Session 1

A 1.1

Current Trends in Near-Infrared Vein Visualization Devices

Nicholas Ivanov, Anca-Iulia Nicu and Nicolae Marius Roman

Abstract: Peripheral venous access is essential for blood sampling, intravenous therapy, and fluid administration, yet vein identification remains challenging in patients with difficult venous access. Near-infrared (NIR) vein visualization has emerged as a non-invasive approach for enhancing superficial vascular visualization by exploiting differences in light absorption between hemoglobin and surrounding tissues. This paper provides a technology-focused overview of current trends and the evolution of NIR vein visualization technologies, addressing the core capabilities of modern systems, including visual outputs, procedural guidance, population-specific applications, difficult-access support, and data capture, recording, and connectivity features, from studies published between 2010 and 2026 with greater emphasis on work from the last three years to reflect the current state of the technology. Clinical evidence indicates variable effectiveness across patient populations and healthcare settings, influenced by patient characteristics, operator experience, training, and workflow integration. The paper also examines validation gaps in advanced features such as three-dimensional vascular mapping and depth estimation. Current technical challenges include limited penetration depth, geometric distortion, parallax, motion artifacts, ambient-light sensitivity, skin surface characteristics, patient variability, and skin-tone-related performance differences. Future developments require improved technical robustness, standardized clinical validation, and stronger integration of advanced imaging capabilities into vascular access workflows.

A 1.2

System Design and Experimental Implementation of a Therapeutic Ultrasound Device

Alexandru Popovici, Cristian Farcas, Ionut Ciocan, Dora Popovici and Edina Nevezi

Abstract: Therapeutic ultrasound requires stable carrier generation, controlled power transfer, and resonant piezoceramic applicators. This paper presents the system-level implementation and electrical evaluation of a laboratory therapeutic-ultrasound prototype. Building on prior characterization of individual piezoceramic discs, selected transducers were integrated with a quartz-referenced 800-899 kHz frequency source, a microcontroller-based user interface, an adjustable output stage, and an independent diadynamic-current generator. Two applicators with different active areas support operation over differently sized treatment regions. Oscilloscope observations documented the TTL carrier, switching at the transducer interface, and repeatable low-frequency waveforms for fixed-diphase and syncopated stimulation modes. A 3 kΩ resistive load provided a controlled condition for electrotherapy-output tests. The study addresses functional and electrical behavior rather than clinical efficacy or formal medical-device compliance. The resulting platform supports laboratory analysis, teaching, and further acoustic validation..

A 1.3

Modeling Visual and Cognitive Performance through the Analysis of Reaction Time, Eye Movements, and EEG Indicators

Alexandra-Maria Lazar, Barbu Cristian, Mihaela Ioana Baritz and Anca Elena Stanciu

Abstract: Visual function and the associated cognitive processes can be investigated through the modeling and analysis of objective parameters that characterize an individual's response to visual-cognitive tasks. Reaction time, response accuracy, eye movement characteristics, and electroencephalographic indica-tors of attention and meditation represent complementary variables that enable the characterization of visual and cognitive performance and the identification of relationships among perceptual processes, attentional mechanisms, and behavioral responses.

This study proposes an approach for modeling visual and cognitive performance using experimental data acquired during computerized cognitive tasks derived from the D2 Test of Attention, the Test of Variables of Attention (T.O.V.A.), and the Stroop Test, implemented in the MATLAB environment. The experimental configurations were adapted for computerized administration and to facilitate the automatic quantification of the parameters of interest. Within the experimental protocol, eye movements were monitored using eye-tracking techniques, while electroencephalographic measurements of attention and meditation were recorded using the NeuroSky MindWave system.
Experimental data were collected from a group of eight healthy participants. For each analyzed experimental interval, mean values of the EEG indicators were determined and subsequently analyzed in conjunction with reaction time, response accuracy, and the characteristics of oculomotor behavior. The results demonstrate the feasibility of an integrated use of behavioral, oculo-motor, and electroencephalographic parameters for modeling visual and cognitive performance and for investigating the relationships among visual responses, cognitive processes, and the dynamics of attention and concentration states.

A 1.4
Embedded Breath-Alcohol Sensing for Driver Safety: An Affordable Connected Interlock System
Paul Farago, Daniel Marchis and Mihaela Cirlugea

Abstract: Alcohol-impaired driving is a major and largely preventable cause of road-traffic injury and death, which makes it an important target for preventive health technology. This work presents SoberStart, an affordable connected breath-alcohol screening and engine-interlock system that aims to keep an at-risk person from starting a vehicle and to support remote safety monitoring. A sensing node built on an ESP32-S3 pairs an MQ-3 sensor with a guided touchscreen and a second-order calibration of breath-alcohol concentration. Each decision travels over a connectionless ESP-NOW link to an independent node that gates engine start, so protection works without Wi-Fi, while a parallel cloud link timestamps every test and alerts a carer, supervisor. Across 40 controlled trials at four concentration levels, the prototype agreed with the intended pass/fail outcome in 39 cases (97.5%), the single error falling exactly at the 0.25 mg/L threshold, responded within three seconds after warm-up, and actuated the remote node in under 15ms. It costs roughly USD 20 in commodity parts. These are laboratory results obtained with calibrated ethanol vapour from cotton swabs as a breath surrogate, over a small test set and without temperature, humidity ot interferent testing. SoberStart is not a certified forensic instrument, but it provides a reproducible basis for biomedical-engineering research and education.

A 1.5
Design, Numerical Modeling, and Implementation of a Pulsed Electromagnetic Field (PEMF) Therapy Device
Claudia Constantinescu, Claudia Pacurar, Marian Gliga, Sergiu Andreica, Lavinia Opris, Calin Munteanu, Alina Udvar and Adina Giurgiuman

Abstract: With the growing need to develop technological solutions and devices that support individuals with various medical conditions, increasing attention has been directed toward a deeper investigation of the applicability of pulsed electromagnetic field (PEMF) therapy. The motivation for selecting this research topic stems from the non-invasive potential of pulsed electromagnetic field therapy to be used in the treatment of various medical conditions and to promote cellular regeneration. PEMF technology has been investigated in a range of biomedical applications, including tissue healing and musculoskeletal conditions. However, the therapeutic response depends on several exposure parameters, including magnetic flux density, frequency, pulse duration, waveform, and treatment duration. The present study does not evaluate biological or clinical responses to PEMF exposure. Instead, it focuses on the engineering aspects of coil design, numerical modeling, and prototype implementation. For this study, a coil was modeled and the magnetic induction values were assessed after varying

the dimensions, material, number of windings and positioning of the coil determining their influence, all by considering the coil fed with PEMF signal with a frequency of 20 Hz, an impulse period of 200 μs and a current of 3A during the impulse period. Also, a PEMF device was created.

A 1.6

Modelling of Locomotor Behaviour Under Visual Impairment Conditions Using LabVIEW

Mirela Gabriela Apostoaie, Barbu Braun, Mihaela-Ioana Baritz and Anca Tătaru (Ostafe)

Abstract: Human gait is a complex biomechanical process, dependent on the visual system for maintaining balance, spatial orientation and anticipating obstacles. People with visual impairments often exhibit compensatory gait adaptations, manifested by trajectory deviations, asymmetries of step length and redistributions of plantar pressure compared to normal. The paper presents a simulation carried out in the graphical programming environment LabVIEW, through which the gait trajectory and the distribution of plantar pressure are modeled in six visual conditions: normal vision (reference), strabismus, age-related macular degeneration (AMD), cataract, glaucoma and blindness. The simulation parameters include the trajectory over a distance of 5 m, body weight (30–160 kg) and the size of the plantar surface (EU 30–48). Deviations from the ideal trajectory are quantified on the longitudinal (OX) and lateral (OY) axes, and plantar pressure is estimated on four functional areas of the sole: heel, medial, metatarsal, phalanges. The simulation results indicate a proportional increase in trajectory deviations with the severity of visual impairment. The plantar pressure distribution reveals a compensatory overload of the heel in conditions of severe visual impairment.

A 1.7

Human Gait Cycle Simulation Model Based on the Duffing Equation and the Umberger Metabolic Model

Anca Ioana Tătaru (Ostafe), Mihaela Ioana Baritz, Mirela Gabriela Apostoaie, Angela Repanovici, Cornel Druga and Gyorgy Bodi

Abstract: In specialized biomechanical research, numerical techniques and analytical relationships are essential for simulating the kinematic and dynamic parameters of the human walking cycle. While video analysis provides subjective and objective evaluations of gait patterns, computerized plantar pressure analysis serves as a quantifiable tool to map foot load distribution and identify prolonged high-pressure regions. Combining these experimental approaches with computational simulations allows for the identification of biomechanical adjustments necessary to optimize posture efficiency and alleviate joint pain during movement or balance tasks. In this paper, the general aspects of the normal gait cycle are first analyzed, followed by the implementation of a numerical simulation model developed in MATLAB. The proposed framework integrates the non-linear Duffing equations for dynamic modeling alongside the Umberger metabolic energy model to evaluate power expenditure. Finally, the model is applied to compare normal walking kinematics and kinetics against those observed in a diabetic foot condition under constrained and unconstrained scenarios. The simulation results quantify key variations in joint angles, tibio-femoral forces, and metabolic energy consumption, providing a useful diagnostic tool for biomechanical assessment and prospective clinical applications.

A 1.8

Scientific and Technical Foundations of Thermomagnetic Therapy: A Proposal for Localized Combined Treatment

Lisandru Leonard, Nicholas Ivanov, Simona Vlad and Rodica Holonec

Abstract: Musculoskeletal disorders are frequently associated with pain, inflammation, stiffness, and limited mobility, motivating the investigation of localized, non-invasive, and adaptable physical approaches. This paper presents the scientific and technical foundations of thermomagnetic therapy, understood here as a proposed therapeutic concept rather than

an established clinical therapy. The approach combines controlled thermal stimulation with magnetic-field exposure applied to the same anatomical region. Two experimental prototypes were developed: SIMLE-S, based on adjustable heating and a static magnetic field generated by permanent magnets, and SIMLE-D, which extends this configuration by adding an electromagnetically generated time-varying magnetic component. The work focuses on the engineering design, implementation, control, and preliminary technical characterization of the two devices, together with a progressive validation methodology including thermal and magnetic characterization, repeatability assessment, numerical simulation, testing on artificial tissue models, and future controlled clinical studies. The presented results support the technical feasibility of the proposed concept but do not establish clinical efficacy or therapeutic synergy.

A 1.9

Simulation and prediction of the effect of orthokeratology treatment to control the myopia progression

Gyory Bodi, Mihaela Ioana Baritz, Mirela Gabriela Apostoaie, Angela Repanovici, Alexandra Maria Lazăr and Anca Ioana Tătaru (Ostafe)

Abstract: The refractive error of the progressive myopia type can be a visual dysfunction for young subjects with important consequences on the quality of life and the activity they carry out. A very modern method of controlling its evolution is orthokeratology, through which subjects with myopia wear a rigid lens at night that flattens the surface of the cornea, thus modifying the dioptric power and therefore the level of refractive error. In order to evaluate the efficiency and level of success of this procedure, the authors of this paper present a way of simulating and predicting the effect of orthokeratology treatment in order to be able to follow and keep under control the possible evolution of myopia. In this regard, the fundamental aspects of the procedure and the importance of the parameters that are involved in the orthokeratological mechanism of optical and geometric modification of the cornea are presented in the first part of the paper. In the second part, the aspects that were the basis for the conception and development of a prediction structure for a sample of 25 patients with progressive myopia problems are presented, exemplifying these through the detailed presentation of a single patient. The results of this methodology are presented in the third part of the paper, for this patient selected from the sample, along with a series of conclusions and confirmations from the specialized literature that followed similar aspects.

A 1.10

Numerical characterization of inductive coupling in a 134.2 kHz veterinary microchip–reader system under representative implantation conditions

Angela Lungu, Claudia Constantinescu, Andreea Nicoleta Paleu and Alexandra Muresan

Abstract: Inductive coupling in passive RFID systems depends on the distance between the implanted transponder and the external reader. This study investigates the effect of implantation depth on a 134.2 kHz veterinary RFID system, considering two placements in donkeys: superficial subcutaneous implantation and deeper implantation within the nuchal ligament. A 19-turn transponder coil and a five-turn reader coil were modelled in ANSYS Q3D Extractor to calculate mutual inductance and the coupling coefficient at different distances. ANSYS HFSS was then used to evaluate electric and magnetic fields and local specific absorption rate (SAR) in multilayer tissue models. Increasing the antenna separation from approximately 5 to 23 mm reduced mutual inductance from 9.87 to 0.259 nH. Under the simulated excitation conditions, the mean magnetic field intensity within the implant capsule decreased from 6.63 to 0.062 A/m. The electromagnetic analysis also showed low local SAR values in the deeper implantation model. The results highlight the influence of implantation depth on inductive coupling and provide an initial assessment of electromagnetic exposure in the surrounding tissues..

Session 2

A 2.1

A Closed-Loop Testbed for Detecting and Mitigating MQTT-Based DoS Attacks in Tele-homecare Systems

Carla-Mihaela Bulzescu and Lăcrimioara Grama

Abstract: Denial-of-Service attacks represent a significant threat to Internet of Medical Things infrastructures, where service availability is directly related to patient safety and continuity of remote monitoring. This paper presents an end-to-end experimental testbed for simulating, detecting, visualizing, and mitigating MQTT-based DoS attacks in a tele-homecare scenario. The proposed architecture combines an ESP32-C6 microcontroller, used as a simulated compromised medical sensor, with a Mosquitto MQTT broker and a Node-RED-based intrusion detection and control platform deployed on a Debian virtual machine. A threshold-based detection mechanism monitors the incoming MQTT publication rate and identifies abnormal traffic patterns associated with flooding attacks. When the predefined threshold is exceeded, the system triggers a multi-channel response that includes dashboard visualization, email notification, audio warning, physical LED indicators, and an active mitigation command sent back to the attacking node. Experimental validation demonstrates that the proposed closed-loop mechanism can detect the attack condition in real time and stop the malicious transmission automatically. The testbed provides a practical and reproducible framework for evaluating cybersecurity mechanisms in telemedicine and remote patient monitoring systems.

A 2.2

Explainable ECG Classification Using Deep Learning and Large Language Models

Luisa Elena Tanase, Cristina Bianca Pop and Viorica Rozina Chifu

Abstract: One leading cause of morbidity worldwide is cardiovascular disease, and one of the most widely used tools for its detection is the electrocardiogram (ECG). This paper presents a system for multi-label arrhythmia classification that predicts five diagnostic superclasses: Normal, Myocardial Infarction, ST/T-Wave Changes, Conduction Disturbance, and Hypertrophy. The proposed approach uses a hybrid deep learning model combining a CNN-Transformer-MLP architecture with a retrieval augmented generation (RAG) module, which produces clinically grounded explanations for the predicted labels. The approach was evaluated on the PTB-XL dataset, using 12-lead ECG signals together with patient age and sex metadata. The results show that the proposed approach achieves a macro-averaged ROC-AUC of 0.9085 on the PTB-XL test fold, demonstrating accurate multi-label classification and the ability to provide guideline-based explanations for clinical decision support sy.

A 2.3

Personalized Menu Application using Machine Learning Dish Recognition

Mihaela Cirlugea, Ioana Marincas and Paul Farago

Abstract: This paper presents NutriFit, an integrated, multi-role web platform designed for automated visual food recognition, dynamic meal plan optimization, and dietitian-guided monitoring. Accurate dietary monitoring and adherence to personalized nutritional goals remain major hurdles in managing a healthy lifestyle and achieving fitness objectives. Existing commercial mobile applications rely heavily on manual text logging and static meal templates, leading to poor user experience and low adoption. The visual recognition engine utilizes a fine-tuned ResNet50 Convolutional Neural Network (CNN) configured via ImageAI and trained on the 101,000-image Food-101 benchmark dataset, achieving an 80% top-1 classification accuracy across 101 dish categories. Complementing the visual detector, a custom heuristic scoring algorithm calculates daily caloric and macronutrient requirements based on personal metrics and dynamically distributes dishes across specific daily meal times, like breakfast, lunch, dinner and snacks, while enforcing variety and repetition constraints. Built on a Python Django Model-View-Template (MVT) framework with a 7-table MySQL relational schema,

NutriFit incorporates explicit Role-Based Access Control (RBAC) across standard users, dietitians, and administrators. Experimental validation confirms the platform's capacity to maintain macronutrient target.

A 2.4

Electromagnetic Field Exposure from Wearable Device Antennas and Its Influence on the Human Wrist

Claudia Pacurar, Vasile Topa, Claudia Constantinescu, Marian Gliga, Lucian Petrascu, Lavinia Opris and Adina Giurgiuman

Abstract: Human exposure to electromagnetic fields has become a topic of major interest in recent years, in the context of their widespread use. The safety of wearable devices, from the perspective of electromagnetic emissions generated by their antennas, is essential for protecting users' health. In this context, the present article analyzes an antenna used in a smartwatch, aiming to determine its specific parameters with respect to the frequency bands characteristic of these devices, as well as the associated electric and magnetic field emissions. Furthermore, human exposure to electromagnetic fields is investigated by evaluating the influence of the wearable device antenna on the wrist, using representations of electric field distribution, magnetic field distribution, and specific absorption rate. Electromagnetic shielding solutions based on the use of suitable materials at the device enclosure level are also investigated. The field representations for these three scenarios are compared with each other and evaluated against the exposure limits established by current standards, emphasizing compliance and the implications for the safe use of these technologies.

A 2.5

Adversarial Vulnerability Assessment of AI-Based Fatigue Detection in Wearable Biomedical Monitoring Systems: A Simulation Study on the WESAD Dataset

Laura Cătălina Dospinescu, Laurențiu Dan Milici, Edi Marian Timofte and Marcel Puşcaş

Abstract: Real-time occupational safety systems increasingly count on machine learning to catch worker fatigue via wearables, yet we know surprisingly little about how easily these models can be tricked. This paper tackles that exact security gap. We simulated white-box attacks—specifically FGSM and PGD with perturbation magnitudes ranging from $\epsilon = 0.01$ to 0.15—against three common classifiers (Random Forest, SVM, and a 1-D CNN) trained on multimodal physiological data from the public WESAD dataset. The results are deeply concerning. Tiny, human-imperceptible tweaks crashed the 1-D CNN's accuracy from a solid 92.3% down to a dismal 31.4%. Even worse, false-negative rates spiked to 81.2% under PGD attacks, creating a critical safety blind spot where exhausted workers would go completely undetected. While adversarial training can win back some of this lost ground ($+29.8$ percentage points under PGD at $\epsilon = 0.10$), it does come with a minor tax on clean accuracy, causing a 4.7 percentage point drop. Ultimately, when viewed through the lens of the EU AI Act (2024/1689), MDR compliance, and established threat taxonomies, our findings show that building adversarially robust pipelines isn't optional—it's a strict safety requirement before these wearable systems ever hit the factory floor.

A 2.6

Biometric Multimodal System for Real-Time Stress Monitoring in Exposure Therapy using Virtual Reality

Andreea Caprita, Mihai Munteanu and Melinda Mitranovici

Abstract: Stress and fear are difficult to quantify objectively through self-reporting, a main factor for why there is a reliance on objective physiological signals instead. This paper presents an integrated system that monitors biometrics in real time during exposure protocols inside of virtual reality (VR), combining collecting the galvanic skin response (GSR) with estimating the heart rate variability (HRV) through optical photoplethysmography (MAX30102); both are wirelessly transmitted via Bluetooth (HC-05) and are synced to events found within the VR application running on the Meta Quest 2. Preliminary results from four

participants confirm the system's capabilities in detecting both the phasic (SCR) and tonic (SCL) components of skin conductance, alongside RMSSD modulation associated with sympathetic activation, supporting the technical feasibility of the proposed architecture..

A 2.7

Support for Clinical Trials and Medical Experiments: Digital Support Tools from Feasibility Analysis to Data Management and Analysis

Sebastian Student, Agata Małgorzata Wilk, Artur Wyciślok and Krzysztof Fujarewicz

Abstract: This paper presents a comprehensive digital ecosystem designed to optimize the entire clinical trial lifecycle. The proposed architecture consists of three core pillars. First, the Feasibility Module enhances early-stage planning by evaluating patient availability and identifying operational bottlenecks. Second, the Trial Navigator provides a proactive, event-driven management cockpit that ensures strict adherence to ICH E6(R3) GCP guidelines and mitigates procedural risks. Finally, the Data Analysis Module offers a modular pipeline for processing and integrating multimodal healthcare data, including clinical, radiomic, and genomic datasets. Together, these integrated tools maximize trial efficiency, maintain regulatory compliance, and support advanced, data-driven modern medical research.

A 2.8

Assisted methodology for testing and monitoring in visual screening and casuistics

Barbu Braun, Corneliu Drugă, Ionel Șerban, Alexandra Lazăr and Mirela Gabriela Apostoaie

Abstract: The paper presents a proposed solution to increase the efficiency of the procedures for the continuous assessment and monitoring of subjects in terms of visual function, through three complementary interdependent software interfaces. The goal is to facilitate patients' access to investigation procedures in medical optical offices, on the one hand, and, on the other hand, to significantly ease the work of doctors and optometrists in the procedures they have to apply. However, the major advantage of this proposed solution would be that, by correlating the information generated quickly through the interfaces, objective, complete, precise reports can be obtained in a very short time and with low costs for each subject investigated, in particular. The paper presents two such reports for the case of two simulated subjects, one female, the other male, both with visual impairments. Due to the proven increase in the efficiency of the procedures, but also its significant simplification, the proposed solution will be able to be implemented in the future in medical optical clinics on an increasingly wider scale.

A 2.9

EMG-Referenced Validation of an Infrared PPG Bracelet Demonstrator for Muscle Contraction Monitoring

Ana Fenesan, Alexandru Ianosi-Andreeva-Dimitrova and Silviu Dan Mandru

Abstract: This study presents the validation of a near-infrared photoplethysmography (PPG)-based wearable bracelet for muscle contraction detection. Surface electromyography (sEMG), acquired using the BIOPAC Systems Inc. MP36 data acquisition unit, was employed as a gold standard reference. Recordings were performed on the forearm flexor muscles and biceps brachii during voluntary contractions, with both systems. The results confirm that the PPG signal captures genuine hemodynamic responses to muscle activation, rather than noise or motion artifacts, as evidenced by temporal agreement with the EMG reference. A MATLAB-based processing pipeline successfully converts the PPG signal into a binary control signal, demonstrating the feasibility of this non-invasive approach for rehabilitation device control.

A 2.10

Determination of glucose levels and clotting times using electrical impedance of blood

Corneliu Druga, Ionel Serban, Angela Repanovici, Barbu Braun, Alexandra Lazar and Ileana Pantea

Abstract: This paper presents the design and development of a portable device that would allow simultaneous monitoring of blood glucose and blood clotting times, using an approach based on impedance measurements. The proposed sys tem is structured around a modular architecture, whose core is represented by the Arduino Uno R3 development board, which coordinates all the other compo nents. It manages both the acquisition of biological data, as well as their pro cessing, display, saving and transmission. The device developed uses the AD5933 integrated circuit for generating the excitation signal and analyzing the electrical impedance..

Session 3

A 3.1

Deep Learning for Brain Tumor Classification in MRI Images: CNN and VGG19 Transfer Learning Approaches

Adina-Bianca Dragomir, Paul-Andrei Pintea and Eva-Henrieta Dulf

Abstract: Automated brain tumor classification from Magnetic Resonance Imaging (MRI) is a critical component of modern medical diagnosis. However, the clinical adoption of these systems depends on more than just raw performance; they must also be robust across different data sources and transparent in their decision-making. Accordingly, this study assesses how architectural design choices influence classification accuracy, interpretability, and domain generalization in deep learning-based brain tumor diagnosis. We systematically investigate two distinct paradigms: a custom Convolutional Neural Network (CNN) trained from scratch and a VGG19-based transfer learning model fine-tuned on a dataset of 5,600 MRI images across four classes (glioma, meningioma, pituitary tumor, and no tumor). In-domain testing revealed that the VGG19 model achieved superior performance (92.88% test accuracy) compared to the custom CNN (83.06%). Conversely, cross-dataset evaluation on the independent Figshare dataset (3,064 images) exposed a severe domain shift sensitivity in the VGG19 model, whose accuracy dropped to 56.17%. In contrast, the custom CNN demonstrated superior generalization, retaining an 81.01% accuracy. Ultimately, this work highlights a crucial trade-off: while complex transfer learning models maximize local accuracy, simpler custom architectures may offer the resilience required for real-world clinical generalization. This generalization advantage is specific to the Figshare distribution: on the multimodal BraTS 2020 dataset, both models performed near chance level, underscoring that domain robustness cannot be assumed to extend uniformly across all external MRI sources.

A 3.2

Integrating Molecular Docking and Systems Pharmacology to Identify Nebuloside A/B as Novel Triterpenoid Inhibitors of the CXCL12/CXCR4 Signaling Axis

Elif Dilara Gökmen, Gamzenur Kabak and Idris Arslan

Abstract: Chemokines are a family of small (8–14 kDa) chemotactic cytokines that regulate essential physiological processes. The CXCL12/CXCR4 signaling axis is a critical mediator of homeostatic signal transduction; however, its overexpression is strongly linked to cancer progression, angiogenesis, and organ-specific metastasis. In this study, we employed a comprehensive systems pharmacology approach to investigate Nebuloside A and B, triterpenoid saponins isolated from *Gypsophila arrostii*, as potential inhibitors of CXCL12. The research workflow integrated target prediction via SwissTargetPrediction, protein standardization using UniProt ID Mapping, and pathway reconstruction through KEGG Mapper. Our analysis revealed that these nebulosides—which share a core oleanolic acid scaffold—significantly modulate key oncogenic pathways, including the Chemokine signaling pathway (hsa04062) and the PI3K-Akt signaling cascade (hsa04151). To validate these findings at the molecular level, in silico docking was performed using AutoDock 4.2 against the high-resolution X-ray structure of CXCL12 (PDB ID: 3HP3). The results demonstrated that

Nebuloside A and B exhibit high binding affinity for the glycosaminoglycan (GAG)-binding surface of CXCL12, potentially disrupting its interaction with CXCR4. These in silico findings suggest that Nebuloside A and B are promising candidate inhibitors of the CXCL12/CXCR4 axis, warranting further experimental validation as part of a natural-product strategy against chemokine-mediated malignancy.

A 3.3

Optimization of a vein visualization system through process automation using convolutional neural networks and the U-Net architecture applied to near-infrared images

Nicholas Ivanov, Anca-Iulia Nicu and Nicolae Marius Roman

Abstract: In this paper, a technique for segmenting veins in near-infrared (NIR) images using deep learning is explored, specifically employing convolutional neural networks (CNNs) and the U-Net architecture. The foundation of the study rests on CNNs' ability to automatically learn spatial hierarchies of features via convolutional filters, making them effective for complex visual tasks, particularly in medical image analysis. U-Net is favored due to its established success in biomedical segmentation under low-contrast and data-limited conditions typical for subcutaneous vein imaging. Its unique encoder-decoder structure is enhanced with skip connections. The implementation involved creating a MATLAB program for displaying masks, which managed preprocessing by importing and resizing image sets to improve efficiency during input to the U-Net network. The next phase involved training the deep neural networks, configuring their layers, and setting runtime. The U-Net network demonstrated its capability to produce effective vein segmentation masks, validated by overlaying these masks onto original images. On the held-out test set, the model obtained a macro Dice score of 0.1135 ± 0.0967 and a micro Dice score of 0.1152. The best individual test image reached a Dice score of 0.2940. The results show that the network can recover parts of the annotated vein structure, although performance varies considerably between images. This methodology illustrates the successful integration of deep learning techniques and classical preprocessing, enabling U-Net to differentiate vein patterns through hierarchical feature extraction while preprocessing enhances the visibility of subtle vascular structures.

A 3.4

Brain Tumor Analysis using Integrated YOLO and Segment Anything Model Architectures

Maria Vasilache and Delia-Alexandrina Mitrea

Abstract: Brain tumors arise from the uncontrolled division of cerebral cells, severely disrupting neurological functions and contributing to high mortality rates. Magnetic Resonance Imaging (MRI) remains the gold standard for diagnosis. However, manual analysis is time-consuming and prone to variability. This study proposes an automated deep learning pipeline integrating the YOLO technique, respectively Segment Anything Model (SAM) for brain tumor detection and segmentation. These were followed by classification through last generation Convolutional Neural Networks (CNNs) and transformers, enhanced through attention mechanisms and Atrous Spatial Pyramid Pooling (ASPP) modules, for improving classification performance and achieving multi-resolution capabilities. Soft and hard (majority) voting procedures were employed as well, for enhancing the tumor detection and classification performance. EXplainable Artificial Intelligence (XAI) methods, in the form of Gradient-weighted Class Activation Mapping (Grad-CAM) were also adopted. The results demonstrate an increased detection, segmentation and classification performance. Thus, a very good accuracy value, of 96.74%, was attained when employing SAM with YOLO prompt and soft voting.

A 3.5

Analysis, through image processing, of the lower limb joints trajectories during different human gait variants

Anca Ioana Tătaru (Ostafe), Mihaela Ioana Baritz, Mirela Gabriela Apostoaie, Barbu Cristian Braun, Angela Repanovici and Gyory Bodi

Abstract: Video methods of analyzing the biomechanics of the walking cycle represent a very practical and efficient modality of observing, extracting and measuring some defining parameters of the human walking cycle. The main objective of the research is to what extent the trajectories and kinematic parameters of the joints of the lower limbs differ between various walking patterns (normal, pathological, simulated), using exclusively video analysis and digital image processing. The key issues addressed in this research are the identification of significant differences between the ankle, knee and hip trajectories (where applicable) for different types of walking and the assessment of the possibility of obtaining the joint variant that offers the highest capacity for discrimination between walking models. In essence, it is important to identify the characteristic kinematic signatures for each type of walk, which can be obtained by processing video sequences in relation to cinematic parameters. Thus in the first part of the paper are presented general aspects of the methodology of image processing analysis to develop a specific procedure. The method and means chosen for this type of evaluation are presented in the second part of the paper, in order to quantify the results and to introduce an index of geometric complexity of walking as a quantitative way of assessing and comparing between normal and pathological walking or with dysfunctions. The aspects highlighted in this paper regarding the results of the applications come to complement the previous and complex methodologies due to the efficiency of important determinations.

A 3.6

Morphology Enhanced U-Net Architectures for Retinal Blood Vessels Segmentation

Marius Ioan George Gaură and Mihaela-Laura Gordan

Abstract: The purpose of this paper is to emphasize the advantages of mathematical morphology in the task of blood vessels segmentation from retinal images. To do that, new architectures embedding morphological operations into a classical U-Net structure, with fixed and trainable structuring elements, are proposed and compared to a baseline U-Net architecture. Two types of layers have been used. The first one includes a non-trainable structuring element, but unlike other existing architectures that place this layer outside the deep U-Net structure, the morphological operation takes place inside the U-Net structure, thus affecting the weights update in the convolutional layers. The second architecture includes a trainable structuring element, capable of being updated during the learning process. All architectures are trained with two loss functions, binary cross-entropy and weighted binary cross-entropy. To validate the performance of the proposed architectures, experiments were performed on CHASE_DB1 dataset. We examined eight morphology-based configurations for blood vessels detection. The results show the morphological layers can be useful in the segmentation of retinal vessels, improving the accuracy of these systems as compared to the baseline.

A 3.7

Adaptive Preprocessing for Colorectal Polyp Segmentation in White-Light Endoscopy

Raul Cardoș, Mihaela Gordan and Georgiana Nagy

Abstract: Specular highlights and suboptimal image contrast in white-light endoscopy (WLE) colonoscopy images degrade the performance of deep learning-based polyp segmentation models. We propose a two-component, model-agnostic preprocessing pipeline that operates on the input image before segmentation model inference without requiring any model modifications. The first component performs specular highlight removal using a detection network, followed by adaptive per-component mask dilation and a no-reference dual inpainter selection mechanism that independently assigns LaMa or MAT to each detected region based on boundary gradient discontinuity and CIE L*a*b* color consistency scoring. The second

component adapts a quaternion frequency-domain contrast enhancement method for the endoscopic domain, introducing contour-based ROI mask extraction and 99^{th} percentile tissue intensity scaling. The pipeline is evaluated across five segmentation model configurations – covering zero-shot, medical-adapted, and polyp-specific supervised models – under three input conditions on five benchmark datasets totaling 798 images. Weak-prompt models show the largest gains, with SAM centroid-prompt improving from mDice 0.398 to 0.554 $(+0.156)$, with very high statistical significance as shown by the Wilcoxon signed-rank test.

A 3.8

Investigations on Neural Correlates in Motor Imagery

Stefan-Alexandru Gigoi, Iulian-Costin Neaga, Dragoș-Daniel Țarălungă and Georgeta-Mihaela Neagu

Abstract: Brain-Computer Interfaces (BCIs) rely on the robust decoding of motor intentions. Event-Related Desynchronization (ERD) in the alpha band (8-12 Hz) is a primary neurophysiological marker for both Motor Execution (ME) and Motor Imagery (MI). However, high inter-subject variability and signal degradation during MI pose significant challenges for BCI classifiers. This study presents a comparative statistical analysis of ME and MI using the PhysioNet EEG dataset comprising of 109 subjects. We propose an automated hybrid preprocessing pipeline utilizing Independent Component Analysis (ICA) integrated with ICLabel for strict artefact rejection. To address anatomical variance, we implement a logarithmic normalization strategy, extracting ERD features in decibels (dB). Statistical validation using Welch's t-test directly contrasts the desynchronization magnitude of ME versus MI. The comparative analysis reveals that while MI shares identical topographic activation zones with ME, it exhibits a quantifiable reduction in median amplitude and greater statistical dispersion. The dB-normalized features effectively standardize ERD measurements across a large cohort, establishing a rigorously purified mathematical foundation for future real-time Deep Learning classification in BCI applications..

A 3.9

A Human-in-the-Loop Framework for Paper ECG Digitization and Clinical Parameter Extraction Using LabVIEW

Rodica Holonec, Laura Grindei, Laszlo Rapolti and Claudia Constantinescu

Abstract: Paper-based electrocardiograms (ECGs) remain an important source of clinical information, yet their integration into modern digital healthcare systems is limited by the lack of machine-processable formats. This paper proposes a Human-in-the-Loop (HITL) framework for the digitization and analysis of printed ECG records using LabVIEW image processing and biomedical signal analysis tools. The method extracts the ECG waveform from a scanned image, reconstructs a calibrated digital signal, and automatically estimates clinically relevant parameters such as heart rate, RR intervals, and QRS complex characteristics. The image-processing operations used for waveform extraction and reconstruction are established techniques; the contribution of this work lies in their integration with bio-medical parameter extraction and expert validation within a unified HITL work-flow. To evaluate the approach, a printed 12-lead ECG record and its corresponding clinical ECG report were used, with the reconstructed aVF lead serving as a representative proof-of-concept case. The automatically extracted parameters were compared with reference values reported in the clinical ECG report. Close agreement was obtained for heart rate, whereas larger deviations were observed for interval-based parameters, highlighting both the feasibility and current limitations of the approach. The proposed methodology combines automated processing with clinical oversight and supports the conversion of legacy ECG records into digital information suitable for archiving, quantitative analysis, and future AI-assisted decision-support applications.

A 3.10

Comparative Analysis of Surface Electromyographic Characteristics Across Five Lower-Limb Muscles in Healthy Subjects

Andreea Halas and Mihai Munteanu

Abstract: Surface electromyography (sEMG) provides a non-invasive approach for investigating neuromuscular activity and characterizing muscle activation during functional movement. This preliminary study aimed to compare electromyographic characteristics across five lower-limb muscles and to investigate inter-subject variability in healthy individuals. Surface EMG recordings from the tibialis anterior (TA), lateral gastrocnemius (GL), rectus femoris (RF), vastus lateralis (VL), and hamstrings (HAM) were analyzed in three healthy subjects selected from a publicly available PhysioNet database. The recorded signals were processed using a LabVIEW-based application developed for signal visualization, MUAP-related event detection and feature extraction. Four characteristics were considered: amplitude, active duration, zero-crossing count, and the number of detected MUAP-related events. The extracted parameters were compared both between muscles within each subject and between subjects for the same muscle. Preliminary results revealed differences in the analyzed characteristics across the five muscles as well as inter-individual variability. These observed trends highlight the importance of considering both muscle-specific and subject-specific characteristics when interpreting lower-limb sEMG recordings and provide a basis for extending the analysis to a larger population.

Session 4

A 4.1

Fully Automated Brain Tumor Volume Estimation via Multiparametric MRI and Constrained Deep Convolutional Networks

Alireza Azadifar

Abstract: Prompt and precise volumetric assessment of malignant brain tumors via magnetic resonance imaging (MRI) remains a cornerstone for effective neurosurgical planning. This study introduces a computationally streamlined, cost-effective paradigm leveraging a tailored deep convolutional neural network topology optimized for semantic tumor segmentation and physical volume quantification. Utilizing the multi-institution BraTS cohort encompassing exactly 369 patient scans, we synthesized three imaging sequences—contrast-enhanced T1-weighted (T1ce), T2, and FLAIR—into a unified multi-parametric three-channel tensor representation. To ensure clinical accessibility, the network was optimized across 15 epochs (825 iterations) to operate exclusively under a central processing unit (CPU) architecture (requiring 236 minutes of training time and zero GPU dependency), bypassing resource-heavy hardware infrastructures. Comparative validation demonstrates that standard single-channel slice processing exhibits catastrophic localization failure, whereas the proposed multi-parametric framework achieves a robust validation accuracy of 89.72%. Furthermore, by integrating a dedicated Equation of Calibration and Volumetric Integration (ECIV) within a proprietary graphical application, "Final Tumor Pro v3," pixel-level classification probabilities are directly mapped to physical volume (mm^3). The model's performance scales progressively from a stable Dice score of 68.39% within highly ambiguous, low-contrast boundary topologies to a peak efficiency of 95.60% across core tumor slices, validating its profound resilience and clinical utility under stringent hardware constraints.

A 4.2

Trajectory optimization for rehabilitation tasks of the upper-limb

Tassos Natsakis, Ioana Anamaria Ulici and Alexandru Codrean

Abstract: Robotic rehabilitation brings the opportunity to assist patients in executing trajectories with much greater accuracy than traditional rehabilitation. However, we need to

calculate these trajectories in a comprehensive approach, to accomplish the objectives of the rehabilitation process. To capitalize on the opportunities of robotic rehabilitation, we have designed a methodology to calculate trajectories which optimize the necessary torque to execute them at certain desired joints. This can be beneficial when performing post-surgical or post-traumatic rehabilitation, since specific regions of the musculoskeletal system should not be overloaded. The methodology is tested under various parameterization approaches (number and location of way-points), and it is demonstrated to be able to consistently calculate trajectories for rehabilitation of the upper limb, that either maximize or minimize the torque required at the level of a chosen joint.

A 4.3

Modular Vibromassage Device for Muscle Recovery

Corneliu Druga, Nicoleta Lungu, Ionel Serban, Angela Repanovici, Mirela Apostoaie and Anca Tataru

Abstract: This paper presents the design and development of a modular vibro-massage device intended for muscle recovery, created as part of a bachelor's thesis. The device integrates basic electronic components – DC motor, microcontroller, potentiometer, and LEDs – into a customizable, ergonomic structure with interchangeable massage forms. Functional testing was conducted using standard tools such as a tachometer and multimeter, confirming the device's performance in terms of vibration intensity, autonomy, and usability. The proposed solution offers a low-cost, adaptable alternative commercial devices, with potential applications in rehabilitation, preventive health and wellness. Functional testing confirmed motor speeds between 3000–12000 RPM, battery autonomy >2 hours, and rapid interchangeability of massage heads (<10 s). Limitations include the absence of clinical validation and long-term durability testing.

A 4.4

A Preliminary Study on a Twisted Strings - based Finger Exerciser

Ioan Popa and Silviu Dan Mandru

Abstract: Twisted string actuators (TSAs) have emerged as a compact and mechanically simple alternative within the broader family of biomedical actuation technologies, alongside shape-memory materials, electroactive polymers, and other soft-actuation principles already applied in exoskeletons, hand prostheses, orthoses, and surgical instruments. This paper presents a preliminary study on the use of TSAs for a forearm-mounted finger exerciser, focusing on the kinematic modelling and mechanical design of the actuation and tendon-routing system. Starting from the original single-separator twist-drive model, a symmetric two-wire configuration with both proximal and distal separators is proposed, providing a more consistent geometric basis for predicting axial contraction from motor rotation. The validity condition $A\alpha < L$ is established to bound the design parameters within a physically realisable operating range. For a representative set of parameters (string diameter 0.5 mm, string radial offset 10 mm, active length 80 mm). The tendon-routing architecture, comprising a forearm-mounted actuator and two tendon guides, is described, along with a lumped efficiency model relating actuator tension to the resulting metacarpophalangeal flexion torque. Mechanical aspects relevant to practical implementation, including orthosis rigidity, guide mounting, and frictional losses, are discussed as a basis for future experimental validation.

A 4.5

Parametric study of a dielectric elastomer actuator as steerable tip for minimally invasive therapy

Ionela Lenuța Pop and Silviu Dan Mandru

Abstract: This paper presents a finite element analysis on a parametric study of a multilayer dielectric elastomer actuator design as a candidate steerable tip for flexible endoscopes. The actuator consists of pre-stretched VHB4910 active layers bonded to a DragonSkin 30 passive substrate. Bending angle and blocked force are evaluated while varying pre-stretch ratio,

passive layer thickness, actuator length, number of active layers, and applied voltage. Results identify pre-stretch ratio, layer stacking and passive layer thickness as dominant parameters controlling curvature and blocked force with inherent trade-offs. Compared with gastroscope targets, the actuator approaches feasible bending angle but exhibits blocked forces several orders of magnitude lower.

A 4.6

Touchless Hand-Gesture Control of a Robotic Arm Applicated in Assistive Healthcare

Cristian Barz, Salajan Roberto and Danci Daniel

Abstract: Touchless interaction is increasingly attractive for public and clinical environments, where it limits the transmission of pathogens through shared surfaces. This paper presents a low-cost, camera-only system that controls a Dobot Magician desktop robotic arm through hand gestures and discusses its potential in assistive healthcare. An open-source MediaPipe pipeline is extended with a custom neural classifier trained on ten user-defined static gestures; recognized gestures are mapped to motion commands through a debounce filter, a multi-second confirmation step and a thread-based execution model that keeps recognition responsive while the arm moves. A safe-motion function bounds the workspace on the x and z axes and inspects joint angles before every move, preventing the over-extension that otherwise locks the arm. Because the interface is voice-free and contact-free in operation, it suits people with speech or hearing impairments and people with reduced mobility who need help with simple object-handling tasks. We describe the arm and the constraints its kinematics impose, give the full command pipeline and the gesture-to-command mapping, and report a validation accuracy of 0.967 for the ten-gesture classifier, recognition at 19–25 frames per second on consumer hardware, and effective protection against unsafe motions..

A 4.7

Narrative Analysis on Existing Barriers for Recovery Technologies on Neurological and Oncological Care

David Mihai Lupu, Mădălina Onciul, Ilie Dănuț Popa, Alina-Beatrice Oltean, Silvia Daniela Pohrib and Adrian Pîsla

Abstract: The number of patients affected by chronic pathologies is steadily increasing in parallel with a severe decrease in the number of healthcare professionals. To balance the situation the use of rehabilitation robotics and sensor-based technologies has gained increasing attention. The presented narrative analysis extracts key findings from our study regarding barriers in the implementation processes of rehabilitation technologies in oncological and neurological contexts. Working closely with clinical settings, researchers developing robotic solutions for medical applications and patients, we identified several critical shortcomings. This study focuses on describing and interpreting these barriers, providing a comparative analysis of implementation challenges across neurological and oncological rehabilitation and clarifying how contextual, organizational and clinical factors differentially influence technology adoption in these two domains.

A 4.8

Experimental EMC Assessment of an Upper-Limb Medical Rehabilitation Robot Prototype

Sergiu Andreica, Marian Gliga, Calin Munteanu, Roxana Both, Calin Vaida and Doina Pisla

Abstract: This paper presents an experimental electromagnetic compatibility assessment of the WRIST-X upper-limb rehabilitation robot prototype. The robot was tested during normal operation under a representative mechanical load. The experimental program included conducted and radiated emission measurements and immunity tests to electrical fast transients, surges, voltage dips, and short interruptions. Conducted emissions remained below the applicable limits, while small exceedances were observed during radiated emission testing. The robot operated normally during the electrical fast transient and surge tests. However, after a short interruption of the supply voltage, the system automatically resumed

operation without an explicit command from the operator. The results indicate the need to improve component placement, cable routing, shielding, grounding, and the software restart function. This study highlights the importance of EMC testing during prototype development to identify and correct possible electromagnetic and functional safety issues before conformity assessment and clinical use.

A 4.9

A Physics-Informed Hybrid Framework for Mechanistic and Data-Driven Tumor Growth Prediction

Eva Dulf, Abigel Kiss and Agnes Tanko

Abstract: Tumor growth is nonlinear, heterogeneous, and difficult to describe using only mechanistic or data-driven models. Mechanistic models provide biological interpretability but often rely on fixed assumptions, while machine learning methods can capture complex patterns but usually lack biological transparency. This work addresses this gap by proposing an adaptive hybrid framework for longitudinal tumor growth prediction. The method combines a physics-informed neural network with a mechanistic multi-compartment tumor model to estimate time-dependent biological parameters and describe the evolution of distinct tumor cell populations. An adaptive fusion strategy integrates experimental observations, neural network predictions, and mechanistic simulations into a single tumor trajectory, while uncertainty estimation and a tumor aggressivity index support interpretation of model reliability and progression behavior. The obtained results show that the proposed framework provides stable and biologically coherent reconstruction of tumor evolution, improving robustness against measurement variability and supporting future therapy-oriented computational oncology studies.

A 4.10

Analysis of the Effect of Temperature on Total Dissolved Solids (TDS) in Water

Ionel Șerban, Andrei Ionuț Șercăianu, Corneliu Nicolae Drugă and Barbu Braun

Abstract: This paper aims to investigate the influence of temperature on total dissolved solids (TDS) in water using three types of water: spring, still, and mineral. Measurements were performed with a JESWO multiparameter device, which provides reliable readings through automatic temperature compensation. Data were collected over a temperature range of 5°C to 75°C, in 5°C increments, with 25°C as a reference. To evaluate measurement accuracy, repeated tests were conducted, with a previous Arduino-based device, resulting in low relative errors of 0.74% for TDS and 0.08% for temperature. The results indicate a clear inverse relationship between temperature and TDS across all samples, with TDS values slightly decreasing as temperature increases. This trend is likely due to reduced solubility of certain dissolved salts at higher temperatures, leading to partial precipitation. Comparative analysis shows that mineral water exhibits more noticeable variations due to its higher mineral content, while spring and still water display smaller changes. Overall, the findings highlight temperature as a significant factor influencing TDS, with implications for water quality monitoring and treatment processes..

A 4.11

Application of Nature-Inspired Algorithms in Cardiac Arrhythmia Recognition

Teodora-Maria-Anca Tarța, Dan Doru Micu and Alina Sorina Danciu

Abstract: Ambulatory ECG (Holter) monitoring produces on the order of 100,000 heartbeats per 24-hour recording, and commercial pre-classification software still requires full manual review because of high false-positive rates on ectopic beats. This paper investigates a beat-level triage architecture, rather than a stand-alone classifier, that routes each beat to one of three confidence tiers — automatically accepted as normal, automatically accepted as abnormal, or flagged for manual review — based on agreement among a heterogeneous clas sifier ensemble. Beat features (268 descriptors spanning time, frequency and wavelet domains) are extracted from the MIT-BIH Arrhythmia Database under an inter-patient train/test

split, and four nature-inspired metaheuristics (Whale Optimization Algorithm, Particle Swarm Optimization, Grey Wolf Optimizer, Sine Cosine Algorithm) are compared as wrapper-based feature selectors under a clinically weighted fitness function. The recommended configuration (a Parti cle Swarm Optimization consensus subset with a Random Forest classifier) re duces manual review volume by approximately 60% while retaining over 97% of ventricular-ectopic beats outside silent auto-acceptance, at 7.9 microseconds inference latency per beat. However, the same configuration fails to detect fu sion-class beats, showing that class rarity remains an unresolved limitation. The results support triage as a feasible, honestly evaluated proof of concept rather than a deployment-ready clinical tool.

A 4.12

A Neural Network-Based Framework for Predictive Control of COVID-19 Transmission

Cristina-Maria Stancioi, Vlad Muresan and Simona Vlad

Abstract: This paper presents a predictive control framework for modeling and managing the dynamics of COVID-19 transmission using a data-driven, neural network-based MISO (Multiple-Input Single-Output) approach. The proposed model integrates epidemiological and environmental variables, including the number of tests performed, indoor and outdoor temperature, humidity, and quantified governmental intervention measures, to capture the complex nonlinear behavior of pandemic spread. Feed-forward neural networks are employed to process each input variable, and their outputs are used within a trained MISO structure to estimate daily COVID-19 case numbers. A proportional–integral (PI) con troller is incorporated to minimize the deviation between predicted and target epidemiological thresholds, generating control actions that adjust mitigation intensity over time. The resulting closed-loop system enables adaptive response to evolving pandemic conditions. The model is trained using the Levenberg–Marquardt algorithm to ensure efficient convergence and accurate parameter estimation. The framework highlights the potential of combining machine learning with control theory for real-time epidemic management and decision support in public health systems.

Session 5

A 5.1

The End of the Body...? From the Transhumanist Project of Overcoming the Biological Body to the Spiritual Realism of a Theology of Bodily Transfiguration

Gabriel Noje

Abstract: Contemporary developments in biotechnology, artificial intelligence, nanotechnology, and digital culture have increasingly challenged the apparently immutable boundaries of human embodiment. Within transhumanist thought, the biological body tends to be perceived as a provisional stage of human existence, burdened by vulnerability, ageing, disease, and mortality and therefore open to radical technological enhancement or even replacement. The emergence of the cyborg, the augmented or bionic body, and projects envisioning the transfer of consciousness into digital environments express, in different ways, the aspiration to overcome biological embodiment and ultimately to attain a technologically mediated form of immortality. Against this horizon, the present study proposes an Orthodox theological reconsideration of the meaning and destiny of the human body. Christian anthropology understands the human person holistically, as an inseparable unity of soul and body; embodiment is therefore neither an accident nor an ontological defect to be eliminated, but a constitutive dimension of personal existence and of humanity's vocation to communion with God. The Incarnation of the Logos offers the decisive theological foundation for this affirmation: by assuming human corporeality, Christ restores its authentic vocation and opens it to sanctification and deification. The Transfiguration on Mount Tabor and, above all, Christ's

bodily Resurrection reveal that the ultimate destiny of the body is not its abolition but its transformation. The risen body remains genuinely bodily and material, yet becomes incorruptible, glorious, spiritualized, and permeated by divine life. Thus, Christian hope does not oppose technological enhancement with a romantic acceptance of biological limitation. Rather, it proposes a different understanding of transcendence: not emancipation from the body, but the transfiguration of the body. This transformation is already anticipated within history through sacramental, liturgical, and ascetic life, in which the body becomes an active participant in the human person's communion with God. The study therefore argues that the Christian theology of bodily transfiguration offers a spiritual realism capable of critically engaging transhumanist aspirations while affirming that the fulfilment of human embodiment lies not in technological self-transcendence, but in resurrection, incorruptibility, and deification.

A 5.2

The Contextual Reading of Scripture and the Integrative Health Paradigm: Contributions to the Dialogue Between Theology and Medicine

Raul Butaș

Abstract: Whenever we read the Bible within its cultural context, we draw closer to its original interpretation, especially regarding what human life on earth entails. Starting from this premise, we discover that man is not merely a body. Scripture presents an integrative vision: the human being is both body and soul. By understanding this, the perspective on life changes, even from a medical standpoint. This paper aims to demonstrate the profound extent to which this form of understanding serves in the treatment of life. Medical technology plays a remarkable role, as does the professionalism of doctors. However, throughout the work, it becomes evident that suffering individuals have needs that transcend physical infirmity. The conclusion we can draw is that medicine should not be devoid of the Christian or biblical perspective on life. By integrating this approach into the medical sphere, the focus would no longer be restricted, and many problems faced by the world in general and medicine in particular—such as abortion, euthanasia, and similar issues—could be addressed in a meaningful way.

A 5.3

Technology and the crisis of meaning: the courage to face discouragement – healing the sense of unfulfillment

Andrei Daniel Misaroș

Abstract: This paper examines the relationship between technological development, the contemporary crisis of meaning, and the experience of discouragement from theological, spiritual, and psychological perspectives. While acknowledging the undeniable benefits of technology, the study also highlights the risks associated with an undiscerning use of the digital environment, including information overload, fragmentation of attention, the weakening of the capacity for reflection and silence, social comparison, isolation, and an intensified sense of unfulfillment. Within this context, the paper proposes Christian courage as a response to discouragement and the loss of existential meaning. Grounded in faith, hope, prayer, and communion with God, courage does not imply the denial of suffering, but rather its acceptance and integration within the broader horizon of Christian hope. Biblical and patristic examples, together with psychological and pastoral perspectives, are employed to emphasize the role of discernment, silence, prayer, community, and sacramental life in the reconstruction of meaning. The paper argues for a balanced approach to technology, one that does not require its rejection but rather its subordination to spiritual values and the dignity of the human person.

In this way, technology can become an instrument of communication, education, and pastoral support, provided that the authenticity of the relationship with God and with one's neighbor is preserved.

A 5.4

Suffering, Hope, and Healing in the Work of George Coșbuc: Perspectives on the Dialogue between Spirituality and Health

Iuliu-Ovidiu Morariu

Abstract: This study explores the literary, anthropological, and spiritual dimensions of suffering, hope, and healing in the work of George Coșbuc. Situated at the intersection of literary hermeneutics, pastoral theology, and the anthropology of health, it examines human vulnerability not only as an individual experience, but also as a relational reality embedded in the familial, moral, and spiritual structures of the Transylvanian village. Coșbuc's poetry is approached as a space in which pain, loss, death, and adversity intersect with faith, solidarity, communal belonging, and the search for meaning. Particular attention is given to the relationship between bodily fragility and inner life, as well as to the role of family, tradition, religious ritual, and collective memory in confronting suffering. Hope is understood as an existential orientation toward restored meaning, dignity, and communion with God, while healing is interpreted in an integrative sense as the renewal of relationships, confidence, resilience, and spiritual balance. Without reducing literary texts to theological or medical discourse, the study highlights the symbolic and pastoral significance of trial, consolation, and recovery. Through historical contextualization and hermeneutic analysis, it seeks to preserve the methodological autonomy of the disciplines involved while showing how Coșbuc's work can sustain a fruitful dialogue between literary studies, pastoral theology, and the anthropology of health.