle a intégré des éléments empruntés au vestiaire masculin et militaire dans une esthétique sophistiquée. Son héritage reste une référence incontournable dans la mode contemporaine, confirmant que le style Chanel est intemporel et continue d'influencer la perception mondiale du raffinement français.

Remerciements: maître de conf. Andreea Preda.

Mots clés: *identité culturelle, élégance, modernité, émancipation stylistique féminine, épice de la mode mondiale.*

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18. CULTURAL ANTHROPOLOGY

1) L'avenir de l'Europe, il devrait être comment?

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Résumé: L'avenir de l'Europe repose sur la collaboration entre ses citoyens et ses États. Actuellement en constante évolution, l'Europe fait face à plusieurs défis, notamment l'inégalité des chances, la dégradation de l'environnement et le manque de coopération entre les nations. L'Union européenne joue un rôle clé dans le développement du continent, en favorisant l'intégration économique et sociale de ses membres. L'éducation est un levier fondamental pour assurer la prospérité future, nécessitant une harmonisation des systèmes d'enseignement et un accès élargi aux ressources éducatives. Par ailleurs, la transition écologique est un enjeu majeur, impliquant des mesures concrètes pour réduire la pollution et promouvoir l'utilisation des énergies renouvelables. L'engagement collectif et des politiques durables sont essentiels pour garantir un avenir stable et prospère à l'Europe et à ses habitants.

Mots clés: *collaboration, innovation, écologie, progrès, responsabilité.*

2) Histoire du ballet

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Introduction: Cette étude propose une brève analyse de l'histoire et de l'importance du ballet, en explorant son évolution et son impact artistique. Bien que ses origines remontent à la Renaissance italienne, c'est en France qu'il a pris sa forme actuelle, devenant une référence mondiale. La création de l'Académie Royale de Danse en 1661 sous Louis XIV a établi les bases techniques et le vocabulaire encore en usage. L'objectif de cette recherche est d'examiner les grandes périodes du ballet et son influence sur la culture et les arts.

Méthodes et résultats: L'approche historique adoptée met en lumière trois grandes périodes du développement du ballet. Dans un premier temps, le ballet classique s'est structuré en France, définissant des principes stricts de posture et de mouvement. Le XIXe siècle marque son âge d'or avec le ballet romantique, qui privilégie l'émotion et la narration, et le ballet classique, qui met l'accent sur la perfection technique. Des figures emblématiques comme Marius Petipa ont contribué à son essor. Au XXe siècle, Rudolf Noureev et d'autres chorégraphes ont modernisé cet art en intégrant des influences contemporaines.

Au-delà de la scène, le ballet a influencé la mode, les arts visuels et la culture populaire, devenant un symbole d'élégance et d'harmonie. Cependant, cette discipline exige un entraînement rigoureux et d'importants sacrifices physiques.

Conclusions: Le ballet ne se limite pas au divertissement; il constitue un patrimoine culturel vivant et un moyen d'expression universel. Son évolution continue d'inspirer et d'influencer le monde artistique.

Remerciements: Mcf Mirea Daniela.

Mots clés: *ballet, Académie Royale de Danse, art, symbole, discipline.*

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3) L'intelligence artificielle dans la construction des véhicules

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Résumé: Le thème abordé explore l'impact de l'intelligence artificielle (IA) sur l'industrie automobile et la culture humaine. Nous examinerons comment l'IA n'est pas seulement une transformation technologique, mais aussi un changement culturel avec des implications éthiques et sociales significatives. L'impact culturel et social de l'IA dans l'industrie automobile inclut le changement de la perception de la société (le véhicule en tant qu'artefact), la confiance dans la technologie et les dilemmes éthiques concernant la responsabilité en cas d'accidents. De plus, l'automatisation affectera les emplois. Nous étudierons des applications concrètes et leurs effets, telles que : les systèmes ADAS (freinage automatique), la conduite autonome (niveaux 1-5) et des études de cas : l'IA dans diverses cultures. Notre présentation mettra en balance les effets (positifs/négatifs) ainsi que l'image d'un avenir plein de possibilités, mais aussi de responsabilités. Une approche anthropologique est essentielle pour comprendre l'impact culturel et social des nouvelles innovations, telles que les véhicules autonomes. Un dialogue éthique et social ouvert est nécessaire pour aborder les dilemmes moraux liés à la responsabilité, à la confidentialité et à la sécurité. L'intégration responsable de l'IA implique non seulement des réglementations techniques, mais aussi une adaptation des valeurs et des comportements sociaux, afin de garantir que ces technologies sont utilisées de manière correcte et équitable. Ainsi, il est nécessaire de trouver un équilibre entre le progrès technologique et le respect de ses implications humaines.

Mots clés: *IA, véhicules, évolution, effets, responsabilités.*

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4) Le handball féminin en France : une excellence sportive et collective

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Introduction: Le handball féminin français s'est imposé comme l'un des plus compétitifs d'Europe, alliant performances aux clubs et succès internationaux. À l'image des grands clubs comme Metz et Brest, ainsi que d'une équipe nationale multiple championne, cette discipline incarne un modèle de réussite collective et d'ambition sportive.

Cette étude explore les piliers de cette réussite : les joueuses emblématiques, les clubs dominants et les stratégies qui ont propulsé la France au sommet du handball mondial. L'objectif de cette approche est de comprendre les dynamiques sportives, structurelles et humaines derrière cette excellence.

Méthodes et résultats: L'analyse s'appuie sur une revue des performances historiques, des statistiques clés et des profils des actrices majeures du handball féminin français. Les résultats mettent en lumière :



1. Les joueuses incontournables:

- **Allison Pineau** – Éluée meilleure joueuse mondiale en 2009, elle a marqué l'équipe nationale par son leadership et sa polyvalence pendant plus de dix ans.
- **Estelle Nze Minko** – Rapidité et intelligence tactique font d'elle une pièce centrale des Bleues.
- **Siraba Dembélé-Pavlović** – Ancienne capitaine, son efficacité en tant qu'ailière gauche reste légendaire.
- **Grace Zaadi** – Demi-centre visionnaire, elle orchestre le jeu avec précision.
- **Cléopâtre Darleux** – Gardienne de but décisive, clé des victoires en situations tendues.

2. Les clubs phares:

- **Metz Handball** – Club le plus titré de France, modèle de formation et de régularité, avec des participations fréquentes en Ligue des Champions.
- **Brest Bretagne Handball** – Rival direct de Metz, finaliste de la Ligue des Champions en 2021, symbole de l'ambition européenne du handball français.

3. L'équipe nationale:

Sous la direction d'Olivier Krumbholz, les Bleues ont remporté :

- **Championnat olympique** (Tokyo 2021).
- **Championnats du monde** (2003, 2017).
- **Championnat d'Europe** (2018).

Leur réussite repose sur une défense rigoureuse et un esprit d'équipe exceptionnel.

Conclusions: Le handball féminin français illustre une harmonie entre talent individuel, structure solide des clubs et vision stratégique. Les succès répétés de l'équipe nationale et des clubs comme Metz ou Brest témoignent d'un écosystème sportif mature. Pour maintenir cette domination, la formation des jeunes talents et l'innovation tactique restent des enjeux majeurs.

Remerciements: maître-assist. Andreea Preda.

Mots clés: *Handball féminin, France, équipe nationale, Metz Handball, Brest Bretagne Handball.*

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5) Sports et activités de montagne

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Introduction: La montagne est une oasis de liberté et d'aventure, elle nous libère de la répétition du quotidien et nous apporte une tranquillité d'esprit. Pour ces raisons, de nombreuses personnes recherchent la liberté de la montagne pour se détendre, se ressourcer, mais aussi ressentir l'adrénaline de certains sports de montagne. Cependant, ils peuvent être divisés en deux catégories générales, les sports et activités de montagne d'été et d'hiver.

Méthodes et résultats: Sports et activités d'été. Ils bénéficient d'un temps chaud et agréable et de vues extraordinaires. L'activité la plus connue de ce type est la randonnée [1], qui consiste à parcourir des sentiers spécialement conçus pour ce type de loisirs. Un itinéraire de randonnée très populaire est le Tour du Mont Blanc [2]. Sachez que le Mont Blanc n'est pas réservé qu'aux grimpeurs, il existe de nombreux sentiers adaptés aux courtes randonnées accessibles à tous. Les emplacements dédiés exclusivement à la randonnée sont répartis sur





une superficie de plus de 170 km, le lieu peut donc offrir une multitude de possibilités. Très similaire à la randonnée, mais sous une forme verticale, l'escalade [3] est un sport extrême qui doit être pratiqué par des personnes expérimentées dans ce domaine. L'escalade consiste à utiliser les mains, les pieds ou toute autre partie du corps pour escalader un mur naturel ou artificiel. Malgré les dangers évidents de ce sport, de nombreuses personnes le pratiquent encore, même si sa popularité a récemment augmenté. En fin de compte, les activités présentées prennent beaucoup de temps à réaliser, c'est pourquoi de nombreuses personnes préfèrent passer plusieurs jours en montagne. Une activité de ce genre peut être le Camping. Entre amis, autour d'un barbecue ou d'un feu de camp, dormir en plein air, loin de la civilisation, est définitivement une véritable aventure et une nuit difficile à oublier.

L'été, aussi pittoresque et apaisant qu'il soit en montagne, ne peut pas être comparé à l'hiver, la saison la plus associée aux plaisirs de la montagne. La plupart des sports de montagne sont des sports d'hiver, comme le ski [4]. C'est un sport qui consiste à glisser en douceur sur la neige à l'aide d'une paire de skis. Ce sport est le plus souvent pratiqué sur des pistes spécialement damées, comme les pistes alpines de Chamonix, en France, offrant plus de 119 kilomètres de pistes de ski. Malgré cela, le ski ne se limite pas aux pistes et aux zones damées. Le ski de piste [5] est le sport extrême qui consiste à skier hors-piste, sur des sentiers naturels. Il peut être pratiqué n'importe où et offre des expériences inoubliables, notamment pour les amateurs d'activités extrêmes, mais malgré cela, le danger rôde constamment, le ski de piste étant l'un des sports les plus dangereux qui soient. Les avalanches, le manque d'équipements à portée de main, le risque de se perdre ne sont que quelques-unes des raisons pour lesquelles le ski de randonnée doit être traité avec respect et prudence. Cependant, l'hiver en montagne offre des expériences pour tous, du snowboard à l'alpinisme et même à l'escalade sur glacier.

Conclusions: En conclusion, les montagnes offrent une expérience unique, avec des opportunités diverses qui ne peuvent être fidèlement reproduites dans les zones urbaines. Cela nous donne un monde avec une toute nouvelle perspective qui, si nous le traitons avec soin et attention, peut nous offrir un lieu plein de vie.

Remerciements: Daniela MIREA.

Mots clés: randonnée, l'escalade, camping, le ski, le ski de piste.

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6) L'Anthropologie de Paris à Travers ses Monuments

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Introduction: Paris, à travers ses monuments, raconte l'évolution des dynamiques sociales et culturelles de la ville. L'anthropologie, en étudiant ces structures, permet de comprendre les rapports de pouvoir et d'identité qui se sont formés au fil du temps.

Méthodes et Résultats: L'étude analyse cinq monuments emblématiques : la Tour Eiffel, l'Opéra Garnier, le Sacré-Cœur, le Louvre et les Grands Boulevards. Chaque monument reflète une transformation sociale, de la démocratisation à la hiérarchisation des classes, en passant par la réconciliation nationale et la redéfinition du pouvoir.



Conclusions: Les monuments parisiens sont des symboles des évolutions sociales et des rapports de pouvoir. L'anthropologie aide à comprendre comment l'architecture et l'urbanisme influencent l'identité et les relations sociales de la ville.

Mots clés: *Paris, anthropologie, architecture, urbanisme, relations sociales, identité.*

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7) Le bonheur dans la société consumériste

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Introduction: Il semble que dans la société actuelle, les individus ne cherchent plus le bonheur représenté par des sentiments sublimes. On croit qu'on peut trouver le bonheur dans le matériel, que celui-ci pourrait être fabriqué et quantifié. On pense que le but du bonheur est d'éviter toutes les émotions négatives et d'obtenir toujours plus. Au moins, c'est ce que dit notre société contemporaine.

Méthodes et résultats: On a oublié que la tranquillité de l'âme c'est un état d'esprit très difficile à obtenir. Il faut toujours filtrer les émotions négatives et réduire les bruits extérieurs. Les sentiments superficiels que nous appelons maintenant bonheur, ne sont qu'une pâle imitation. Le philosophe français Émile Auguste Chartier a lancé l'hypothèse suivante : « Le bonheur est une récompense qui vient à ceux qui ne l'ont pas cherchée ». Alors, pourquoi confondre le bonheur avec la réussite ? Pourquoi mesurons-nous le bonheur par le prix d'une voiture, quand notre âme est vide et que la seule émotion que nous ressentons c'est la fierté. C'est la réalité ! On est très matérialistes dans tout ce qu'on fait et, paradoxalement, on déteste de l'admettre. Nous sommes tous prêts à croire que tout ce que nous possédons, nous appartient. On doit changer notre style de vie par rapport à ce qu'on veut accomplir. Essayons d'être reconnaissants pour les choses que nous avons reçues plutôt que simplement fiers de ce que nous avons acquis. La validation donnée par les autres semble plus précieuse que nos sentiments artificiels de fierté, créés par un égocentrisme profond, pour dissimuler un manque de confiance.

L'humanité est prête à dire que nous ne nous trompons pas quand on dit que l'argent représente une grande partie du bonheur. Et cela c'est le problème de notre société, très bien révélé par Gilles Lipovetsky dans son livre *Le bonheur paradoxal*. Il affirme que : « L'hédonisme, la consommation promettent des bonheurs, de l'évasion, c'est une société qui stimule une marche au bonheur dans ses référentiels, mais la réalité c'est que l'on voit la multiplicité des anxiétés, la morosité, l'inquiétude, le ras le bol, l'insatisfaction quotidienne. » Nous agissons ainsi parce que l'invalidation des valeurs contemporaines conduit au déni du progrès du monde. Ainsi, nous remplissons notre âme avec des sentiments éphémères pour nous aveugler au désastre émotionnel qui nous entoure. Certains trouvent du soutien dans les écrits du philosophe Schopenhauer : « Le bonheur positif et parfait est impossible ». On sait que l'œuvre de cet auteur représente un manifeste du pessimisme philosophique, mais le concept décrit ci-dessus est corrélé avec un contexte bien défini. La quête du bonheur d'un idéaliste est complètement différente de celle des gens ordinaires. Kant, quant à lui, affirme que « La richesse, la considération, même la santé ainsi que le bien-être complet et le contentement de son état, est ce qu'on nomme le bonheur ». Alors, la félicité parfaite résulte



d'un ensemble de facteurs qui sont très difficiles à réunir. Mais les individus ont parfois la capacité de sélectionner les émotions qu'ils ressentent. Pourquoi ne pas utiliser ce pouvoir à notre avantage, pour retenir seulement ce qui est beau et bénéfique à notre âme et à notre bien-être.

Conclusions: Ne nous laissons pas décourager. Il faut être audacieux dans la quête du bonheur et éviter de tomber dans le piège de l'illusion produite par la société de consommation. Le vrai bonheur consiste dans le fait de rendre les autres heureux.

Mots clés: *bonheur, quête, consumérisme, idéalisme, matérialisme.*

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8) L'évolution des avions de chasse

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Introduction: Cette présentation explore en détail l'évolution des avions de chasse à propulsion réactive, depuis les premières générations, marquées par des avancées technologiques majeures, jusqu'aux modèles les plus récents, intégrant des systèmes de pointe en matière d'aérodynamisme, de furtivité et d'armement. Nous mettrons en lumière les caractéristiques distinctives de chaque génération d'aéronefs, en analysant leur impact sur les stratégies aériennes et leur contribution à l'évolution de l'aviation militaire moderne.

Méthodes et résultats:

Première Génération (1945-1955)

Les avions de cette époque sont les premiers à utiliser des moteurs à réaction, remplaçant progressivement les avions à hélice de la Seconde Guerre mondiale. Cependant, ils restent limités à des vitesses subsoniques et utilisent principalement des mitrailleuses et des canons pour le combat aérien.

Exemples : Messerschmitt Me 262, F-86 Sabre, MiG-15.

Deuxième Génération (1955-1965)

Avec l'essor des technologies aéronautiques, les avions de chasse deviennent supersoniques et intègrent des radars embarqués, permettant d'améliorer la détection et le ciblage des ennemis.

Exemples : MiG-21, F-104 Starfighter, Dassault Mirage III.

Troisième Génération (1965-1980) – Transition vers l'ère moderne

Les avions de chasse deviennent plus polyvalents, capables de remplir plusieurs missions (chasse, bombardement, reconnaissance).

Exemples : F-4 Phantom II, MiG-23, Dassault Mirage F1.

Quatrième Génération (1980-2000) – La Polyvalence et l'Avancée Électronique

Les avions sont conçus pour être multi-rôles, pouvant s'adapter à diverses missions avec un large éventail d'armes.

Exemples : F-15 Eagle, MiG-29, Dassault Mirage 2000.

Cinquième Génération (2000 - Présent) – La Suprémie Technologique

Les avions de cinquième génération sont caractérisés par leur furtivité, leur grande capacité de fusion des capteurs et une connectivité avancée avec d'autres systèmes de combat.

Exemples : F-22 Raptor, F-35 Lightning II, Dassault Rafale (génération 4,5).



Conclusions: Les avions de chasse ont connu une évolution significative en surmontant des obstacles que les ingénieurs de l'après-guerre considéraient comme insurmontables, tels que le passage au régime supersonique, le développement de nouveaux systèmes de furtivité ainsi que l'amélioration des capacités de combat des aéronefs. Ces avancées ont permis d'accroître leur efficacité opérationnelle, leur polyvalence et leur domination dans l'espace aérien moderne.

Remerciements: Nous remercions notre professeure coordinatrice Daniela Mirea pour son soutien et ses conseils précieux.

Mots clés: *Propulsion réactive, Supersonique, Furtivité, Polyvalence, Avionique avancée.*

9) Mode et construction identitaire, étude de cas : Coco Chanel

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Résumé: Associée souvent à la frivolité et à l'éphémère, la mode peut être envisagée sous un angle idéologique car ce phénomène riche de significations nous apporte des renseignements concernant la dynamique sociale, culturelle, idéologique d'une époque. Système des codes et des langages complexes, la mode représente le miroir d'une société, elle s'interroge sur des questions d'essence philosophique : altérité, construction identitaire, transformation, appartenance à un groupe social, changement de paradigme. Notre intervention se propose de se questionner sur l'impact que le travail de Coco Chanel a eu sur la mode féminine, dans un contexte social et historique précis. Nous mettons en évidence les innovations qui ont définitivement changé la mode à une époque où les femmes étaient contraintes par des corsets inconfortables et des robes lourdes. Chanel a apporté une vision révolutionnaire: la mode doit être simple, confortable et néanmoins sophistiquée. Elle a introduit des matériaux non conventionnels, comme le jersey, et a créé des vêtements qui offraient aux femmes plus de liberté de mouvement. Chanel ne s'est pas contentée des vêtements – elle a également révolutionné le monde des accessoires. L'héritage laissé par Coco Chanel dépasse la mode. Elle a redéfini la féminité, montrant que le style ne signifie pas seulement opulence, mais aussi simplicité raffinée. Bien qu'elle soit décédée en 1971, la maison Chanel continue d'être l'une des marques de mode les plus influentes au monde, et sa vision de l'élégance et de la liberté reste aussi actuelle qu'il y a un siècle. Coco Chanel n'a pas seulement créé des vêtements – elle a créé un style qui a résisté à l'épreuve du temps et a inspiré des générations entières.

Mots clés: *construction identitaire, mode, changement de paradigme, liberté de mouvement, simplicité, raffinement, héritage, transformation.*

10) L'histoire du savon de Marseille

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Résumé: Le savon de Marseille est un produit emblématique de la tradition artisanale française, dont l'histoire remonte au Moyen Âge. Originellement fabriqué dans la région de Marseille, ce savon naturel, principalement composé d'huile d'olive, de soude et d'eau, est rapidement devenu un symbole de qualité et d'authenticité. Dès le XVIIe siècle, sa production



s'est structurée autour de règles strictes et d'une fabrication artisanale rigoureuse, ce qui a permis de garantir sa réputation et son succès. Utilisé à la fois pour des raisons hygiéniques et ménagères, il s'est répandu au-delà des frontières françaises. Cependant, avec l'industrialisation et la mondialisation, la production du savon de Marseille a subi des transformations, tout en conservant une part de son savoir-faire ancestral. Aujourd'hui, il demeure un symbole de la culture méditerranéenne et de l'artisanat français, apprécié pour ses qualités écologiques et ses vertus douces pour la peau.

Mots clés: *Symbolisme méditerranéen, Méthodes artisanales, Propriétés naturelles, Savonnerie, Authenticité certifiée.*

11) L'Intelligence Artificielle: Révolution Technologique et Enjeux du Futur

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Résumé: L'intelligence artificielle (IA) transforme profondément de nombreux domaines, de la santé à l'industrie en passant par la finance et l'éducation. Grâce à l'apprentissage automatique et aux réseaux de neurones, elle permet d'automatiser des tâches complexes et d'améliorer la prise de décision. Toutefois, son développement soulève des défis éthiques, notamment en matière de protection des données et de biais algorithmiques. Il est essentiel d'encadrer son usage afin de garantir un progrès technologique bénéfique pour la société. L'intelligence artificielle (IA) redéfinit les interactions entre l'humain et la technologie, ouvrant de nouvelles perspectives tout en soulevant des interrogations fondamentales. Entre automatisation et adaptation, ses implications s'étendent à divers domaines, transformant les processus de décision et d'apprentissage. Cependant, son évolution interroge les notions d'éthique, de responsabilité et d'impact sociétal. La maîtrise de cette dynamique repose sur un équilibre entre innovation et régulation, afin d'en exploiter le potentiel tout en anticipant ses défis.

Mots clés: *Apprentissage automatique, automatisation, réseaux de neurons, éthique de l'IA.*

12) Traditions religieuses et pratiques culturelles en Roumanie

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Résumé: La Roumanie, pays majoritairement orthodoxe, est profondément marquée par ses traditions religieuses. Des fêtes comme Pâques et Noël rythment la vie spirituelle et sociale avec des rituels tels que la peinture des œufs ou les chants de Noël. Les monastères peints, comme ceux de Bucovine, témoignent de l'importance de l'art religieux. Des pratiques populaires, comme la danse de la Capra ou les croyances sur les strigoi, mêlent paganisme et religion. Aujourd'hui, ces traditions, transmises de génération en génération, continuent de jouer un rôle vital dans la culture roumaine et attirent de nombreux visiteurs, préservant un patrimoine unique et vivant. Les traditions religieuses et pratiques culturelles roumaines sont un pilier de l'identité nationale, combinant foi, folklore et histoire. Leur préservation, malgré la modernisation, témoigne de l'attachement des Roumains à leur héritage. Ces coutumes uniques, qui mêlent spiritualité et créativité, restent une source de fierté et un pont entre le passé et le présent.



Mots clés: *Pâques, les monastères, strigoi, traditions roumaines, monastères orthodoxes; revenants.*

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13) La société de consommation

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Résumé: La société de consommation est un modèle économique où les individus sont encouragés à acheter et consommer des biens et des services de manière constante. Cette société, qui s'est intensifiée au XXe siècle avec l'avènement de la publicité, du crédit à la consommation, de la production de masse et de l'hédonisme, place la consommation au cœur de l'identité sociale. L'hédonisme, axé sur la recherche du plaisir et du confort immédiat à travers la consommation, est devenu un moteur puissant dans la quête incessante de nouveaux biens. Ainsi, les objets de consommation ne sont plus seulement des nécessités, mais des symboles de statut, de plaisir et d'appartenance à un groupe social.

Les avancées technologiques et la mondialisation ont facilité l'accès à une grande variété de biens. Cependant, ce modèle de consommation pose de nombreuses interrogations sur ses effets. D'une part, il stimule la croissance économique et la création d'emplois, mais d'autre part, il engendre une surproduction et une surconsommation, avec des impacts environnementaux significatifs. La pollution, l'épuisement des ressources naturelles et l'accroissement des inégalités sociales sont des conséquences directes de ce modèle.

Dans ce contexte, des alternatives comme la consommation responsable, le minimalisme et l'économie circulaire gagnent en popularité. La prise de conscience des enjeux écologiques et sociaux pousse certains à reconsidérer leur rapport à la consommation, à privilégier une approche plus éthique et durable des biens et à adopter des pratiques de consommation plus responsables..

Mots clés: *société de consommation, hédonisme, impact environnemental, mondialisation, consommation responsable.*

14) L'histoire du petit déjeuner: Une évolution mondiale

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Introduction: Le petit déjeuner, considéré aujourd'hui comme un repas essentiel, est le résultat d'une évolution historique et culturelle complexe. Son apparition et sa transformation au fil du temps reflètent les changements économiques, sociaux et nutritionnels à l'échelle mondiale.

Méthodes et résultats:

1. Les origines du petit déjeuner

Dans l'Antiquité, le petit déjeuner était souvent une collation frugale. Les Égyptiens consommaient du pain et de la bière, les Grecs trempaient du pain dans du vin, tandis que les Romains privilégiaient des fruits et du fromage. Toutefois, au Moyen Âge, l'Église condamnait



ce repas, le considérant comme un signe de gourmandise. Malgré cela, les travailleurs manuels et les moines continuaient à prendre un repas matinal pour assurer leur force physique.

2. La mondialisation du petit déjeuner

C'est au XVIII^e siècle que le petit déjeuner commence à se mondialiser, notamment grâce à l'arrivée de nouvelles boissons exotiques : le thé, le café et le chocolat. Importées d'Asie et d'Amérique, ces boissons deviennent progressivement accessibles à un plus grand nombre, influençant les habitudes alimentaires en Europe et au-delà. Ce phénomène illustre comment l'histoire du commerce et des échanges a façonné la culture alimentaire.

3. L'industrialisation et l'essor des céréales

Avec la Révolution industrielle, les modes de vie changent et les repas doivent s'adapter à un rythme plus rapide. Aux États-Unis, au début du XX^e siècle, les céréales du petit déjeuner sont introduites comme une alternative saine aux repas copieux. John Kellogg et d'autres pionniers en nutrition jouent un rôle clé dans la promotion de ces aliments, qui deviendront rapidement populaires dans de nombreux pays.

4. Diversité et tendances actuelles

Aujourd'hui, le petit déjeuner varie énormément selon les cultures. En France, il est souvent composé de viennoiseries et de café, tandis qu'au Japon, il inclut du riz et du poisson. Les tendances modernes mettent en avant des options plus équilibrées et rapides, comme les smoothies, les protéines végétales et les alternatives sans gluten.

Conclusions: L'histoire du petit déjeuner est un excellent exemple de la manière dont les pratiques alimentaires évoluent sous l'influence des changements sociaux, économiques et culturels. Ce repas, autrefois négligé, est devenu un symbole de la mondialisation et de l'évolution des modes de consommation.

Mots clés: *histoire alimentaire, petit déjeuner, mondialisation, industrialisation, habitudes culturelles.*

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15) Les animaux de compagnie: une histoire d'amitié millénaire

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Résumé: Dans cette présentation, nous parlerons de l'histoire des animaux de compagnie, en nous concentrant particulièrement sur trois exemples des plus connus : le chien, le premier animal de compagnie, domestiqué à partir du loup dès l'époque préhistorique, initialement pour la protection et la chasse ; le chat, considéré comme sacré dans l'Égypte ancienne ; et les perroquets, qui étaient considérés comme un symbole de statut social élevé dès l'Antiquité.

Tous ces animaux ont acquis au fil du temps un rôle essentiel dans la vie de l'homme. D'un point de vue psychologique, ils aident considérablement à réduire le stress et l'anxiété, augmentent le niveau des hormones du bonheur, ainsi que de l'ocytocine, l'hormone de l'affection. Les thérapies utilisant des animaux sont rapidement devenues populaires. Les chiens sont souvent utilisés dans ces thérapies en raison de leur capacité à réduire le stress et les troubles mentaux. Les chats, bien qu'indépendants, offrent un confort émotionnel grâce à leur présence apaisante. Les perroquets, grâce à leur capacité unique à communiquer, stimulent l'activité mentale et réduisent la solitude.

Enfin, nous nous intéresserons à quelques curiosités concernant la présence des animaux de compagnie dans les guerres menées par leurs propriétaires.



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Mots clés: *animaux de compagnie, curiosités, amitié, psychologie, histoire.*

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19. COMMON SECURITY AND DEFENCE POLICY

1) The European Union's Common Security and Defence Policy (CSDP): Analyzing the EU's Peacekeeping Role

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Introduction: The Common Security and Defence Policy (CSDP) represents a cornerstone of the European Union's (EU) efforts to ensure regional stability, peace, and security. Established in the early 2000s, CSDP aims to promote peace, prevent conflicts, and strengthen international security through coordinated actions among EU member states. In recent years, the policy has significantly evolved to respond to both traditional and non-traditional security challenges, such as cyber threats, terrorism, hybrid warfare, and the rise of geopolitical tensions. This paper examines the key developments in CSDP over the past decades, focusing on its impact on the EU's broader global security strategy and its role in shaping the EU's external relations. The primary objective of the research is to assess the policy's efficacy in tackling contemporary security issues, with particular emphasis on emerging security threats, and to propose recommendations for strengthening its strategic autonomy and operational capacity in the future. By evaluating the successes and shortcomings of the CSDP, the paper aims to offer insights into how the EU can enhance its role as a global security actor.

Methods and Results: This paper adopts a mixed-methods approach, combining qualitative content analysis and case studies to evaluate the operational outcomes and effectiveness of the CSDP. The content analysis includes a review of EU policy documents, official reports, and academic articles, as well as an assessment of strategic documents reflecting the EU's evolving security and defense approach. Additionally, case studies of key CSDP operations, such as the EU's involvement in peacekeeping missions in the Balkans and Africa, assess their impact on regional stability and conflict resolution. A comparative analysis of CSDP and NATO operations highlights the EU's challenges in achieving strategic autonomy and operational effectiveness, particularly due to political divergences among member states. The results show that, while the CSDP has made strides in conflict prevention, peacekeeping, and civilian crisis management, its reliance on NATO for military assets and the divergent security priorities of EU members have hindered its ability to act decisively and independently in crises. Moreover, the paper identifies areas where the EU could enhance its capabilities, including improving defense coordination, reducing fragmentation in procurement, and developing more robust military assets within the CSDP framework.

Conclusions: The CSDP has been crucial in enhancing the EU's role as a global security actor, particularly in terms of conflict prevention, peacekeeping, and diplomatic interventions. However, the policy faces significant limitations, including the lack of sufficient military assets, the political fragmentation of member states, and the dependence on NATO for defense capabilities. Moving forward, the EU must prioritize the creation of a more cohesive security framework that reduces dependence on external partners and strengthens its defense autonomy. Key recommendations include the establishment of a European Defense Fund to support military innovation and interoperability among member states, as well as the development of joint military operations and strategic defense initiatives. Additionally, increasing collaboration with international organizations such as the United Nations and



NATO, while reducing redundancies, will enhance the EU's ability to respond effectively to global security threats.

Keywords: *Common Security and Defence Policy, European Union, Strategic Autonomy, Crisis Management, Military Cooperation, International Security.*

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2) The EU Strategic Compass-a Roadmap for Security and Defence Autonomy

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Introduction: The EU Strategic Compass, adopted in March 2022, serves as a comprehensive roadmap for strengthening the European Union's security and defense autonomy in response to evolving geopolitical challenges. The paper examines the key objectives of the Strategic Compass, including the establishment of a 5,000-troop rapid deployment force (EU RDC) by 2025, the Crisis Response Operation Core (CROC) with a 60,000-strong force, and enhanced military mobility across member states.

Methods and Results: This paper employs a qualitative research approach, utilizing policy analysis, official EU documents, and expert commentary to examine the objectives and implementation of the EU Strategic Compass. Primary sources include the European External Action Service (EEAS), European Parliament reports, and EU defense strategy documents, complemented by secondary sources such as academic studies.

The findings demonstrate that the EU Strategic Compass represents a significant step toward strengthening Europe's defense autonomy, yet challenges remain in terms of operational coordination, resource allocation, and political consensus among member states.

1. *Strengthened Military Capabilities* – The establishment of a 5,000-troop rapid deployment force (EU RDC) by 2025 and the 60,000-strong CROC force marks a concrete effort to enhance the EU's rapid response and operational preparedness. However, concerns exist over interoperability and funding disparities among member states.

2. *Increased Defense Investments* – The ReArm Europe Initiative (€800 billion) and the European Defense Industrial Strategy (EDIS, 2024) aim to transition the EU into a "war



economy mode”, strengthening its industrial base. However, the dependence on external military suppliers and the slow pace of implementation present potential risks.

3. *Enhanced Security Resilience* – Efforts to counter hybrid threats through cybersecurity initiatives, intelligence sharing, and situational awareness have improved coordination among EU states. NATO’s “Task Force X” initiative in the Baltic Sea, utilizing unscrewed naval drones, demonstrates progress in maritime security.

4. *Energy Independence as a Strategic Component* – The RePowerEU Plan to reduce reliance on Russian fossil fuels is a critical factor in enhancing security resilience. However, the EU’s transition to renewable energy remains an ongoing challenge due to infrastructure and investment constraints.

5. *Geopolitical and Strategic Partnerships* – The Berlin Plus Agreement (2003), Sea Guardian Operations (2016), and Operation Irini (2020) reflect continued EU-NATO collaboration. L

Conclusions: Overall, the research highlights that while the Strategic Compass strengthens EU security autonomy, institutional, financial, and geopolitical challenges must be addressed to fully realize its potential. The findings underscore the importance of long-term investment, member state coordination, and external partnerships in achieving a more resilient and self-reliant European defense framework.

Acknowledgements: I would like to express sincere gratitude to the Students’ International Conference “CERC” 2025 for providing the opportunity to present this research and contribute to the discussion on European security and defense policy.

Keywords: *EU Strategic Compass, European defense autonomy, security policy, military readiness, rapid deployment capacity, hybrid threats, NATO cooperation.*

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3) Russian Propaganda Towards the Republic of Moldova: Implications for the EU’s Common Security and Defence Policy

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Introduction: Propaganda used to undermine countries has made information warfare a vital instrument in hybrid warfare. Moldova is especially susceptible to Russian influence because of its intricate connections to both the West and Russia. Disinformation efforts try to weaken Moldova's sovereignty and its Western affiliation by focusing on these ties.

As George Orwell once remarked, “*The most effective way to destroy people is to deny and obliterate their own understanding of their history*”¹. This statement is highly relevant to the current situation in Moldova, where Russian propaganda seeks to erase or manipulate the nation’s understanding of its past to destabilize the country and create divisions within its society. The author will provide evidence to demonstrate how Russian propaganda aims to achieve this by distorting Moldova’s historical consciousness.

Methods and Results: The influence of Russian propaganda on the Republic of Moldova is examined in this study, which also analyzes the threat's hybrid nature in relation to European security and the EU's Common Security and Defence Policy (CSDP). Using a mixed-



methods approach that combines qualitative research and quantitative data analysis, the study pinpoints the main disinformation tactics employed by Russian political players and media. These include historical revisionism, cultural exploitation, and psychological coercion, all of which are intended to erode public confidence in democratic institutions, erode Moldova's sovereignty, and create social divisions. The study identifies trends in Russian disinformation campaigns, including in the use of energy reliance as a political and economic influence tool and the propagation of pro-Russian attitude through common cultural and historical narratives.

This study evaluates Moldova's countermeasures, such as the National Security Strategy, independent fact-checking projects, media literacy campaigns, and strategic communication policies intended to counter misinformation, in light of the dynamic nature of information warfare. Despite the fact that these actions have strengthened Moldova's institutional resilience, combating Russian propaganda's sophistication and adaptability still presents formidable obstacles. The results show that, in spite of Moldova's efforts, disinformation tactics still have an impact on elections, public opinion, and the political climate of the nation.

The study comes to the conclusion that more EU involvement through the CSDP is necessary due to Moldova's strategic significance to European security. In order to mitigate long-term hybrid risks, Moldova and European institutions must coordinate their efforts, improve technical support, and establish regulatory frameworks. A proactive and all-encompassing strategy incorporating media supervision, cybersecurity, and regional collaboration will be essential to preserving Moldova's democratic resilience and sovereignty as Russian propaganda continues to change.

Conclusions: The impact of Russian propaganda on Moldova's political, social, and security environment was investigated in this study, emphasizing the threat's hybrid nature. Russian misinformation uses strategies like social manipulation, historical revisionism, and geopolitical narratives to take advantage of Moldova's historical and cultural connections to Russia. These initiatives weaken Moldova's resistance to outside influence, increase societal divisions, and diminish faith in democratic institutions. Independent fact-checking projects, media literacy campaigns, and rising public awareness, however, have begun to offset these tactics.

Moldova's National Security Strategy officially recognizes Russian disinformation as a security threat, enabling the government to strengthen strategic communication, allocate resources to counter-propaganda measures, and enhance national defense. Efforts to build resilience include improving media infrastructure, reducing energy dependence on Russia, and fostering a "whole-of-society" approach to information security. However, challenges remain, including political instability, online misinformation, and limited enforcement by tech companies.

From a Common Security and Defence Policy (CSDP) perspective, Moldova's struggle against Russian propaganda underscores the need for sustained international support. Strengthening cooperation with the EU through technical assistance, regulatory measures, and security coordination is crucial for safeguarding Moldova's sovereignty. While progress has been made, long-term success depends on continued reforms, enhanced institutional resilience, and deeper integration with European security initiatives.

Acknowledgements: Lect.univ.dr.ing. Postolache Florin.

Keywords: *Moldova, Russian propaganda, disinformation, national resilience, security.*

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4) Securing the Digital Landscape: Combating AI-Driven Misinformation and Cyber Threats

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Introduction: In the digital age, disinformation and misinformation have become critical threats to security and stability. Advanced technologies such as artificial intelligence (AI), deepfake generation, and automated bot networks amplify the spread of false information, leading to manipulation, confusion, and potential destabilization of institutions and societies. Without effective cybersecurity measures, these threats can exploit vulnerabilities in information systems, compromise data integrity, and influence decision-making processes at a large scale.

Cybersecurity plays a crucial role in countering these risks. Disinformation campaigns often leverage hacking techniques, phishing attacks, and social engineering to infiltrate systems and propagate deceptive narratives. This paper explores how disinformation exploits technological vulnerabilities and examines defensive strategies, including AI-driven detection, cybersecurity frameworks, and counter-disinformation methodologies.

Methods and Results: Detecting and countering disinformation in a technical context presents significant challenges due to the wide range of manipulation techniques used to alter, fabricate, and distribute deceptive content. The rise of AI-driven content generation further complicates the task, making it increasingly difficult to distinguish between genuine and manipulated information. As disinformation campaigns become more sophisticated, an effective response requires a multi-layered cybersecurity strategy.

One of the key approaches involves **automated disinformation detection**, where AI-powered classifiers analyze large datasets to identify misleading narratives. By leveraging natural language processing (NLP), sentiment analysis, and fact-checking algorithms, these systems can detect inconsistencies and flag suspicious content. Additionally, **deepfake and synthetic media analysis** plays a critical role in identifying manipulated visual content. Machine learning models assess video and image artifacts, focusing on facial irregularities, lighting inconsistencies, and pixel distortions to uncover signs of tampering.

Beyond content analysis, monitoring online activity is essential for identifying the sources and spread of disinformation. **Network behavior analysis** utilizes cybersecurity tools to track bot-driven misinformation, employing graph-based models and anomaly detection techniques such as intrusion detection systems (IDS) to recognize coordinated inauthentic activity. In parallel, **cyber threat intelligence (CTI) and incident response** frameworks enhance preparedness by analyzing threat intelligence feeds, conducting digital forensics, and performing penetration testing to detect vulnerabilities that could be exploited by malicious actors.



To strengthen information security, **countermeasure implementation** integrates multiple defense strategies. AI-driven content verification helps validate the authenticity of online information, while blockchain-based tracking systems ensure the integrity of digital records. Furthermore, cybersecurity architectures such as zero-trust models and encryption protocols enhance data protection, preventing unauthorized access and manipulation.

Conclusions: Our findings indicate that disinformation campaigns are evolving rapidly, leveraging generative AI models and sophisticated cyberattack techniques to maximize their impact. Addressing this growing threat requires continuous advancements in cybersecurity, the development of more resilient verification mechanisms, and stronger collaboration between public and private sector stakeholders to reinforce digital defenses.

Keywords: *Disinformation, misinformation, AI-driven threats, deepfake detection, cybersecurity, cyber threat intelligence (CTI), social engineering, network security, hybrid security threats.*

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5) The Future of Nuclear Deterrence in Europe

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Introduction: The idea of shared European nuclear weapons dates back to 1957 when France, West Germany, Italy, the Netherlands, Belgium, and Luxembourg created EURATOM. EURATOM aimed to promote nuclear energy but also to develop nuclear weapons. This plan was abandoned when Charles de Gaulle, France's president in 1958, decided to pursue an independent nuclear program for France.

Methods and Results: The paper examines two main options for European nuclear deterrence. A unified European nuclear force could enhance strategic independence, but faces legal, political, and logistical hurdles. The EU's legal framework does not support creating a military command for nuclear weapons, and achieving consensus among member states is unlikely due to opposition from countries like Ireland and Austria. Also, France could extend its nuclear deterrence to other European nations, akin to the US's NATO nuclear sharing. However, legal barriers such as the NPT and TPNW prevent full nuclear sharing, limiting France's ability to offer comprehensive protection.

Conclusions: Establishing a European nuclear deterrent is fraught with challenges, including legal restrictions and political opposition. The most feasible option may be for France to offer its nuclear protection unilaterally under existing defense agreements like NATO's Article 5.

Keywords: *European nuclear weapons, nuclear deterrence, EURATOM, France, European Union, nuclear umbrella.*

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6) The impact of Energy Security on future Common Security and Defence Policy Missions and Operations

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Introduction: In a perpetual changing world, energy security remains one of the most critical problems which need to be addressed. This problem is made worse by the boiling-hot climate change issue, which sometimes gets ignored in the need to satisfy energy security in the short term through conventional and already implemented means - which translates in burning more fossil fuels. But the risk which climate change represents to the entire world should not be forgotten or neglected, as it is a serious existential threat.

Methods and Results: To solve this problem, the author considered an alternative which usually is considered infamous, as it has a history of creating more problems: nuclear energy. To get a grasp on what is the general opinion of nuclear energy, the author firstly created a survey for the public to answer. Secondly, the author studied if nuclear energy is as dangerous as it is believed to be and took a deep dive into the sources of the materials required to build the renewable systems.

Conclusions: Nuclear power plants have a greater power output and are more reliable and safe than they are believe to be. Furthermore, renewable sources of energy, such as wind turbines, solar panels and hydroelectric plant have a huge ratio between the land fingerprint and power output; they are not reliable enough and create new problems, especially regarding the production of such systems.

Keywords: *Energy security, Nuclear energy, Renewable energy, Climate change.*

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7) Environmental Threats and Military Strategy: The Role of CSDP in Climate Adaptation

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Abstract: Environmental threats, particularly those driven by climate change, are increasingly shaping military strategy and security policies. The European Union's Common Security and Defence Policy (CSDP) has begun integrating climate adaptation measures to enhance operational resilience and address emerging risks such as resource conflicts, displacement, and extreme weather events. This paper examines the role of the CSDP in climate adaptation, focusing on policy frameworks, military preparedness, and cooperative security efforts. By assessing current initiatives and future challenges, it highlights the necessity of aligning defense strategies with sustainable and adaptive approaches to ensure long-term security.

Keywords: *Climate Security, Military Resilience, EU Defense Policy, Strategic Adaptation.*

8) The Evolution and Challenges of the EU's Common Security and Defense Policy: From Conception to Implementation, Case Study on the EUFOR Althea Operation

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Introduction: The European Union's Common Security and Defense Policy (CSDP) has evolved significantly since its inception in 1999, aiming to establish the EU as a major global security actor. Despite advancements, its implementation faces challenges such as diverging national priorities and limited capabilities. The EUFOR Althea operation in Bosnia and Herzegovina serves as a pivotal case study, highlighting both the strengths and limitations of the EU's security approach. This presentation examines the CSDP's evolution and operational challenges through the lens of EUFOR Althea, exploring how the EU balances strategic autonomy with collective action in complex security environments.

Methods and Results: What was built by devastating World War II onto the European continent in utter ruins? Millions died, millions were injured, and millions were forced to leave their home countries. The Holocaust saw six million Jews perish. Determined never to allow wars of such enormity to recur, the founding leaders of Europe sought to create what today is known as the European Union.

In the Brussels Treaty of 1948, Belgium, France, Luxembourg, the Netherlands, and the United Kingdom laid the groundwork for the Western Union, primarily for mutual defense against possible Soviet aggression and to promote economic, social, and cultural cooperation among these countries. This, in turn, initiated the construction of the European Union in a series of stages. From the outset of these initiatives, the European Union has aimed for establishing its crisis management capabilities so that it can independently realize defence and security beyond NATO and United States. This vision informs the establishment of the CSDP in 1999.

The CSDP is hampered by challenges that limit its efficiency, including the absence of a common European army, inadequate defence budget, and political disparities among EU member states. NATO operates with a unified command structure, whereas CSDP depends upon voluntary contributions from states, creating delays in operations. One possibility has



been to set up a European Union Rapid Reaction Force comprising 5,000 soldiers for crisis intervention. Political disagreement among member states also causes significant deficiencies in strategic unity that affect defense spending and international security policy. Budget limitations are equally detrimental to the CSDP in highlighting the need for advancement. Also, there are external threats against the EU, especially in North Africa and the Middle East, where instabilities create illegal migration. Strengthening partnerships, border security, and training in conflict areas are required approaches toward best dealing with these issues.

This case study investigates the European Union Force Althea operation in Bosnia and Herzegovina, a prime instance in the testing of the EU Common Security and Defense Policy. EUFOR Althea, deployed after NATO's Stabilization Force (SFOR), represented the first large-scale military operation carried out by the EU under CSDP to enforce the compliance of the 1995 Dayton Peace Agreement. The focus of the analysis will center on the historical background of the operation from the standpoint of the Bosnian War, evolving mandates and roles through its challenges of operations.

Triggered by ethnic perspectives following the dissolution of Yugoslavia, the Bosnian War saw a violent confrontation between Serb forces, supported by Belgrade; with Croat militias, supported by Croatia, both opposing Bosniak-led government forces. The brutality of the war, exemplified by the genocide in Srebrenica (1995), accounted for NATO intervention and the Dayton Accords that established Bosnia as a decentralized state divided into Serb (Republika Srpska) and Bosniak-Croat entities. NATO SFOR stabilized the area until 2004 when the EU took over the responsibility through EUFOR Althea under UN Resolution 1575.

EUFOR Althea's original mandate was a combination of military deterrence and civilian stabilizing tasks. With 7,000 troops deployed in three multinational zones, it employed Liaison and Observation Teams (LOTs) with the aims of monitoring local tensions, collecting illegal weapons and supporting police reforms. However, the mission was confronted with systemic challenges: (1) strategic divergences among EU states over Bosnia's political future, illustrated by disputes over centralizing reforms vs. entity autonomy; (2) a resource gap, with only 15 out of 27 EU members contributing with troops; and (3) the long-term impacts of EUFOR were undermined by political stagnation in Bosnia, with ethnonationalist leaders obstructing reconciliation.

In 2010 and thereafter, EUFOR operated progressively under the model of "deterrence by presence" with only 600-1200 troops, while undertaking training of Bosnian forces. This not only prevented escalation toward violent scenarios but also failed to address the core causes of instability such as corruption and institutional paralysis.

Conclusions: Post-1945 attempts at cooperation in the European Union sought to avert war conflicts through CSDP. However, the initiative is extremely limited in capability because it lacks a common army, budgetary constraints and conflicting politics among member states. Not only does the EUFOR Althea operation in Bosnia serve as an example of a highly complex practical exercise of CSDP, but it also involves strategic differences, financial deficits, and lack of capacity to deal with the roots of political instability. Although EUFOR's presence has prevented violent conflict, it does not resolve the deeper issues threatening Bosnia, necessitating continuing evolution of the security and defense capacities of the EU.

Acknowledgements: COL (AF). Prof. Eng. Cristian-Emil MOLDOVEANU, PhD.

Keywords: *EU Common Security and Defense Policy, EUFOR Althea, Bosnian War, post-conflict stabilization, NATO-EU cooperation.*

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9) An Analysis of the Member States's Military Assets and Political Willingness for an eu Operation in the Solomon Islands

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Abstract: The Solomon Islands hold significant geopolitical importance in the South Pacific due to their strategic location, historical military relevance and growing influence on the global stage. Proximity to vital trade routes and the potential for military base development make them highly sought after within the Indo-Pacific security framework. China's increasing involvement through a contentious security agreement has raised concerns among nations like Australia, the U.S. and other Western countries about shifting power dynamics in the region. To reinforce EU's strategic position in the Pacific Sea, the member states should start by controlling Solomon islands. This may not be an easy mission, but through the highest level of interoperability among allied states, it could become a real success, taking as an example the Pegase mission, which took place between June and August 2024.

Keywords: *Indo-Pacific rivalry, economic potential, maritime interface, logistical challenges.*

10) The Impact of Hybrid Warfare on the European Union's Common Security and Defence Policy

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Introduction: Since the beginning of the 21st century, the term "hybrid warfare" has evolved significantly, reflecting the growing complexity of military, political, and socio-economic strategies employed by both state and non-state actors. These strategies aim not only to win traditional armed conflicts, but also to exert power and influence on other states. This article analyzes the European Union's capabilities in addressing the challenges posed by hybrid warfare, focusing on its effectiveness in combating disinformation campaigns, managing the humanitarian crisis in Ukraine, and responding to Russian aggression. While hybrid warfare does not alter the fundamental nature of war, recent events demonstrate its potential to significantly influence the outcomes of conflicts.

Methods and Results: This research is based on a qualitative analysis of policy documents, strategic reports, and case studies. The findings reveal that although the EU has strengthened its Common Security and Defence Policy (CSDP) mechanisms, vulnerabilities persist in areas such as cybersecurity, strategic communication, and crisis management. The study also examines key EU initiatives aimed at countering disinformation campaigns.

Conclusions: As hybrid warfare increasingly blurs the lines between traditional and non-traditional conflicts, the EU must enhance its strategic autonomy, intelligence-sharing, and resilience against military and information warfare. Strengthening cooperation with NATO and member states, reinforcing cybersecurity infrastructure, and improving public awareness of misinformation are crucial for safeguarding European security. A proactive and adaptive approach is essential in countering the evolving nature of hybrid threats in the 21st century.

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Keywords: *Hybrid warfare, CSDP, misinformation, EU security.*

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20. ERASMUS+ AND MILITARY ERASMUS EXPERIENCES

1) Erasmus Student in WAT Poland

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Introduction: This paper presents an overview of my Erasmus experience in WAT, Poland, as part of my final year of undergraduate studies. The exchange program provided an opportunity to enhance both academic and personal development through specialized coursework, extracurricular activities, and cultural exposure. The primary objective was to integrate international perspectives into my studies and to develop skills relevant to my future career.

Methods and Results: During my Erasmus period, I attended courses in logistics, gaining insights into supply chain management, transportation, and warehouse operations. These courses were complemented by practical projects that allowed for hands-on application of theoretical knowledge. Additionally, I participated in a research group where I had the opportunity to present a segment of my bachelor's thesis, receiving valuable feedback from peers and professors.

Beyond academics, the Erasmus experience also facilitated cultural enrichment. I visited several museums and historic cities across Poland, deepening my understanding of the country's heritage. Moreover, through social events and collaborations, I formed international friendships that contributed to a broader cultural awareness and improved communication skills in an intercultural environment.

Conclusions: The Erasmus program at WAT, Poland, provided an invaluable combination of academic learning, research engagement, and cultural immersion. The logistics courses and projects significantly enhanced my knowledge in the field, while participation in research activities helped refine my analytical and presentation skills. Furthermore, the cultural experiences and friendships established during this exchange have contributed to personal growth and an expanded global perspective. Such experiences are essential for fostering adaptability and professional readiness in an increasingly interconnected world.

Acknowledgements: I extend my gratitude to my academic coordinators, the faculty at WAT, and my home university for facilitating this exchange program. Special thanks to my peers and mentors for their guidance and support throughout the experience..

Keywords: *Erasmus, logistics, research, cultural exchange, Poland, international education.*

2) Numerical Simulation Regarding the Penetration of a 5.45mm Caliber Bullet through an Aluminium Plate

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Introduction: The purpose of this paper is to analyse the effect of the penetration of a 5.45 mm caliber bullet through an aluminium plate, topic of interest of an Erasmus + programme in which both authors took part.

Methods and Results: During an Erasmus+ programme at WAT (Military University of Technology) in Poland the main point of interest was creating a simulation of the penetration





of a 5.45 mm caliber bullet through an aluminium plate using different methods, in order to analyse the process and to find the most accurate one.

For this purpose the application used was Ansys Autodyn. Considering a 2d axisymmetric model, three methods were taken into account: Lagrange, Euler and SPH.

The Lagrange model considers the bullet and plate as two completely separate objects and based on the properties of the material and model of penetration calculates the state of the system for every iteration. The Euler model instead considers the entire system as being a whole body. The third model follows the same criteria as the Lagrange model but the bullet and plate are considered as being made of extremely small cells.

Not only did the Erasmus + programme give the opportunity to study a very interesting and challenging terminal ballistic topic, but also represented a way to broaden the cultural boundaries and to create meaningful friendships.

Conclusions: After the simulations were done, the best results were obtained with the SPH method. The Euler method was not the most suitable and the Lagrange gave good results but was also laborious.

Acknowledgements: The coordinator teacher, Lt.col. eng. Bartosz Fikus.

Keywords: *Simulation, Lagrange, Euler, SPH, penetration.*

3) Design and configuration of an automatic take-off and landing system for a fixed-wing UAV system based on LiDAR technology - Bachelor's degree internship at the Military University of Technology in Warsaw

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Introduction: During a two-month Bachelor's degree internship at the Military University of Technology in Warsaw, I aimed to develop control algorithms using a Raspberry Pi 4 and Pixhawk flight controller, for a fixed-wing UAV system based on LiDAR technology. This experience provided hands-on practice with multiple kinds of sensors, SOLIDWORKS and MATLAB Simulink applications, as well as SITL and HITL testing on Linux, thereby enhancing project management, critical thinking, and problem-solving skills in UAV technology. For the Polish coordinating professors, I developed an integrated system that includes a flight controller equipped with microphones and ultrasonic receivers. This system, to be mounted on a UAV, is designed to intercept the direction and descent speed of a bomb or projectile launched from the air.

Methods and Results: The LiDAR sensor, positioned downward, operates with a high sampling rate, providing real-time altitude measurements within a range of 0.2 m to 50 m with an accuracy of ± 0.2 cm. The sensor was interfaced with the Pixhawk flight controller, while a Raspberry Pi 4 executed the custom control algorithms. The system was initially validated through SITL simulations, which offered a real-time 2D representation of the UAV's performance, and later through HITL testing on Linux to ensure reliable performance under practical conditions.

High fidelity signal processing framework was implemented, including an Extended Kalman Filter for sensor fusion and low-pass filtering to reduce noise. Additionally, integration with SOLIDWORKS supported the precise mechanical configuration of the LiDAR mounting, ensuring an unobstructed view of the ground during flight. Flight data collected during real outside testing showed that the system could accurately and automatically adjust flight parameters in real time.



Conclusions: Successful integration of the LiDAR sensor with both hardware and software components on a real fixed-wing UAV frame and implementation of the quadcopter system to intercept the direction and descent speed of a bomb or projectile launched from the air.

Acknowledgements: I gratefully thank the Faculty of Mechatronics, Armament and Aerospace, Department of Avionics of Military University of Technology, Warsaw for their invaluable support and guidance throughout this project. I'm also thankful for Erasmus+ and the Military Erasmus office, as well as the Department of Integrated Aviation and Mechanical Systems of the Military Technical Academy Ferdinand I, Bucharest, for making this internship possible.

Keywords: *UAV Navigation, LiDAR, Autonomous Takeoff, Precision Landing.*

4) Erasmus Experience at the National Military University "Vasil Levski", Veliko Tarnovo

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Introduction: This abstract presents our personal experience during the Erasmus mobility at the National Military University "Vasil Levski" in Veliko Tarnovo, Bulgaria. As final-year students, our main focus was on developing our diploma project, but the mobility also provided an opportunity to explore a new cultural and academic environment.

Methods and Results: During our stay, we worked closely with our academic supervisor, who maintained an open and supportive approach, ensuring that our project progressed efficiently. Although we did not attend courses, we interacted with international students, exchanging perspectives and experiences, which enriched our understanding of different educational and cultural backgrounds.

Beyond the academic aspects, we had the chance to explore Bulgaria. Veliko Tarnovo, the historical capital of the Second Bulgarian Empire, impressed us with its medieval architecture and vibrant atmosphere. However, the most remarkable experience was visiting Sofia, a city that blends modernity with history, offering an impressive cultural diversity.

Being military students, we found the environment at the National Military University quite familiar, making the adaptation process smooth. Additionally, communication was not a challenge, as English is widely spoken.

Conclusions: Our Erasmus experience at the National Military University "Vasil Levski" was both academically and personally rewarding. The guidance of our supervisor, the interactions with international students, and the opportunity to explore Bulgaria made this mobility a valuable experience. It has broadened our perspectives and contributed to our professional and personal growth, preparing us for future challenges.

Keywords: *Erasmus mobility, military university, cultural exchange, academic experience, Bulgaria.*



5) Commando Half Marathon – A Multicultural Challenge for Military Students

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Introduction: Participation in international events strengthens the bonds between partner institutions and contributes significantly to the academic, personal, and physical development of students. This abstract presents the experience of two Romanian students from the Military Technical Academy “Ferdinand I” who took part in the “Commando Half Marathon” organized by the Military University of Technology in Warsaw, Poland. The event was held between February 13–16, 2025, and brought together participants from multiple European military academies.

Methods and Results: The delegation, composed of Cadet Toader Cîmpan (2nd year, Topogeodesy) and Cadet Sebastian-Ștefăniță Licurici (1st year, Computer Systems for Defense), was warmly welcomed at the opening dinner hosted on campus. The atmosphere encouraged cultural exchange and dialogue between students from countries such as Greece, Lithuania, Finland, Denmark, and Ukraine.

The second day focused on academic engagement. Participants toured the host university’s modern facilities, including specialized laboratories and classrooms. Professors presented ongoing research and training methods, emphasizing a high standard of education and innovation. In the afternoon, participants prepared their 10 kg rucksacks for the upcoming challenge, filling them with sand as per competition rules.

The third day featured the half marathon itself. The course was demanding, combining rough terrain with the extra burden of the 10 kg rucksacks. Despite the intense physical strain, both students completed the race with determination and in honorable time. The event concluded with a festive dinner where the efforts of all participants were recognized. The shared experience fostered camaraderie and left lasting impressions of solidarity and mutual respect.

Conclusions: This experience proved to be invaluable both institutionally and personally. From an institutional standpoint, it enhanced the international visibility of the Military Technical Academy “Ferdinand I” and reinforced its partnerships with allied institutions. On a personal level, the event challenged the students’ endurance, adaptability, and teamwork skills, while also enhancing their intercultural communication abilities. It served as an excellent platform for applying theoretical knowledge in practical, high-pressure environments.

The presence of international peers created opportunities for language practice and offered new perspectives on military education across Europe. The host institution provided outstanding support, ensuring the smooth execution of the event.

Acknowledgements: We would like to thank the organizing team from the Military University of Technology in Warsaw, especially Capt. Pawel Jaskiewicz, and our Erasmus+ coordinator for their support and encouragement.

Keywords: *Commando Half Marathon, Military Students, Physical Endurance, International Cooperation, Intercultural Exchange, Erasmus+.*



6) Exploring Perspectives: A Critical Thinking Journey in the Heart of Piemont

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Introduction: This presentation highlights our intercultural experience in the Blended Intensive Program Erasmus+ on Problem Solving and Critical Thinking, held in Turin, Italy.

Methods and Results: The program began with an engaging fictional geopolitical scenario, involving multiple international entities. Throughout the course, we explored topics such as mathematics, statistics, game theory, strategic games, and cryptography. What made this learning experience unique was its alignment with the scenario—each newly acquired skill was essential for solving the upcoming challenges.

As the program progressed, students were mixed into diverse teams, each representing an entity within the scenario. After every class, teams were given problem sets that required them to apply their newfound knowledge. At the end of each day, they issued a press release, incorporating previous events and newly solved tasks, for the development of the scenario's storyline. The final day culminated in a group presentation, where we summarized our decisions and put our public speaking skills to the test.

The diversity within each group played a fundamental role in enhancing our overall learning experience. Each participant originated from different countries and pursued distinct academic specializations, including engineering, military sciences, and social sciences. This multidisciplinary composition fostered an enriching exchange of knowledge, as it enabled us to gain insights into unfamiliar fields while simultaneously sharing expertise in our own domains. The collaborative environment not only broadened our intellectual horizons but also cultivated a sense of mutual respect and appreciation for different academic perspectives.

Beyond the structured learning sessions, we actively engaged in extracurricular activities that further reinforced our interpersonal connections. We explored the cultural and historical landmarks of the host city alongside our friends, immersing ourselves in its rich heritage and local traditions. These experiences collectively contributed to the strengthening of social bonds, creating international friendships and a deeper cultural understanding that extended beyond the academic setting.

Conclusions: This Erasmus+ program introduced us to an innovative approach to teaching and learning, where theoretical knowledge was immediately applied to practical, scenario-based challenges. Moreover, this method has proven to be universally beneficial, as the skills acquired are transferable to various academic, professional, and personal contexts. The ability to assess situations objectively, anticipate potential outcomes, and adapt to unforeseen challenges is crucial in today's fast-changing world. This interactive and immersive learning process has not only strengthened our problem-solving capabilities but has also encouraged collaborative thinking and innovative approaches to overcoming obstacles, like a productive and practical tool that equips us with the necessary mindset to tackle real-world problems efficiently and effectively.

Acknowledgements: CDR. Assoc. Prof. Eng. Moldoveanu Cristian-Emil, PhD.

Keywords: *Erasmus+, Problem Solving, Scenario-Based Learning, Teamwork, Intercultural experiences.*





7) Erasmus Mobility in Royal Military Academy, Belgium

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Introduction: This abstract offers a personal overview of our Erasmus exchange experience in Belgium, focusing on the academic, cultural, and personal aspects of studying abroad. We chose to share this experience because it had a meaningful impact on our journey as students and as individuals. Being part of the Erasmus program gave us the opportunity to explore a different way of learning, meet people from all over Europe, and adapt to a new environment. Belgium, with its rich mix of languages and cultures, turned out to be the ideal place for this kind of experience — both challenging and rewarding.

Methods and Results: The Erasmus exchange in Belgium had a significant impact on both our academic and personal development. Academically, we were exposed to different teaching styles and coursework that encouraged critical thinking and collaboration. Participating in seminars and group projects with international students helped us understand various perspectives and improved my ability to work in multicultural teams. We also extended my language skills, particularly in English and French, by using them in both academic and everyday contexts.

On a personal level, we became more independent and confident in navigating new environments. Living in a foreign country pushed us to adapt quickly, manage our time and resources effectively, and overcome cultural differences with openness and curiosity. We built meaningful friendships with people from all over Europe, many of whom we continue to stay in touch with. These relationships not only enriched our social life but also gave us a deeper appreciation for diversity and inclusion.

Conclusions: Overall, this Erasmus experience in Belgium has broadened our perspective, strengthened our independence, and our appreciations for cultural diversity grew. It was more than just an academic exchange — it was a chance to grow, connect, and discover both a new country and new sides of myself.

Acknowledgements: Cdor. Cristian MOLDOVEANU.

Keywords: *Erasmus, Belgium, program, academic, study, exchange.*

8) Life in Lithuania

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Abstract: The Erasmus+ program has long been a cornerstone of international academic exchange, offering students an unparalleled opportunity to study abroad, develop cross-cultural skills, and build lifelong connections. This paper explores the unique experiences of Erasmus students in Lithuania, focusing on the social, academic, and cultural dimensions of their stay.

Through qualitative interviews and surveys conducted with students from diverse backgrounds, this study delves into the challenges and rewards of adapting to Lithuanian culture, navigating university life, and managing personal growth in a foreign environment. Key topics include cultural integration, the impact of language barriers, academic expectations, and the vibrant student life shaped by local traditions and international interactions.

Findings reveal that students often experience a transformative journey marked by personal development, increased resilience, and a broadened worldview. However, cultural





adjustments and homesickness can pose challenges. The study offers insights for universities, Erasmus coordinators, and students on how to optimize the Erasmus experience in Lithuania.

Keywords: *Erasmus+, Lithuania, student life, cultural integration, international exchange.*

9) Navigating New Experiences: Academic and Cultural Growth in Portugal

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Introduction: Military engineers specializing in computer and electronics engineering are traditionally trained in problem-solving, systems thinking, and technical innovation. However, leadership in modern defense environments demands a more multidimensional profile one that includes communication, intercultural awareness, adaptability, and decision-making under uncertainty. The Erasmus International Spring Semester 2025 in Portugal provided a unique opportunity to integrate these vital leadership skills into the formation of future military officers. This abstract outlines how the participation in modules focused on leadership, communication, culture, and security policy contributed to developing transferable competencies essential for leading teams, managing missions, and navigating the social realities of modern defense operations.

Methods and Results: The program included interdisciplinary modules such as Portuguese Culture, Cross-Cultural Communication, Digital Leadership, and Military Leadership. The semester emphasized experiential learning, collaboration, intercultural exchange, and leadership development.

From day one, students joined multinational teams, simulating real-world deployments and requiring rapid adaptation to diverse cultural and organizational settings. Communication-focused modules enhanced students' ability to interpret behavior, manage cultural differences, and lead multicultural teams.

Technological modules like Digital Leadership, Cyber Security, and Space Applications provided practical and strategic training for coordinating hybrid teams and managing projects with digital tools. Leadership modules developed soft skills such as empathy, decision-making, and team motivation through challenges and role-playing scenarios.

Courses on Law of Armed Conflict and Common Security and Defence Policy expanded students' ethical and geopolitical understanding, integrating legal and strategic perspectives into their technical education.

Conclusions: Through the International Spring Semester 2025, we were exposed to essential leadership, communication, and decision-making skills that are often absent from a traditional engineering education.

While our technical background equips us to solve complex problems and design advanced systems, this international experience filled a critical gap by preparing us to lead people, navigate multicultural environments, and think strategically in unpredictable situations.

We learned to communicate effectively across cultural and disciplinary boundaries, manage teams under pressure, and adapt our leadership style to diverse contexts. These are not just complementary to our engineering skills, they are vital for becoming well-rounded officers capable of guiding both technology and teams in future defense missions.

Acknowledgements: Col. (AF) Prof. Eng. Moldoveanu Cristian Emil, PhD.

Keywords: *Erasmus+, Leadership, Communication, Adaptability, Technology, Strategy.*





10) Learning to Navigate: Robotics, Culture, and the Unexpected

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Abstract: This presentation explores the intersection between smart robotics and intercultural learning, shaped by our experience during the Smart Robotics international semester at the Saint-Cyr Academy in France. Over the course of four months, we navigated a blend of hands-on projects and theoretical courses that challenged us to design and program autonomous behaviors using TurtleBot robots. What started as a simple curiosity: "how can robotics solve real-world problems?" quickly turned into a deep dive into algorithms, sensors, and navigation systems.

But the real learning happened somewhere between the code and the conversations. Working in international teams pushed us to collaborate across cultures, adapt to different working styles, and find common ground in problem-solving. At the same time, living in France gave us the chance to step outside the classroom and experience a different culture firsthand—from everyday life to iconic landmarks, and everything in between.

This talk highlights the technical foundation of our work, the collaborative process behind it, and the unexpected personal growth that came along the way. In the end, our biggest takeaway is this: in a world increasingly shaped by intelligent systems, innovation means more when it's paired with openness, curiosity, and a willingness to learn from one another.

Keywords: *Smart Robotics, Intercultural Learning, Engineering Education, Autonomous Systems, International Collaboration.*

11) Practical Experience in Energetic Materials and Nanodiamond Production at OZM RESEARCH

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Introduction: This paper presents the comprehensive practical experience gained during an eight-week traineeship at OZM RESEARCH, an institution specialized in the research and development of energetic materials and nanodiamonds. Under the supervision of Mr. Krupka Miloslav, CEO of the agency, and Mr. Dimitar Mitev, Head of Nanomaterials Research, the traineeship provided extensive hands-on training in multiple areas, including laboratory procedures, equipment testing, material synthesis, and safety protocols in handling explosives.

Methods and Results: One of the primary focuses of the traineeship was the study, verification, and practical application of equipment manuals, ensuring that measuring devices such as Heating Block instruments and the XSpark 10 electrostatic spark sensitivity tester met operational and safety standards. The work involved analyzing, testing, and optimizing these devices for enhanced usability, particularly refining the installation manual for XSpark 10 to improve its implementation in laboratories lacking dedicated installation personnel.

Another significant aspect of the program was the synthesis and characterization of nanodiamonds. The process involved step-by-step laboratory work, including explosive detonation for nanodiamond production, separation of the resulting suspension, and purification techniques such as centrifugation and controlled drying. The chemical and physical properties of nanodiamonds were further analyzed by measuring pH levels and evaluating the impact of processing variables on the final product.



In addition, the traineeship included extensive work with plastic explosives, from formulation to testing. The explosives were prepared by mixing energetic and binding components, forming them into standardized charges, and equipping them with detonation systems. Testing procedures involved controlled detonation in automated environments, evaluating the performance of different explosive compositions and their potential applications in nanodiamond synthesis.

The program also provided exposure to historical and modern military ordnance through an academic visit to the Police Academy in Pardubice and participation in an ammunition exhibition. This experience enriched the understanding of explosive technologies, covering a broad spectrum of munitions from World War II to contemporary defense systems.

Conclusions: The traineeship concluded with finalizing laboratory procedures for nanodiamond synthesis, ensuring proper documentation, and securing plastic explosives in airtight foils for safe storage. This comprehensive experience significantly enhanced practical skills in explosive handling, nanomaterial processing, and laboratory instrumentation, offering valuable insights into the interdisciplinary field of energetic materials and advanced material research.

Keywords: *energetic materials, nanodiamond synthesis, explosive testing, laboratory instrumentation, traineeship experience, Czech Republic.*

12) Sharpening Skills and Strengthening Alliances: Our Erasmus Military Training Experience in Greece

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Introduction: In this article, we will share our experience in an Erasmus mobility program of the "Blended Intensive Program" type, which took place at the Hellenic Academy in Athens. We will highlight the skills we acquired during the training and how this program contributed to our professional and personal development.

Methods and Results: Over the course of five days, we participated in an intensive training camp at the academy, where each day was dedicated to a specific set of activities. On the first day, we were introduced to the weapons we would be using, primarily the G3A3 rifle. Additionally, we attended our first Tactical Combat Casualty Care (TCCC) lesson, where we learned essential techniques for assisting an injured ally on the battlefield.

The second day included our first live-fire exercise from an Armored Personnel Carrier (APC) and an orientation training session to enhance our navigation skills. On the third day, we advanced to shooting with the Heckler & Koch HK11 from a fixed position and participated in a night shooting exercise using tactical goggles, which helped us adapt to low-visibility conditions.

Day four was dedicated to Close-Quarters Battle (CQB) training, where we learned advanced tactics for engaging threats in confined environments. The day concluded with a physically demanding 15 km march, designed to test our endurance and resilience. On the final day, we consolidated all our newly acquired skills in a simulated victim rescue scenario, where teamwork and quick decision-making played a crucial role in mission success.

Conclusions: This training program provided us with invaluable skills and a deeper understanding of military tactics and operations. It broadened our perspectives and reinforced our commitment to excellence. We are determined not only to become competent officers in the Romanian Army but also to uphold NATO standards. Military Erasmus mobilities



emphasize unity, collaboration, and self-improvement, making them essential stepping stones toward becoming model officers.

Acknowledgements: We would like to thank our professor for his guidance and the help that he has provided us with.

Keywords: *Erasmus, military training.*

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13) The Experience of Participating in International Air Force Cadet's Week Deblin Poland

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Introduction: Participating in the International Air Force Cadets' Week, hosted by the Polish Air Force University in Dęblin, was an incredible opportunity to dive into aviation training and connect with an international group of cadets. One of the standout moments was spending time in the flight simulators, where we got to sit in realistic cockpits and practice maneuvers like takeoffs, landings, and even emergency responses. These advanced machines, complete with detailed controls and screens, showed us how pilots train for real missions and how technology helps them stay sharp. It was both challenging and thrilling, giving us a clear picture of the skill and focus needed in the air force.

Methods and Results: The visits to the 41st Air Training Base and Warsaw brought even more to the experience. At the 41st Training Base, we toured hangars filled with training aircraft, watched instructors explain maintenance routines, and learned how cadets progress from beginners to skilled aviators. The base combined Poland's proud military past with today's standards, which made it fascinating. Then, in Warsaw, we walked through historic streets, saw landmarks like the Royal Castle, and reflected on the city's recovery from World War II. These trips showed us how the air force fits into both training and a nation's story, adding layers of meaning to the week.

What made this trip truly special was the mix of cultures among the cadets. People from different countries—like pilots-in-training from Europe, Asia, and beyond—shared meals, swapped stories about their lives, and even taught each other phrases in their languages. One night, we had a cultural event with music and food from everyone's home countries, which turned strangers into friends. This blend of backgrounds made every moment richer, transforming the week into more than just a training program—it became a celebration of teamwork and respect.

Conclusions: The International Air Force Cadets' Week in Dęblin left me with new skills, lasting memories, and a deep admiration for the global air force community.

Keywords: *International mobility, Erasmus.*



14) Discovering Coimbra: An Erasmus Experience

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Introduction: Coimbra, one of Portugal's most historic and academically renowned cities, offers a unique Erasmus experience combining high-quality education and a rich cultural heritage. The University of Coimbra, a UNESCO World Heritage Site, attracts international students seeking both academic excellence and an immersive cultural journey. This abstract presents an overview of the Erasmus experience in Coimbra, highlighting its academic opportunities, cultural integration, and personal development aspects.

Methods and Results: The Erasmus experience in Coimbra was structured around both academic and extracurricular activities. Academically, students participated in lectures, seminars, and collaborative projects at the University of Coimbra. The methodology included attending courses in fields of study relevant to the students' home institutions, engaging in interdisciplinary research, and working alongside international peers. Practical learning was emphasized through laboratory work, field studies, and internships.

The social aspect of the Erasmus program was equally significant. Participants took part in cultural exchange events, language tandem programs, and social initiatives organized by the Erasmus Student Network (ESN). The program facilitated interactions with students from diverse backgrounds, enhancing cross-cultural communication and adaptability. Furthermore, excursions to historical sites such as the Joanina Library, the Old Cathedral, and the picturesque Mondego River allowed students to immerse themselves in Portuguese history and traditions.

Results indicate that students developed not only academically but also personally. Enhanced language skills, broader global perspectives, and improved problem-solving abilities were commonly reported benefits. Surveys conducted post-program demonstrated increased confidence in professional networking and a greater appreciation for cultural diversity. Many participants established lasting friendships and professional connections, demonstrating the program's long-term impact.

Conclusions: The Erasmus experience in Coimbra proved to be a transformative journey, fostering both intellectual and personal growth. The combination of high-quality education, cultural immersion, and international networking provided students with valuable competencies for their future careers. Coimbra's welcoming atmosphere, historical richness, and academic excellence made it an ideal destination for an Erasmus exchange.

Acknowledgements: Special thanks to the Erasmus program coordinators, University of Coimbra faculty members, and the Erasmus Student Network (ESN) for their continuous support and guidance.

Keywords: *Erasmus, Coimbra, international exchange, cultural immersion, academic development, student mobility.*



15) Learning Across Cultures: My Erasmus Adventure in Torino

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Introduction: This paper presents my Erasmus+ experience in Torino, Italy, as part of the LOAC (Law of Armed Conflict) course. The Erasmus+ program fosters cross-cultural learning and academic development, offering students the opportunity to enhance both their professional and personal skills. This paper aims to highlight the impact of the program on my educational growth, intercultural adaptation, and the acquisition of new competencies in the field of international humanitarian law.

Methods and Results: The methodology is based on a reflective analysis of my academic and cultural experiences during the LOAC course. The study covers aspects such as course structure, teaching methods, student engagement, and cultural immersion. The LOAC course focused on the principles of international humanitarian law, the protection of civilians during armed conflicts, and the legal frameworks governing warfare. It incorporated case studies, simulations, and discussions on contemporary issues, which deepened my understanding of legal applications in armed conflict scenarios. Key outcomes include an enhanced ability to analyze legal frameworks, improved critical thinking skills, and a broader perspective on the ethical implications of warfare. Additionally, the Erasmus experience facilitated networking with peers from diverse backgrounds, fostering collaborative learning and global awareness.

Conclusions: The Erasmus+ experience in Torino through the LOAC course significantly contributed to my academic and personal growth. It provided a platform for international collaboration, knowledge exchange, and a deeper understanding of international humanitarian law. The insights gained will be instrumental in my future professional endeavors, equipping me with essential skills for working in legal and policy-related fields concerning armed conflict.

Acknowledgements: I would like to express my gratitude to my academic coordinator, Col.(AF) Cristian Moldoveanu, for the guidance and support throughout this experience.

Keywords: Erasmus+, LOAC, Law of Armed Conflict, international humanitarian law, academic mobility, Torino.



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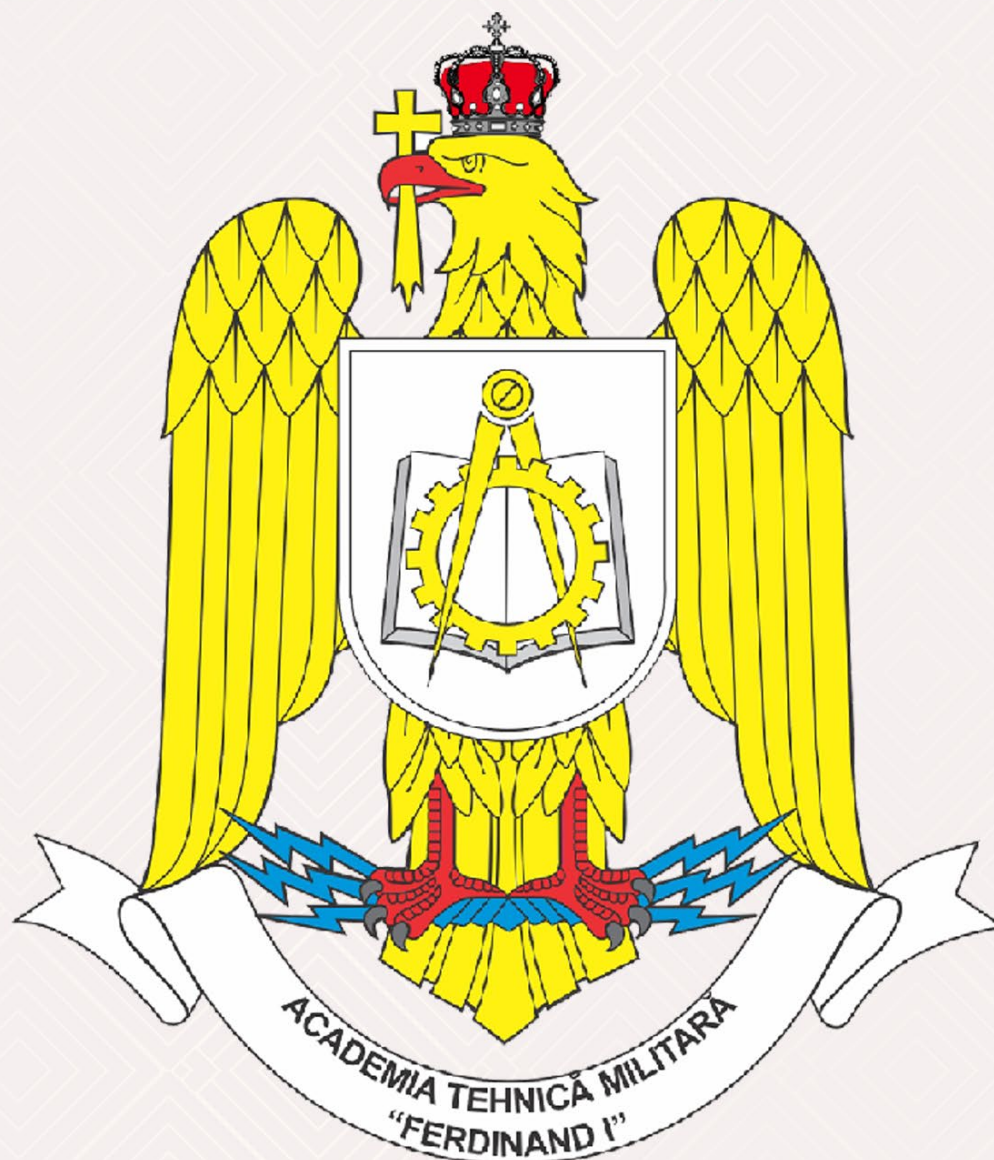




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