



Book of Abstracts

**The Fourth Serbian
International Conference on
Applied Artificial Intelligence
(SICAAI)**

May 29-30, 2025, Zlatibor, Serbia

The Fourth Serbian International Conference on Applied Artificial Intelligence (SICAAI)

May 29-30, 2025, Zlatibor, Serbia

**The Fourth Serbian International Conference on Applied Artificial Intelligence,
Kragujevac – Book of Abstracts**

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- **University of Kragujevac**



Sponsors

- **Ministry of Science, Technological Development and Innovation of the Republic of Serbia**
- **Data cloud technology**
- **Bioengineering Research and Development Center (BIOIRC)**



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Welcome Message

Dear colleagues and students,

On behalf of the Organizing Committee, it is a pleasure to welcome you at the Fourth Serbian International Conference on Applied Artificial Intelligence (AAI2025) which takes place at Zlatibor, Serbia, on May 29th-30th, 2025.

AAI2025 provides an exceptional Serbian and international forum to share the state-of-the-art research knowledge and results on the innovative theories, methodology and applications of artificial intelligence and its sub-domain like deep learning, machine learning in different areas such as medicine, economy, education, law, smart city, government, industry etc. Moreover, the conference aims to provide a platform for researchers and practitioners for both academia and industry to share the information about cutting-edge developments in the field of artificial intelligence.

It also aims to:

- provide early-stage researchers with an inspiring event allowing them to connect to relevant experts in related fields;
- provide an exciting venue for researchers to network and establish national and international collaborations;
- bring together leading experts from all relevant scientific domains to enhance the understanding of Artificial Intelligence;

Topics cover the following:

AI IN DOMAIN-SPECIFIC APPLICATIONS

- AI in Computational Biology, Medicine and Biomedical Applications
- AI in WWW, Communication, Social Networking, Recommender Systems, Games and E-Commerce
- AI in Finance and Risk Management

AI IN DATA ANALYTICS AND BIG DATA

- Visual Analytics for Big Data
- Computational Modeling for Big Data
- Large-scale Recommendation and Social Media Systems
- Cloud/Grid/Stream Data Mining for Big Velocity Data
- Semantic-based Big Data Mining

MACHINE LEARNING AND DATA MINING

- Pre-processing, Dimension Reduction and Feature Selection Computing, Bayesian and Neural Networks
- Learning Graphical Models and Complex Networks
- Active, Cost-Sensitive, Semi-Supervised, Multi-Instance, Multi-Label and Multi-Task Learning

- Transfer/Adaptive, Rational and Structured Learning

AAI2025 will host the following renowned plenary speakers in the area of applied artificial intelligence:

- **Prof. Borko Furht** – Florida Atlantic University, Boca Raton, Florida, USA; **Title: *Collaborative Innovation in AI: Partnerships Between Academia, Industry, and Government***
- **Prof. David Naccache** – ENS' Information Security Group, Paris, France; **Title: *Using AI to Discover Conjectures – The Balkans Continued Fraction Example***
- **Prof. Freddy Gabbay** – VLSI Research Lab, The Institute of Applied Physics, The Hebrew University of Jerusalem; **Title: *AI at the Edge of Precision: Accelerating AI Efficiency with Approximate Computing***
- **Prof. Zoran Bosnić** – University of Ljubljana, Ljubljana, Slovenia; **Title: *The Road to General AI in Medicine: The Promise and Challenges***
- **Prof. Naphtali Rishe** – The inaugural Outstanding University Professor, Florida International University, USA; **Title: *Generative AI for Robust Map Generation from Satellite Imagery***
- **Prof. Hermann Maurer** – Fakultät für Informatik und Biomedizinisch Technik, Institut für Human-Centered Computing (HCC), Graz University of Technology, Austria; **Title: *Large Documents Must Allow More than Passive Reading***
- **Prof. Alexander D. Stajković** – Dean's Professor in Business, University of Wisconsin-Madison, School of Business, USA; **Title: *The Role of AI in Outdating Homo Sapiens***
- **Prof. Veljko Milutinović** – Life Fellow of the IEEE, Washington, D.C., USA Member, a Former Trustee and Treasurer, Academia Europaea, London, GBR Founding Member, Serbian National Academy of Engineering, Beograd, SRB Foreign Member, Montenegrin National Academy of Sciences and Arts, Montenegro; **Title: *Digital Preservation of Family Heritage Enhanced Using Artificial Intelligence***
- **Prof. Kyoung Mu Lee** – Dept. of ECE, Seoul National University (SNU), Seoul, South Korea; **Title: *3D Computer Vision: Reconstruction, Generation, and Manufacturing***
- **Prof. Panos Razis** – University of Cyprus, Nicosia, Cyprus; **Title: *On the Mission of the Cosmos University in Data Science and Artificial Intelligence***
- **Prof. Gerhard Klimeck** – Purdue University, West Lafayette, USA; **Title: *The Mission of NanoHUB***
- **Prof. Luca Benini** – University of Bologna, Bologna, Italy; **Title: *Open Platforms for the Embodied AI era.***
- **Prof. Onut Mutlu** – ETH, Zurich, Switzerland; **Title: *Fundamentally Accelerating Genome Analysis***
- **Prof. Jon Eckhardt** – University of Wisconsin, WI, USA; **Title: *On the Mission of the University of Wisconsin in the Domain of Entrepreneurship and Discovery***

We have received more than 100 high-quality research papers. As a result of the strict review process and evaluation, the committee selected over 50 papers as extended abstracts.

After the review, full papers from the AAI2025 conference will be published by Springer Verlag in the series “Applied Artificial Intelligence 4: Medicine, Biology, Chemistry, Financial, Games, Engineering”.

We must also admit that the conference certainly would not have been so successful without the efforts of many people who were actively engaged in organization of such a major academic event. We express gratitude to the members of the program and scientific review

committee as well as to all the chairs, organizers and committee members for their dedication and support.

On behalf of the Organizing Committee, we wish you all a pleasant stay at Zlatibor and a productive conference.

Prof. Nenad Filipović, Conference Program Chair

Organizing Committee

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- Nenad Filipović, University of Kragujevac

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- Vesna Ranković, University of Kragujevac
- Vladimir Ranković, University of Kragujevac

Honorary consultants:

- Miloš Đuran
- Miloš Kojić
- Veljko Milutinović

Technical Program

Thursday 29 May 2025

09:00 - 09:30	Opening Ceremony - Day I: Academician Bela Balint , Minister of Science, Technological Development and Innovation Prof. Vladimir Rankovic , Rector of the University of Kragujevac Prof. Nenad Filipovic , Chair of the AAI2025 conference
09:30 - 10:30	Keynote speakers: <i>Large Documents Must Allow More than Passive Reading</i> Prof. Herman Maurer <i>Collaborative Innovation in AI: Partnerships Between Academia, Industry, and Government</i> Prof. Borko Furht Chair: Nenad Filipović
10:30 - 11:00	Coffee Break
11:00 - 12:00	Keynote speakers: <i>Fundamentally Accelerating Genome Analysis</i> Prof. Onur Mutlu <i>3D Computer Vision: Reconstruction, Generation, and Manufacturing</i> Prof. Kyoung Mu Lee Chair: Veljko Milutinovic
Session T.1A 12:00-14:00 Energy, Transport and Environmental Science Chair: Boban Stojanovic	

T.1A.1 - Application of Neural Networks in Assessing Body Comfort During Driving – Igor B. Saveljić, Slavica D. Mačužić Saveljić

T.1A.2 - Comparative Analysis of Expert-Based and AI-Driven Methodologies in Children's Traffic Safety Education – Aleksandar Trifunović, Aleksandar Senić, Nenad Filipović, Dragan Lazarević

T.1A.3 – Dynamic LSTM-Based Framework for Adaptation to Concept Drift in Energy Consumption Forecasting – Jelena Joksimović, Janez Povh

T.1A.4 – A CCGAN-Driven Method for Context-Aware Correction of River Flow Time Series – Boško Laković, Dušan Stefanović, Nenad Bogdanović, Boban Stojanović

T.1A.5 – The use of AI in Developing Architectural Designs/Expo Pavilion Project – Aleksandar Rudnik Milanović

T.1A.6 – Comparison of CNN Architectures for Earthquake Damage State Classification of Different Building Types – Miloš Kovačević, Filip Đorđević, Mladen Nikolić, Đorđe Nedeljković, Zoran Babović, Zoran Pucanović, Marija Ivanović, Nevena Simić, Marko Marinković

T.1A.7 – Crop Yield Prediction Using Sentinel-2 Satellite Imagery and Deep Learning Models – Karlo Bala, Marko Pavlović, Michele Bandecchi

T.1A.8 – Short Review of Machine Learning Support in the Development of Soft Piezoelectric Materials – Kristina Vasić, Marija Branković, Danilo Petrović, Ana Kaplarević Mališić, Nenad Grujović, Fatima Živić

Session T.1B 12:00-13:30

Signal and Image Processing

Chair: Tijana Geroski

T.1B.1 – Lung Cancer Classification from CT Images Using the DINOv2 Vision Transformer Architecture – Sylvester Agyapong, Tijana Geroski, Nenad Filipović

T.1B.2 – Unlocking Cardiographic-Based Biometric Potential: Insights from Feature Selection – Ilija Tanasković, Ljiljana B. Lazarević, Goran Knežević, Nikola Milosavljević, Olga Dubljević, Bojana Bjegojević, Nadica Miljković

T.1B.3 – Feature Subset Selection for Low Back Pain Prediction: Machine Learning Approach – Minja Vuković, Olivera Đorđević, Ljubica Konstantinović, Nadica Miljković

T.1B.4 – Human-AI Collaboration in Shaping Modern Survey Design: Opportunities and Challenges – Resulbegoviq Hakile, Stamatović Irina

T.1B.5 – Comparison of RFE and SHAP for PRV Feature Ranking in Cognitive Stress Scenario – Katarina Vujić, Marija Novičić, Milica M. Janković

T.1B.6 – Feature-Based Machine Learning and Deep Learning Networks for Real-Time Stress Classification from GSR and HR Signals – Tanja Vuković, Jovana Malešević, Matija Štrbac

14:00 - 15:00

Buffet Lunch

Session T.2 15:00-16:30

LLM models and Big Data

Chair: Zhou Liang

T.2.1 – The Possibilities and Limitation in Automatic Personality Trait Detection Based on Text Essays Written in Serbian – Miljan Đorđević, Veljko Milutinović

T.2.2 – Analysis and Forecasting of Electricity Consumption in the Data Center – Danilo B. Savić, Velibor Isailović, Vladimir Mladenović

T.2.3 – Enabling Robust Elderly Care Robotics: Task Decomposition and Self-Evaluation Frameworks Enhanced by Large Language Models – Jingzhen Guo, Liteng Liu, Wenlong Zhao, Liang Zhou

T.2.4 – Tackling Online Harassment Using Natural Language Processing and Metaheuristic Optimization – Nikola Novaković, Luka Jovanović, Miodrag Živković, Petar Spalević, Nebojša Bacanin, Vico Zeljković, Katarina Milojković

T.2.5 – Fuzzy C-Means over Node Embeddings Outperforms Leiden for Overlapping Community Detection in Large-Scale Customer Graphs – Miloš Jovičić, Nikola Prodanović, Aleksandra Vulović, Gordana Jovičić, Aleksandar Radaković, Nenad Filipović

T.2.6 – Fairness Through Synthesis: Bias Mitigation Through Probabilistic Modeling and Matching Techniques – Vasileios C. Pezoulas, Nikolaos S. Tachos, Stefanos Gkikas, Manolis Tsiknakis, Dimitrios I. Fotiadis

16:30 - 17:00	Coffee Break
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17:00 - 18:00	<p>Keynote speakers:</p> <p><i>Using AI to Discover Conjectures – The Balkans Continued Fraction Example</i> Prof. David Naccache</p> <p><i>Generative AI for Robust Map Generation from Satellite Imagery</i> Prof. Naphtali Rish</p> <p>Chair: Tijana Geroski</p>
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Session T.3 18:00-20:00

Chemical and Biological applied AI

Chair: Zoran Markovic

T.3.1 – Using Agent-Based Models for Generation of Surrogate Model Virtual Population: Atherosclerosis Case Study – Lemana Spahić, Nenad Filipović

T.3.2 – Diabetes Melitus and AI-Clinical Practice – Tamara Bošković, Nenad Filipović

T.3.3 – Machine Learning Based Prediction of Cell Death after Silver Nanoparticle Treatment – Safi Ur Rehman Qamar, Wasi Ur Rehman Qamar, Nenad Filipović

T.3.4 – Recognizing Patterns of Emerging Chronic Obstructive Pulmonary Disease in Heart Failure Patients Through the Use of Machine Learning Techniques – Ognjen Pavić, Lazar Dašić, Anđela Blagojević, Tijana Geroski, Nenad Filipović

T.3.5 – Benefits of Using Genetic Algorithms in Estimation of Parameters of a Numerical Model for Prediction of Cancer Progression – Tijana Đukić, Nevena Milivojević Dimitrijević, Marko Živanović, Nenad Filipović

T.3.6 – Harnessing Artificial Intelligence for the Design of New Potential Inhibitors of the Lipxygenase – Tamara M. Mladenović, Dušica M. Simijonović, Edina H. Avdović, Dejan A. Milenković, Zoran S. Marković

T.3.7 – Smarter than Mutation: AI-Based Drug Modification Against Pharmacological Resistance – Kristina Milisavljević, Žiko Milanović, Marko Antonijević

20:00 - 24:00	Gala Dinner
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Friday 30 May 2025

9:00 - 9:30	Keynote speaker: <i>The Road to General AI in Medicine: The Promise and Challenges</i> Prof. Zoran Bosnić Chair: Borko Furht
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9:30 - 10:00	Coffee Break
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Session F.1A: 10:00-12:00

Financial, Marketing and Law applied AI

Chair: Marko Selakovic

F.1A.1 – Leveraging Deep Learning and Word Embeddings for Financial Sentiment Analysis with ChatGPT-Based Data Augmentation – Vesna M. Ranković, Ljiljana N. Matić, Zoran S. Kalinić

F.1A.2 – The Role of Artificial Intelligence in Marketing Strategies: Opportunities and Challenges – Ana Spasojević

F.1A.3 - Algorithmic Dependencies and Regulatory Gaps: Journalism in the Age of AI – Tanja Krešvan

F.1A.4 – Will AI Replace Humans in Strategizing Communications? Ethical Considerations – Marko Selaković, Nikolina Ljepava, Marija Gačić, Nenad Filipović

F.1A.5 – The Interplay of Artificial Intelligence and International Public Law: Principle of Non-Intervention – Dragan Dakić

F.1A.6 – Self-Driving Dilemmas: The Collision of Technology and Legal Responsibility – Žaklina Spalević, Aleksanda Stojnev Ilić, Petar Spalević, Miloš Ilić, Dobrivoje Dubljanin

F.1A.7 – International Science Olympiads in Artificial Intelligence: a Passing Trend, or Here to Stay? – Vladimir M. Milovanović

F.1A.8 – Economic Evaluation of Heart Failure Strategies in the StratifyHF Project – Marija Gačić, Milica Kaplarević, Lazar Velicki, Đorđe Jakovljević, Nenad Filipović

Session F.1B: 11:00-12:00

Generative AI

Chair: Veljko Milutinovic

F.1B.1 – Gamifying Risk Management: a Generative AI-Driven Tetris-Inspired Simulation for Enhanced Decision-Making – Zoran Č. Keković, Tijana Z. Čomić, Dragan V. Vukmirović, Ozren Dzigurski

F.1B.2 – A Comparison of Six Selected Computing Paradigms – Veljko Milutinović, Nenad Korolija

F.1B.3 – A Rapid Review on Artificial Intelligence Algorithms in The Study of Benthic Ecosystems: Applications, Performance and Future Trends – Gabriel Rivas-Mena, Nenad Filipović

12:00 - 14:00	<p>Keynote speakers:</p> <p><i>AI at the Edge of Precision: Accelerating AI Efficiency with Approximate Computing</i> Prof. Freddy Gabbay</p> <p><i>Digital Preservation of Family Heritage Enhanced Using Artificial Intelligence</i> Prof. Veljko Milutinovic</p> <p><i>On the Mission of the Cosmos University in Data Science and Artificial Intelligence</i> Prof. Panos Razis</p> <p><i>The Mission of NanoHUB</i> Prof. Gerhard Klimeck</p> <p>Chair: Zoran Bosnic</p>
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14:00 - 15:00	Buffet Lunch
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Session F.2: 15:00-16:30

Heart Failure

Chair: Bogdan Milicevic

F.2.1 – Software Architecture for StratifyHF: Heart Failure Risk Stratification and Diagnosis – Bogdan Milićević, Miljan Milošević, Miloš Ivanović, Nenad Filipović

F.2.2 – Heart Failure Disease Progression Assessment in Patients Through the use of Traditional Machine Learning Approaches – Anđela Blagojević, Smiljana Tomašević, Ognjen Pavić, Lazar Dašić, Tijana Geroski, Andrej Preveden, Lazar Velicki, Nenad Filipović

F.2.3 – Impact of Different Biomarkers on the Prediction Capabilities of Machine Learning Models in the Diagnosis of Heart Failure – Lazar Dašić, Anđela Blagojević, Ognjen Pavić, Tijana Geroski, Nenad Filipović

F.2.4 – Prediction of Different Symptoms Emergence in Heart Failure Patients Using Machine Learning Approaches – Teodora Jeremić, Lazar Dašić, Ognjen Pavić, Anđela Blagojević, Nenad Filipović

F.2.5 – Assessment of Morbidity in Patients with Heart Failure Using Traditional Machine Learning Techniques – Đorđe Ilić, Ognjen Pavić, Lazar Dašić, Anđela Blagojević, Nenad Filipović

F.2.6 – Risk of Death Assessment in Patients Suffering from Heart Failure Using Regression Analysis Techniques – Filip Filipović, Lazar Dašić, Anđela Blagojević, Ognjen Pavić, Nenad Filipović

16:30 - 17:00	Coffee Break
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17:00 - 18:30	<p>Keynote speaker: <i>On the Mission of the University of Wisconsin in the Domain of Entrepreneurship and Discovery</i> Prof. Jon Eckhardt <i>The Role of AI in Outdating Homo Sapiens</i> Prof. Alexander D. Stajković <i>Open Platforms for the Embodied AI era</i> Prof. Luca Benini Chair: David Naccache</p>
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Session F3: 18:30-19:45 Biomedical and Sport Engineering Chair: Aleksandra Vulovic	
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F.3.1 – Predicting of Controlled Drug Release from Intraocular Lens Using a Genetic Algorithm – Ana N. Mirić, Strahinja P. Milenković, Nevena N. Milivojević, Marko N. Živanović, Nenad D. Filipović

F.3.2 – Random-Forest Risk Classification in Hypertrophic Cardiomyopathy Patients – Jelena Pavić, Ognjen Pavić, Marko Živanović, Katarina Virijejić, Tamara Mladenović, Nenad Filipović

F.3.3 – Explainable AI for Continuous Glucose Monitoring Data – Aleksandra I. Stojnev Ilić, Dragan H. Stojanović, Natalija M. Stojanović, Miloš N. Ilić

F.3.4 - Enhancing Robotic Grasping with Attention Mechanism and Slam-Based in the Dynamic Grasping Scenario – WL Zhao, JZ Guo, S Zhang, LT Liu, YM Jiang, JC Guo, L Zhou

F.3.5 - Multipurpose Wearable Sensory Device for Heart Failure Diagnosis and Biomarker Measurement - Nemanja Marković, Tijana Geroski, Ognjen Pavić, Lazar Dašić, Emil Jovanov, Nenad Filipović

19:45 - 20:00	Closing Ceremony
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Keynote Speakers

Prof. Borko Furht

Florida Atlantic University, Boca Raton, Florida, USA

Collaborative Innovation in AI: Partnerships Between Academia, Industry, and Government



Abstract:

In this presentation, we explore the critical role of collaborative innovation in AI, emphasizing the importance of partnerships between academia, industry, and government. We highlight a successful model of cross-sector collaboration through the NSF-sponsored Industry/University Cooperative Research Center for Advanced Knowledge Enablement, which boasts 45 industry members and supports over 50 applied research projects. We will showcase real-world examples of how these partnerships drive technological advancements and address complex societal challenges. Additionally, we will discuss successful projects led by our faculty and students that have resulted in start-up companies, patent inventions, and commercially successful products and services. By examining these case studies, we aim to demonstrate how structured collaboration fosters innovation and maximizes the impact of AI and emerging technologies.

Prof. David Naccache

ENS' Information Security Group, Paris, France

Using AI to Discover Conjectures – The Balkans Continued Fraction Example



Abstract:

Using AI in experimental mathematics is a thrilling area of exploration. In this paper, we explore the properties of a specific family of continued fractions involving Catalan's constant using AI. Our main result is a stunning machine-generated closed formula allowing to compute those continued fractions. Having distinguished different cases associated to regions in the plane, we nickname those continued fractions "The Balkans" as they divide into areas which are related, but still different in nature. Since we do not provide formal proofs of those machine-constructed formulae, we do not claim them to be theorems. Still, each and every proposed formula was extensively tested numerically to hundreds of decimals.

Prof. Freddy Gabbay

VLSI Research Lab, Institute of Applied Physics,
The Hebrew University of Jerusalem

AI at the Edge of Precision: Accelerating AI Efficiency with Approximate Computing



Abstract:

The rapid evolution of Generative AI models has ushered in groundbreaking advancements across industries, but their ever-increasing complexity presents a critical challenge: the need for efficient and scalable hardware accelerators. As model sizes grow exponentially, traditional computing paradigms struggle to meet the demands for higher performance, lower latency, and reduced energy consumption - particularly at the edge, where resource constraints are more pronounced. This talk explores how innovative microarchitectural approaches can unlock new frontiers for Generative AI computing. Central to this vision is the integration of approximate computing techniques, which embrace the trade-off between precision and efficiency to deliver significant gains in hardware efficiency and power savings with relatively negligible compromise in model accuracy. By leveraging decomposition, dynamic scheduling, and value-based computing, we can optimize execution efficiency, prioritize critical computations, and reduce redundancy, paving the way for next-generation AI accelerators. The talk will also highlight the role of these approaches in enabling efficient Generative AI at the edge, where constraints on power, latency, and hardware resources are most acute.

Prof. Zoran Bosnić

University of Ljubljana, Ljubljana, Slovenia

The Road to General AI in Medicine: The Promise and Challenges



Abstract:

The evolution of General AI (AGI) in medicine marks a paradigm shift from narrow, task-specific AI models to systems capable of reasoning, adapting, and autonomously making complex medical decisions. AGI aspires to integrate and synthesize vast amounts of multimodal data, adapt to new medical scenarios, and provide real-time clinical insights with human-like comprehension. The talk will examine the latest breakthroughs in multimodal AI, self-supervised learning, and real-time clinical decision-making, exploring how AGI could enhance diagnostics, treatment personalization, and drug discovery. We will also address critical challenges, including interpretability, ethical concerns, and the safe integration of AGI into clinical workflows. As we move toward more intelligent and autonomous medical AI, we must balance innovation with responsibility to ensure these advancements improve patient care and healthcare efficiency.

Prof. Naphtali Rische

Inaugural Outstanding University Professor
Florida International University, USA

Generative AI for Robust Map Generation from Satellite Imagery



Abstract:

Maps comprised of vector tile representations of geographic features play a crucial role in geospatial analysis, navigation, urban planning, smart city development, environmental monitoring, and emergency rescue operations. Conventional map construction relies heavily on supervised machine learning methods, requiring corresponding satellite-map image pairs, an often-unrealistic expectation. Here, we will review advanced generative AI methods for map generation, as well as present deep learning algorithms developed by our team, utilizing our TerraFly Geospatial System and Satellite and Aerial Imagery Repository. One of the methodologies applied focuses on roads as a key element by developing a semantic segmentation model for road extraction from satellite imagery. This method relies on aligned input and output images, which can lead to inaccuracies when ground truth images are misaligned. A novel approach to map construction applies AI, where the model learns how to map underlying objects in satellite imagery through self-supervised techniques and generates accurate maps. In real-world scenarios, this approach may face limitations due to spectral variations in satellite imagery and the adversarial susceptibility of AI models. Our work has addressed these challenges with the goal of practical applicability. We have developed a robust map generation framework encompassing three key components. First, we have designed a novel self-supervised generative adversarial network (GAN) equipped with contrastive learning. This work marks the first application of Kolmogorov-Arnold Network (KAN) layers, replacing standard multi-layer perceptrons (MLPs) in image-to-image generation improving feature expressiveness. Second, we have developed a dual-directional AI method to translate satellite images across spectral bands and generate consistent color-channel imagery, mitigating domain variation issues. Third, we have created a forensic detection framework by integrating a large vision-language model to accurately detect generated map images, ensuring robustness against adversarial misuse. Experiments conducted with a custom dataset from the TerraFly mapping system demonstrate both the quality of generated maps and the effectiveness of forensic detection, paving the way for advanced and trustworthy map generation in real-world applications. The novel algorithms presented here were developed primarily by Arpan Mahara, a Ph.D. candidate under Prof. Rische's mentorship.

Prof. Hermann Maurer

Fakultät für Informatik und Biomedizinisch
Technik, Institut für Human-Centered Computing
(HCC), Graz University of Technology, Austria



Large Documents Must Allow More than Passive Reading

Abstract:

When looking at a typical library of documents or books in some organization, it is surprising to see that basically one can read them (a passive activity), but usually cannot do much more, like adding “annotations” (text, pictures, clips, links, etc.) for oneself or other readers without ruining the structure of the document at issue. Some first attempts (like adding comments at the end of document for all, or adding in some places notes for one self) can be observed, but the spectrum of Interactivity is very limited in all systems. The new system NID (Net Interactive Documents), used already in some large organizations is supposed to show many possible additional features and will reach a certain level of maturity by mid 2025.

In NID, in addition to ordinary annotations (also in the middle of pictures!), it is possible to ask and answer questions, to conduct discussions, but all under various control mechanisms that allow to guarantee quality, not supporting the spreading of fake news as is common in social media. Annotations can also be visible only to selected persons; search comes in many variants: as well-known full text search, as object search (e.g. locating all pages in a document that show part of a human), searching over entire collections of documents or even search in annotations, etc.). Items in the system are analyzed by AI techniques to point to possibly related material. By introducing a special GPT system, it can be restricted to use information (language independent) from well-definable quality-controlled sources.

Many of the surprising features will be shown live by accessing a major system with some 1,5 million objects and over 5.000 digitized books [Austria-Forum and NID](#).

Prof. Alexander D. Stajković

Dean's Professor in Business, University of
Wisconsin-Madison
School of Business, USA



The Role of AI in Outdating Homo Sapiens

Abstract:

It is ostensibly a forgone conclusion that AI will help us be more efficient and effective in just about everything we do. More prospective thinking is needed to discuss whether there are limits to transcending human limitations by AI? In this talk, I explore the precipices upon which the human species currently stands with regard to future applications of AI and discuss the notion that homo sapiens might be on the cusp of the next step in the ontological evolution.

However, we will need to voluntarily decide to change from being homo sapiens to what we might be next. For example, as our cognitive and morphological identities get intertwined with the digital realm, we can transform through AI-enhanced bioengineering (e.g., genetically ingenerated designer babies; super-productive and obedient workers), cyborg expansion (e.g., mechanically enhanced humans), and human robotization devoid of organic chemistry.

What if some choose to upgrade to genetically or mechanically enhanced super humans and some prefer to stay good-old homo sapiens? How will the former treat the latter if the most relevant example is how we treat the chimps with only 2 percent DNA differences? It is not the best analogy, but an observable one. Transcending the biological blueprint that has defined us for millennia might deliver a shattering blow to our trek as homo sapiens, but maybe it is time?

As we contemplate this transition, technical mechanics could go wrong and unleash monsters nobody wanted or predicted. Philosophical debates of redefining the meaning of being human are needed. Humans have advanced from brutes to brilliance, and nobody tells us what to do on this Planet. But we have reached a point where a society must juxtapose what we could do with AI technology in front of us and, perhaps more importantly, what we should do going forward.

Prof. Veljko Milutinović

Life Fellow of the IEEE, Washington, D.C., USA
Member, a Former Trustee and Treasurer,
Academia Europaea, London, GBR Founding
Member, Serbian National Academy of
Engineering, Beograd, SRB Foreign Member,
Montenegrin National Academy of Sciences and
Arts, Montenegro



Digital Preservation of Family Heritage Enhanced Using Artificial Intelligence

Abstract:

The article presents a novel approach that enables an effective inter-generational dialogue, based on the application of artificial intelligence and data mining, tuned to the Internet and large heritage related data bases. It presents the essence and the potentials of the presented approach. It also presents two illustrative examples. Finally, it sheds light on the newly open research problems in this important and emerging field.

Tools do exist that enable a book to be connected with ChatGPT and the other AI systems, plus with the Internet, so that the questions asked come not only from the Internet, but from the given book, too. In addition, the facts in the book could be given a higher weight, so that the answers are based on the book, but shaped with facts from the Internet, in order to derive an effective answer. One experiment of this sort is described here, realized in cooperation of scientists from Serbia, Austria, Pakistan, and the USA. The implementation is oriented to the cell phone environment, which ensures possibly a wider application of the application described in this article, especially among the younger population that does not like to read paper books, but needs the wisdom from those books. This is the main point: Assume that a person has a question for which the answer is in one paragraph of a 1000-page book. The person may not like to read the entire book, just to find the crucial paragraph, and especially that will not be the case if the person is in hurry. However, it is the matter of only one minute of typing, for the person to enter the question into this cell-phone application, and another up-to-a-minute to obtain the answer. This approach is especially useful for the passing of values and wisdom from one generation to the next. Also, it could be used for inter-cultural dialogue, if proper language translators are incorporated. With proper additional explanations built into the hyper-links, inter-cultural gaps could be bridged. And finally, if a data mining system is also incorporated, hidden knowledge could be searched for and found. Some examples are given in this talk.

Prof. Kyoung Mu Lee

Dept. of ECE, Seoul National University (SNU),
Seoul, South Korea

3D Computer Vision: Reconstruction, Generation, and Manufacturing



Abstract:

One of the important problems in computer vision is reconstructing and understanding three-dimensional (3D) objects and scenes from images. The environment we live in is composed of 3D structures, and the ability to reconstruct and comprehend 3D information is essential for survival. Moreover, it is a crucial element in creating AI systems, such as autonomous vehicles and robots that resemble humans. Recently, advancements in deep learning and generative Large Multimodal Models (LMMs) have enabled not only 3D reconstruction and understanding, but also the generation of 3D scenes or objects. Furthermore, it has become possible to automatically manufacture these reconstructed and generated 3D objects. In this talk, we will review the past, present, and future of 3D problems and technologies in computer vision from the perspectives of 3D reconstruction, generation, and manufacturing.

Prof. Panos Razis

University of Cyprus, Nicosia, Cyprus

**On the Mission of the Cosmos
University in Data Science and Artificial
Intelligence**



Abstract:

This keynote sheds light on the mission of the Cosmos University in Cyprus, and on the scope of its Master's programs in Data Science and Artificial Intelligence, with respect to the upcoming High Luminosity Data in High Energy Physics. Special attention is given to the CMS experiment in high energy physics at CERN.

Prof. Gerhard Klimeck

Purdue University, West Lafayette, USA

The Mission of NanoHUB



Abstract:

The [nanoHUB.org](https://nanohub.org) is a science and engineering gateway comprising community-contributed resources and geared toward education, professional networking, and interactive simulation tools for nanotechnology. It has been funded by the United States National Science Foundation (NSF) and it is a product of the Network for Computational Nanotechnology (NCN). The NCN supports research efforts in nanoelectronics, nanomaterials, nanoelectromechanical systems (NEMS), nanofluidics, nanomedicine, nanobiology and nanophotonics. All this is a support for the edge research in the emerging scientific fields.

Prof. Luca Benini

University of Bologna, Bologna, Italy

Open Platforms for the Embodied AI era



Abstract:

The AI revolution is accelerating from its perception-focused origins to the generative era, where foundation models, trained on trillions of mostly unlabelled samples via self-supervision, produce multi-modal outputs such as text, sound, images. Foundation models are poised to disrupt multiple businesses. However, even more fundamental disruption will come when we will be able to “embody” these models in cars, robots, eyeglasses, etc. To achieve this goal, we need to tackle major challenges in energy efficiency, safety, security and real-time predictability of fine-tuned foundation models, while curtailing their sheer computational complexity. In this talk, I will focus on designing hardware and systems for embodied AI, moving from perceptive to generative models and leveraging an open-platform approach, based on RISC-V processors and accelerators, to ensure long term sustainability, safety and security.

Prof. Onur Mutlu

ETH Zurich, Switzerland

Fundamentally Accelerating Genome Analysis



Abstract:

Genome analysis is the foundation of many scientific and medical discoveries as well as a key pillar of personalized medicine. After an individual's genome is sequenced, many computational steps are taken to reconstruct and analyze the genome. Unfortunately, these computational tasks are often very slow and energy hungry, in many cases requiring very expensive computational resources. As a result, even though sequencing technology improvements have enabled high-throughput and portable sequencing devices, like nanopore sequencers, interesting and potentially critical analyses still take days or even weeks and also cannot be performed in portable devices.

This talk describes our ongoing journey in greatly improving the performance and energy efficiency of genome analysis (with a focus on at least two major issues in genome analysis, i.e., read mapping and metagenomics analysis). We show that significant improvements are possible with both algorithmic and hardware-based approaches and their combination. We conclude with a foreshadowing of future challenges brought about by very low-cost new sequencing technologies and their potential use cases in public health, science, and medicine.

Prof. Jon Eckhardt

University of Wisconsin, WI, USA

On the Mission of the University of Wisconsin in the Domain of Entrepreneurship and Discovery



Abstract:

The keynote sheds light on the mission of the University of Wisconsin, and on the scope of its future programs in Entrepreneurship enhanced with essentials of management and artificial intelligence.

Book of Abstracts



APPLICATION OF NEURAL NETWORKS IN ASSESSING BODY COMFORT DURING DRIVING

Igor B. Saveljić¹[0000-0002-0707-5174] and Slavica D. Mačuzić Saveljić²[0000-0003-2635-2496]

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Abstract:

In transportation, comfort is a cornerstone of vehicle quality assessment, significantly impacting drivers and passengers alike. Despite extensive research, a precise method to quantify driving comfort remains elusive. This study addresses this gap by investigating the effects of whole-body vibrations during driving across diverse speeds and road conditions, integrating measured and predicted root mean square (r.m.s.) acceleration values. Real-world road tests provided empirical r.m.s. acceleration data, capturing the dynamic vibrational environment, while an Artificial Neural Network (ANN) model was developed to predict these values with high accuracy. The research involved ten male participants, whose varied anthropometric characteristics ensured a comprehensive analysis of vibration effects. Results demonstrated the ANN model's exceptional precision in forecasting r.m.s. acceleration, offering a robust framework for evaluating whole-body vibration and its influence on comfort. By combining practical road data with advanced predictive modeling, this study introduces an innovative approach to understanding and enhancing driving comfort. This synergy of empirical and computational methods provides fresh insights into optimizing the travel experience across diverse driving scenarios.

Keywords: artificial neural network, comfort, road, vibration.

Acknowledgement: This research was supported by the Ministry of Education, Science and Technological Development of the Republic of Serbia through projects TR35041 (Faculty of Engineering, University of Kragujevac) and 451-03-136/2025-03/200378 (Institute for Information Technologies, University of Kragujevac).



COMPARATIVE ANALYSIS OF EXPERT-BASED AND AI-DRIVEN METHODOLOGIES IN CHILDREN'S TRAFFIC SAFETY EDUCATION

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Abstract:

Improving children's safety in traffic is one of the key priorities of modern societies, and educating children on traffic rules and behavior is a crucial element in the prevention of traffic accidents. With the development of advanced technologies, especially in the fields of Artificial Intelligence (AI) and Machine Learning (ML), new opportunities are emerging for creating and adapting educational content to the cognitive and behavioral characteristics of children. This study compares the effectiveness of two educational programs - one developed using artificial intelligence and the other designed by a multidisciplinary team of experts (engineers, psychologists, and pedagogues). The sample included 120 children aged 8 to 11, divided into three groups: Experimental Group 1 (AI-developed program), Experimental Group 2 (expert-developed program), and an adaptive control group. After the initial training, children whose results did not meet the threshold for safe behavior were switched to the alternative methodology, and their progress was measured again; these results were categorized under the adaptive control group. Data on demographics, cognitive characteristics, initial and final test scores, as well as responses in traffic simulations were used to develop machine learning models. These models analyzed the key factors influencing children's learning success and predicted which methodology (AI-developed or expert-developed program) would likely be more effective for each child individually. The results showed that both approaches led to significant progress. However, by applying an adaptive model and machine learning, it was possible to predict and individualize the educational process in advance, thereby increasing the overall efficiency of the program. The study highlights the strong potential for integrating AI and ML into children's traffic safety education programs, and points to the need for further development of hybrid, personalized, data-driven educational approaches.

Keywords: artificial intelligence, machine learning, traffic safety, children, education, personalized learning, adaptive Instruction, behavioral simulation.



DYNAMIC LSTM-BASED FRAMEWORK FOR ADAPTATION TO CONCEPT DRIFT IN ENERGY CONSUMPTION FORECASTING

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Abstract:

Accurate energy consumption forecasting is critical for optimizing energy management industrial systems, and manufacturing environments. However, energy consumption patterns are often subject to sudden concept drift, where external factors such as varying occupancy levels and changes in operational schedules can cause significant deviations from expected patterns over time. Accurate one-day-ahead predictions with 15-minute granularity are critical in energy management systems (EMS) because high-granularity forecasting enables precise planning for battery charge and discharge cycles, ensuring efficient energy storage and utilization. Current state-of-the-art models, including Long Short-Term Memory (LSTM) networks, struggle to adapt to these dynamic shifts for multi-step prediction vectors, leading to a degradation in the model reliability throughout the day. To address this challenge, this paper proposes a dynamic LSTM-based forecasting framework designed to adapt to concept drift in energy consumption data. The framework incorporates two levels of prediction: short-term forecasts for the next hour (4-step, 15-minute interval) predictions and long-term forecasts for 96 prediction steps, capturing the entire day's energy consumption. In this framework, short-term predictions model acts as a fine-grained feedback mechanism. Short-term predictions consistently deviate from the actual data that could indicate a larger underlying shift in the data, necessitating retraining. However, if the drift from the short-term model predictions to the long-term model forecasts becomes pronounced, we handle the concept drift arising from fluctuating operational conditions by dynamically updating the long-term predictions throughout the day, without retraining the long-term model. New data are incorporated to refine the day-ahead forecast continuously, ensuring that the model adapts to any shifts in energy demand patterns.

In our study, we apply this framework to a real-world setting within the Laboratory for the Factories of the Future at Rudolfovo, where the laboratory operates as a consumer of energy in an industrial context. The laboratory's energy usage exhibits varying work schedules, intermittent machine operation and ad-hoc events, influencing its energy demand. The proposed framework is validated using energy consumption data from the laboratory, which simulates the energy behaviour of industrial systems. We demonstrate that, by integrating short-term predictions with long-term forecasting, the model improves forecast accuracy, adapts to dynamic consumption patterns, and reduces computational overhead associated with non-informed model retraining. Our results highlight the efficacy of the dynamic update mechanism in real-world industrial settings, where energy consumption patterns are volatile and constantly evolving.

Keywords: energy consumption, long short-term memory, concept drift, energy management systems, recurrent neural networks.

Acknowledgement: The authors' research was co-funded by the Republic of Slovenia, the Ministry of HE, Science and Innovation, and the Slovenian Research and Innovation Agency of the European

Union - NextGenerationEU through the DIGITOP project and by the Slovenian Research and Innovation Agency (ARIS) through the annual work program of Rudolfovo. The work is also funded through the business experiment Advanced Multi-objective Optimization of Energy Management - AIMED-HPC, which received funding through the FFplus project, which is financed by the European High-Performance Computing Joint Undertaking (JU) under the funding agreement No. 101163317. The JU receives support from the Horizon Europe program of the European Union.



A CCGAN-DRIVEN METHOD FOR CONTEXT-AWARE CORRECTION OF RIVER FLOW TIME SERIES

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Abstract:

Hydraulic models are often used for river management, flood prediction, and water resource planning, as they can simulate water flow under various conditions. Model inputs consist of flow rate time series, which are derived from rating curves based on measured water levels. Various environmental and technical factors can affect the accuracy of rating curves, which in turn reduces the accuracy of the flow rates and compromises the precision of the hydraulic model. To improve model accuracy, the obtained flow rates often need to be manually corrected by experts.

To assist experts in correcting flow rates more efficiently, we developed a method that allows them to apply a correction at a specific moment in time, after which the flow rates in the surrounding correction period are automatically adjusted to ensure that the corrected flow rates throughout the period follow the typical pattern of river flow for the given regime. The extent of the correction period is determined so that it includes all points in the time series that have a significant correlation with the point corrected by the user. To determine the typical dynamics of a river for a specific flow regime, we use a CCGAN model trained on historical data that includes various flow regimes, which is further used to synthesize a typical period of flow rates for the desired flow regime. Historical flow regimes are characterized using continuous conditions, defined by three variables: the flow rate at the middle of the considered periods and the average flow rates at the beginning and the end of those periods. The flow rates for the correction period are obtained by blending the measured flow rate with the synthesized flow rate, respecting the expert's flow correction and maintaining the continuity of the time series. Verification of the inflows of the part of the Danube River passing through Serbia has shown that the flows obtained using this method meet expert expectations while preserving all the statistical properties of the original time series.

Keywords: hydrological modeling, AI-based correction, Continuous Conditional GAN.



THE USE OF AI IN DEVELOPING ARCHITECTURAL DESIGNS / EXPO PAVILION PROJECT

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Rudnik Urbanism Design Architecture

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**corresponding author*

Abstract:

Nicholas Negroponte first highlighted the necessity of integrating AI into the design process in his 1970 publication, “The Architecture Machine”, produced by MIT. A crucial foundation for architectural design utilizing AI, such as 2D and 3D software, was established in the early 1990s when computers replaced pencils and drawing boards, becoming essential tools for developing architectural projects. An important date had been anticipated for 20 years, and as the third decade of the 21st century commenced, the reduction of processing time reached its peak. With the aid of the internet and online tools, based on the pay-and-use principle, architects can now approach design from an entirely new perspective, even without specialized drawing software. Nevertheless, it is evident that although there are various alternatives that even omit having any concept as a sketch during the pre-design phase, employing specialized 2D and 3D software along with drawings facilitated by a computer mouse or pencil will not be entirely disregarded. Rather, earlier software versions and established databases will be utilized for optimal refinement of the solution in the post-production stage, leading to a decrease in the array of options and the proposed solutions down to selecting the most suitable choice, which undoubtedly expedites the process towards the desired final presentation. The use of AI in the post-production phase of the Expo pavilion design, employing all three stages from 2D, 3D to AI prompt-generated final visuals, earned an international award at Italy's leading online design competition.

Keywords: architectural design, image generation, simulations, AI tools, prompt.



COMPARISON OF CNN ARCHITECTURES FOR EARTHQUAKE DAMAGE STATE CLASSIFICATION OF DIFFERENT BUILDING TYPES

Miloš Kovačević¹[0000-0002-8216-4564], Filip Đorđević^{1*}[0000-0002-4596-0131], Mladen Nikolić²[0009-0002-8943-2709], Đorđe Nedeljković¹[0000-0001-7637-3776], Zoran Babović³[0000-0002-8651-2730], Zoran Pucanović¹[0000-0002-6623-0189], Marija Ivanović¹[0000-0002-0929-432X], Nevena Simić¹[0000-0003-3391-3204] and Marko Marinković¹[0000-0001-6642-8403]

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Abstract:

Rapid and reliable post-earthquake damage assessment of the built environment is critical for prioritising response and recovery efforts. This study investigates deep-learning strategies for classifying different building types into three damage states: slight, moderate and severe, using photos that capture both the structure and its surrounding context. Unlike many prior works that rely on tightly cropped images of specific cracks, our dataset intentionally preserves a wider field of view, making the task more realistic yet significantly more challenging.

Two convolutional neural network (CNN) architectures are examined: ResNet-18 and ConvNeXt-Tiny. A two-stage training protocol is employed. In the first stage, before training on the original photos, a ResNet-18 model is pre-trained on a subset composed exclusively of close-up patches, providing a strong damage sensitivity. Second stage uses the original training set of the photos, extended using horizontal-flip augmentation. The same protocol is then replicated for ConvNeXt-Tiny architecture.

Results show that dataset expansion and simple augmentation improve ResNet-18 recall, confirming the benefit of contextual diversity. Nevertheless, ConvNeXt-Tiny consistently outperforms ResNet-18, achieving a recall of 72% and an F-score of 0.85. The findings highlight the importance of appropriate selection of CNN architectures, especially for demanding tasks.

The proposed workflow offers a pragmatic route toward scalable, context-aware earthquake damage assessment tools, and provides a benchmark for future research on holistic post-disaster image analytics.

Keywords: earthquake damage assessment, damage-state classification, convolutional neural networks, context-aware imagery.



CROP YIELD PREDICTION USING SENTINEL-2 SATELLITE IMAGERY AND DEEP LEARNING MODELS

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Abstract:

The goal of this research is to train a model for predicting crop yields in Argentina. Data were collected for soybeans and corn from 9 fields during 2022, 2023, and 2024. Satellite images from Sentinel-2 in L2A processing were used as input data for the model, while target data such as geographical latitude, longitude, and yield were collected from the harvester during the harvest. Due to the relatively small dataset, the crop areas were divided into 160 x 160 meter tiles (approximately 2 hectares per tile), and the average yield was calculated for each tile. A total of 493 samples for soybeans and 655 samples for corn were obtained. The input data consists of 6 images selected from a set of available images collected 4-5 months before the harvest and up until the harvest. To ensure the model's robustness and reduce overfitting, the images were selected randomly but always in the same order. A very small CNN model was used for yield modeling, with the primary goal of avoiding overfitting. During training, 80% of the samples were used for training, and the MSE loss function was applied. For evaluation purposes, 1,000,000 samples were generated from the entire area covered by crops. The evaluation results showed that although there are certain deviations in the predictions at the tile level, these deviations are symmetric, so the model provides a good yield prediction at the field level.

Keywords: crop yield prediction, agriculture forecasting, remote sensing.



SHORT REVIEW OF MACHINE LEARNING SUPPORT IN THE DEVELOPMENT OF SOFT PIEZOELECTRIC MATERIALS

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Abstract:

This paper presents a short review, with case studies, of a machine learning (ML) application in the development and characterization of soft piezoelectric materials, including polymers, composite elastomers, and natural materials in various forms, such as scaffolds, hydrogels and 3D printed structures, for advanced biomedical devices. In the discovery of new materials, it is crucial to understand the complex relationships among material composition, structure, functional properties and their effects on piezoelectric performance. Different ML techniques have been increasingly used to recognize these relationships, predict material properties and optimize compositions. One of the challenges is the selection of relevant descriptors and features for ML models that can be defined through different experimental measuring techniques (e.g. piezoresponse force microscopy and impedance spectroscopy) that can also provide experimental datasets for model training.

A wide range of ML methods is studied, including supervised and unsupervised learning, deep learning, reinforcement learning, transfer learning, Gaussian process regression, genetic algorithms, and evolutionary strategies. Supervised learning models are commonly used for classification tasks and performance prediction, such as the prediction of output charge, stress and strain, based on the input parameters such as composition, morphology, and processing conditions. Unsupervised techniques such as clustering and dimensionality reduction are often used to uncover hidden patterns in material datasets, while Gaussian process regression is valued for its ability to quantify uncertainty in predictions, making it particularly useful for exploring material design spaces when data is limited or expensive to collect. These data-driven approaches are highly dependent on training datasets, whereas determining accurate material properties and performance metrics for soft piezoelectrics remains a major challenge due to their complex structures and sensitivity.

Keywords: soft piezoelectric materials, machine learning, ML-driven design, data-driven models, material performance prediction.

Acknowledgment: This paper is funded through the EIT's HEI Initiative SMART-2M project supported by EIT RawMaterials, funded by the European Union and supported by the projects No. 451-03-137/2025-03/200107 and No. 451-03-137/2025-03/200122, Ministry of Science, Technological Development and Innovation, Republic of Serbia.



LUNG CANCER CLASSIFICATION FROM CT IMAGES USING THE DINOv2 VISION TRANSFORMER ARCHITECTURE

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Abstract:

Medical imaging is a crucial tool in the diagnosis and management of a wide range of diseases. Traditionally, the interpretation of medical images has relied on manual assessment by clinicians, a process that can be time-consuming and may contribute to delays in diagnosis and treatment. Moreover, diagnostic accuracy can be affected by inter-observer variability and limitations in clinical expertise, potentially leading to misdiagnosis. Deep learning approaches like convolutional neural networks (CNNs) used to be state-of-the-art in performing classification of disease in medical images. However, CNNs often face limitations such as restricted receptive fields and challenges in capturing long-range dependencies within images.

These drawbacks underscore the need for more advanced and flexible architectures, such as those relying on Vision Transformers (ViT). In response, this study investigated the use and optimization of the latest version of DINOv2 Vision Transformer (ViT), for the analysis of computed tomography (CT) images aimed at detecting lung cancer. This study utilizes three publicly available datasets: IQ-OTH/NCCD lung cancer dataset, the Lung Nodule Dataset with Histopathology, and the Chest CT-Scan Images Dataset. These datasets are pre-processed and merged into a unified database, with all images resized and augmented to ensure consistency and enhance model robustness. The adopted architecture uses self-attention mechanisms to capture global contextual information, offering a more comprehensive representation of image features compared to traditional convolutional approaches. Model performance is evaluated using evaluation metrics such as accuracy, F1 score, precision, sensitivity, specificity etc. To demonstrate the advantages of the proposed approach, results are compared with those obtained using a conventional CNN model, highlighting the improved detection capability of the ViTbased framework.

Keywords: vision transformer, convolutional neural networks, medical image processing, classification, cancer.

Acknowledgement: This research was supported by the Ministry of Science, Technological Development and Innovation of the Republic of Serbia, contract number [451-03-136/2025-03/200107 (Faculty of Engineering, University of Kragujevac)].



UNLOCKING CARDIOGRAPHIC-BASED BIOMETRIC POTENTIAL: INSIGHTS FROM FEATURE SELECTION

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Abstract:

The proposed study explores the role of electrocardiogram (ECG) and impedance cardiogram (ICG) features in biometric identification, focusing on their contributions to classification accuracy and resilience to emotional excitability. We use our publicly available dataset containing 202 ECG and ICG recordings from healthy participants. Each recording includes two segments: a resting baseline and an anger-induced state. From each recording, 18 samples are extracted (9 per segment), with an overall of 29 features (16 from ECG, 6 from ICG, and 7 from both ECG and ICG) derived from signals. The analysis reveals that features from both ECG and ICG rank highly in importance, consistently appearing in the top 10 assessed by both Gini and permutation importance, with ECG features slightly outperforming by occupying the top 5 positions. In our multicollinear dataset, it is observed that the Random Forest model systematically reduces the Gini importance scores of highly correlated feature pairs, showing that their actual contribution to the classification process is reduced. In parallel, statistical analysis reveals that 13 (6 from ECG, 4 from ICG, and 3 from both ECG and ICG) features exhibit statistically significant changes between baseline and anger states, with no clear emerging pattern regarding which type of features is the most affected. However, features derived from the QRS complex remain stable and do not exhibit significant changes.

Keywords: biometric identification, electrocardiogram, emotional variability, feature importance, impedance cardiogram, random forest.



FEATURE SUBSET SELECTION FOR LOW BACK PAIN PREDICTION: MACHINE LEARNING APPROACH

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Abstract:

Low Back Pain (LBP) is a common health problem that can severely affect a person's everyday life. Early prediction, diagnosis, and treatment progress assessment are crucial for timely recovery and prevention. We propose a method to automatically classify patients with (26 participants) and without neuropathic pain (71), as well as healthy subjects (41) based on the specific set of features. Additional aim is to identify the subset of features or their combination that yields the highest F1 score and accuracy.

Random forest is utilized as it deals successfully with small sample size on three subsets of data: descriptive features (age, marital status, education, and body mass index), Range of Motion (ROM) for trunk flexion and extension, and features measured with Ultrasound (US). Both relative (rUS) and absolute (aUS) muscle thicknesses are measured with US on the left and right *lumbar multifidus* and *transversus abdominis* during rest and maximal voluntary contraction. Measurements of *lumbar multifidus* are also performed for voluntary contraction. The dataset is split into 70% and 30% for training and testing. Stratified cross-validation with 10 folds is deployed for monitoring model stability.

Surprisingly, the highest averaged F1 score is obtained from using solely descriptive features (0.93 ± 0.02) in comparison to other subsets: ROM (0.89 ± 0.03), rUS (0.89 ± 0.04), and aUS (0.90 ± 0.03) for classification of healthy subjects and patients. The highest mean F1 score (0.93 ± 0.03) is achieved with descriptive and ROM features. Although this combination yields an F1 score almost the same as when applying just a descriptive subset, its averaged accuracy is higher (0.91 in comparison to 0.90 for descriptive subset). aUS performs slightly better than rUS subset, but without significant differences in evaluation metrics. Classification of patients with and without neuropathic pain, as well as healthy subjects, with all features, results in much worse metrics than classification of healthy subjects and patients reaching low accuracy (0.69 ± 0.04) and F1 score (0.65 ± 0.04).

Somewhat unexpectedly, our results reveal that descriptive data can be used solely as LBP predictors as they achieve better performance than quantitative metrics (ROM and US feature subsets). Such finding speaks in favor of the importance of demographic parameters for LBP prediction. Besides a larger study sample with more balanced classes, our future research will also focus on the selection of the most important features, as well as on the incorporation of other demographic parameters and psychosocial elements for assessing their relevance in predicting LBP.

Keywords: ultrasound, low back pain, range of motion, feature selection, random forest.



HUMAN-AI COLLABORATION IN SHAPING MODERN SURVEY DESIGN: OPPORTUNITIES AND CHALLENGES

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Abstract:

In the era marked by technological advancements, human-AI collaboration is opening new frontiers in survey design, particularly in social research, enabling more adaptive, scalable, and innovative approaches to capturing social data. This paper explores the evolving collaboration between researchers and AI systems in the development of smarter, more adaptive, and context-sensitive survey instruments. Drawing from contemporary methodological frameworks and recent empirical practices, the paper examines how large language models (LLMs), such as ChatGPT, can assist in the initial generation of survey questions, detect syntactic and semantic ambiguities, and support the personalization of instruments for diverse populations. Particular attention is given to the role of AI in enhancing cultural sensitivity, exploring how human-AI collaboration can bridge contextual knowledge gaps and support the development of survey instruments that resonate across diverse cultural settings. The study critically analyzes limitations related to cultural sensitivity, model bias, and the potential erosion of researcher agency, emphasizing the need for human oversight and rigorous cognitive pretesting to ensure validity and reliability. Based on the Total Survey Error (TSE) framework, the paper proposes a structured model of Human-AI teaming in survey design. The model highlights key phases in which AI can meaningfully contribute without displacing the nuanced judgment and ethical responsibility of the researcher. Ultimately, the paper advocates for an integrative approach, one that leverages computational efficiency while preserving methodological integrity, to advance the future of empirical research in the social sciences.

Keywords: artificial intelligence, survey design, human-ai collaboration, methodological innovation, social research.



COMPARISON OF RFE AND SHAP FOR PRV FEATURE RANKING IN COGNITIVE STRESS SCENARIO

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Abstract:

Pulse rate variability (PRV) metrics offer direct insights into autonomic nervous system activity and serve as physiological markers for individual stress responses. In the experiment presented in this paper, photoplethysmography (PPG) signals were recorded during two cognitively induced stress tasks. The segmentation of PPG signals was performed using various configurations, differing in window duration and time shift. A comprehensive set of PRV-related features in time, frequency, and non-linear domain was extracted from each PPG segment. Two feature selection approaches were applied to identify the most relevant PRV parameters for stress detection: Recursive Feature Elimination (RFE) and SHapley Additive exPlanations (SHAP), both with XGBoost machine learning model. To further assess the utility of each feature selection method, the subject-wise cross-validation was conducted using the selected optimal feature subsets, enabling a performance-based comparison between RFE and SHAP. The comparison between RFE-selected and SHAP-ranked features demonstrated a high overlapping, reinforcing the reliability of the overlapped PRV parameters.

Keywords: cognitive stress, pulse rate variability, recursive feature elimination, shapley additive explanations, photoplethysmography, feature selection.

Acknowledgement: This work was financially supported by the Ministry of Science, Technological Development, and Innovation of the Republic of Serbia under contract number 451-03-136/2025-03/200103. The research was partially conducted in the premises of the Palace of Science, Miodrag Kostić Endowment.



FEATURE-BASED MACHINE LEARNING AND DEEP NEURAL NETWORKS FOR REAL-TIME STRESS CLASSIFICATION FROM GSR AND HR SIGNALS

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Abstract:

Continuous stress monitoring using physiological signals is an important goal in wearable health technology. This work presents a comparative framework for classifying stress levels using both feature-based machine learning (ML) and deep neural networks (NN), based on data collected with a custom-designed wearable electrode system. The focus is on Galvanic Skin Response (GSR) and Heart Rate Variability (HRV), as these are among the most informative signals for stress detection.

We conducted a pilot study on three participants in whom we measured GSR from the fingers and electrocardiogram (ECG) from the chest using commercial sensors. The experimental protocol consisted of four consecutive 5-minute phases: a relaxation phase followed by arithmetic tasks with increasing stress levels: (1) without time pressure, (2) with time constraints, and (3) with time constraints and a social stressor (a distracting observer). Each phase was segmented into 60-s windows with 50% overlap, and a total of 18 GSR and HRV features were extracted. Feature selection using Principal Component Analysis (PCA) reduced the set to seven features, which yielded better classification accuracy. The best results were achieved using kNN (88.5%) for binary classification (relaxation vs. stress) and 68% using Decision Tree for three classes.

Based on these results, we have subsequently developed a wearable system based on a custom textile integrated electrodes that can simultaneously acquire GSR and ECG signals from the left upper arm. As signal acquisition at this location presents challenges due to motion artifacts and signal stability, we have further addressed these issues via signal preprocessing. We started to collect data using the new system and by now we have obtained recordings from seven participants.

In the upcoming phase, we aim to use the same methodology and introduce ML algorithms (SVM, kNN, Decision Tree, LDA, Naïve Bayes) to this newly recorded data. From the tonic component of GSR, features such as the mean, standard deviation, and slope are to be computed, while the set of features from the phasic component will include number of Skin Conductance Responses (SCRs), SCR amplitudes (mean, max, sum), and temporal features such as the mean and the total duration from onset to peak. HRV features that we will introduce are mean RR interval, SDNN, RMSSD, pNN50, HF, HF norm, LF/HF ratio, and the Baevsky stress index. In the deep learning approach, we will rely on raw segmented GSR tonic and phasic components, along with the HR signal, as input for various NN architectures, including Long Short-Term Memory (LSTM) and CNN-LSTM models.

We aim to evaluate both approaches using cross-validation techniques, such as leave-one-subject-out. Performance will be assessed using accuracy, F1-score, and confusion matrices, with an emphasis on identifying models suitable for deployment in real-time stress monitoring systems. This is the first step in the development of a cardiometabolic wearable, and in future research we plan to include additional relevant input variables such as temperature, humidity and hydration to further improve our AI model and the real-time stress classification.

Keywords: GSR, HRV, AI, stress detection, neural network, wearable system.



THE POSSIBILITIES AND LIMITATIONS IN AUTOMATIC PERSONALITY TRAIT DETECTION BASED ON TEXT ESSAYS WRITTEN IN SERBIAN

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Abstract:

The area of personality computing has passed its 20th year of existence. A lot of research in this field has been carried out, but by far the largest amount of work has been done based on data coming from English sources, and English-speaking parts of the internet in general. Throughout our past research in surveying this field, we have found that, to achieve a novel result, often times, it is enough to simply conduct research on a dataset whose language of origin is not English. Past studies have proven that the standard discriminators of personality do not always hold across different cultures, so studying language and culture-encoded differences among various cultures, languages and people could prove insightful in teaching us what makes us similar and where we might differ based on the language group and culture we belong to. With this in mind, in this study, we collect a small dataset of student essays written in Serbian, alongside students' MBTI and Big5 personality trait test results, and conduct a smaller-scale pivot study into the ability of automatic personality classifier algorithms, primarily based on various machine learning techniques, to predict the personality traits of students of several Serbian universities. We test existing English-optimized solutions, but also develop our own automatic personality classifiers. The results of this study also show that a potential method of benchmarking automatic language translation tools may lie in measuring how well a text writer's personality is being translated into the language of translation.

Keywords: automatic personality classification, personality computing, human-centered computing, psychological assessment, machine learning.



ANALYSIS AND FORECASTING OF ELECTRICITY CONSUMPTION IN THE DATA CENTER

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Abstract:

This research focuses on the practical application of the time series forecasting models for energy consumption management in data centers, using one rack cabinet as a case study. Four models: SARIMAX, Random Forest, XGBoost, and LSTM were evaluated for their predictive performance.

Among them, XGBoost demonstrated the highest accuracy and computational efficiency, making it the most suitable model for real-world deployment. Its ability to quickly and accurately capture complex, nonlinear patterns enable data centers to anticipate power demands with precision. LSTM showed strong performance in long-term forecasting, particularly useful for capacity planning, while Random Forest and SARIMAX offered reliable results in short-term scenarios with specific strengths.

The practical implications of these findings are substantial. Integrating models such as XGBoost into energy management systems allows for dynamic load balancing, improved cooling strategies, and predictive maintenance scheduling. This leads to optimized energy consumption, reduced operational costs, and minimized risk of overloading. Moreover, accurate long-term predictions facilitate strategic infrastructure planning and resource allocation. Importantly, better energy forecasting supports sustainability goals by lowering the carbon footprint of data centers through reduced energy waste.

By leveraging advanced machine learning models, data centers can transit from reactive to proactive energy management, achieving greater efficiency, scalability, and environmental responsibility. This study provides a solid foundation for the implementation of predictive analytics in modern data center operations.

Keywords: Data Center, machine learning, big data, data mining, energy efficiency.



ENABLING ROBUST ELDERLY CARE ROBOTICS: TASK DECOMPOSITION AND SELF-EVALUATION FRAMEWORKS ENHANCED BY LARGE LANGUAGE MODELS

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Abstract:

Background: With the intensifying global aging population, home healthcare robots face challenges in adapting to dynamic environments and complex task demands. This study aims to enhance the safety, accuracy, and reliability of robot control in elderly care by addressing limitations in existing Large Language Models (LLMs), such as instability in code generation and lack of robustness. The proposed system integrates task decomposition, self-evaluation mechanisms, and optimized prompting techniques to improve robotic task execution for home healthcare.

Methods: A structured six-module architecture (task description, controllable units, available code, task flow, limitations, and requirements) guides the model to generate precise control codes through step-by-step reasoning. A dual-decision model and supervision module validate generated code iteratively (up to three times) to mitigate errors caused by hallucinations or misunderstandings. Complex tasks are broken into reusable basic task groups (e.g., grasping, handing objects), reducing learning complexity and enhancing generalization. The model was trained on a dataset of 2,000 real-world home care scenarios and evaluated in eight practical tasks using a 7-DOF manipulator equipped with a human-like dexterous hand.

Results: Experimental evaluations demonstrated the new system proposed by us achieved a 97.3% task success rate, outperforming baseline models such as LLaMA3. CoT prompting with optimal reasoning steps improved accuracy from 0 to 1 while reducing response time to 0.14 seconds. Three self-evaluation loops increased accuracy by 20% with minimal latency increase (0.09 seconds).

Conclusion: The new system proposed by us significantly advances robotic home care by integrating LLMs with task decomposition and iterative validation. The proposed framework ensures high accuracy, safety, and adaptability in dynamic environments, addressing critical challenges in elderly assistance. Future work should focus on real-time adaptability in unstructured settings and enhanced human-robot collaboration. This research underscores the potential of LLM-driven robotics to revolutionize home healthcare services for aging populations.

Keywords: large language models, task decomposition, self-evaluation mechanism, home healthcare robots.



TACKLING ONLINE HARASSMENT USING NATURAL LANGUAGE PROCESSING AND METAHEURISTIC OPTIMIZATION

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Abstract:

Online harassment involves repeated aggressive or offensive behaviour across digital platforms, often evading moderation due to high content volume, evolving language, and circumvention techniques. While AI offers a scalable solution, challenges such as data quality, model selection, and hyperparameter tuning impact its effectiveness. Hyperparameter tuning is particularly complex, as it is an NP-hard problem that directly affects model performance. This study explores metaheuristic optimization to enhance AI-based harassment detection. Natural language processing (NLP) techniques in combination with the LightGBM classifier analyse real-world data, applying the crayfish optimization algorithm (COA) to refine hyperparameters. By improving classification accuracy and efficiency, this approach aims to make AI-based moderation more adaptive and effective in combating online harassment.

Keywords: cyberbullying, social media harassment, natural language processing, term-frequency inverse document frequency, metaheuristics optimisation.



FUZZY C-MEANS OVER NODE EMBEDDINGS OUTPERFORMS LEIDEN FOR OVERLAPPING COMMUNITY DETECTION IN LARGE-SCALE CUSTOMER GRAPHS

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Abstract:

Graph clustering and machine learning algorithms can be valuable in analyzing complex social, biological or engineering networks by uncovering densely connected node groups called communities. Graph-based customer segmentation often involves overlapping communities, a scenario where crisp partitioning algorithms can mis-represent user behaviour. We therefore benchmark a soft method Fuzzy C-Means (FCM) applied to node-embedding vectors (Node2Vec, 128 dims) against two hard baselines, Leiden and Louvain, and one overlapping baseline, BigCLAM, all running inside Neo4j. Experiments use three public network datasets from Kaggle along with 50 synthetic graphs with planted overlaps of 10–30%. Clustering quality is measured with Overlap-NMI, Omega-Index, and Fuzzy-ARI; scores are averaged over the graph ensemble and assessed with paired bootstrap tests. FCM delivers the best mean Overlap-NMI and Fuzzy-ARI, significantly outperforming Leiden and Louvain, while matching BigCLAM yet running 2–3× faster on 100 k-node graphs. The results confirm that FCM’s membership grades capture nuanced, cross-segment affinities that crisp modularity maximisers overlook. We discuss parameter-selection symmetry, scalability, and privacy-preserving deployment, and outline next steps: validating on proprietary e-commerce graphs, exploring fuzzy variants of Infomap, and integrating uncertainty-aware embeddings to further improve customer insight.

Keywords: Fuzzy C-Means, node-embedding vectors, graphs.

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FAIRNESS THROUGH SYNTHESIS: BIAS MITIGATION THROUGH PROBABILISTIC MODELING AND MATCHING TECHNIQUES

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Abstract:

Nowadays, mitigating data bias while preserving data utility presents a significant challenge, particularly in classification tasks, where sensitive attributes affect the AI models' outcomes. In this work, we propose a straightforward data bias mitigation approach which utilizes synthetic data to augment under-represented groups and thus to enhance fairness during decision-making. High-quality synthetic samples are generated through probabilistic modeling based on the Bayesian Gaussian Mixture Models with optimal components estimation (BGMM-OCE) algorithm. Graph-based matching is then performed using the Gower distance to restrict the synthetic samples to those that precisely match the "profiles" of the real ones. XGBoost classifiers are trained on the original and the bias mitigated datasets, where the test set is isolated from the real dataset (80/20) for fair comparison. The proposed approach is evaluated on the well-known UCI's adult income dataset (39,215 samples, 15 features). The sensitive attribute was set to gender, and the class imbalance (CI) was used for bias detection. Our results (Fig. 1) show that our proposed approach significantly improves fairness metrics [CI original: 0.34, CI mitigated: 0.04] without reducing the model's predictive performance (mean AUC improved from 0.89 to 0.92 across 1,000 bootstrap resampling iterations).

Keywords: bias mitigation, synthetic data generation, BGMMOCE, fairness.

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USING AGENT-BASED MODELS FOR GENERATION OF SURROGATE MODEL VIRTUAL POPULATIONS: ATHEROSCLEROSIS CASE STUDY

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Abstract:

Agent-based models (ABMs) are increasingly recognized as powerful tools for capturing the mechanistic complexity and inter-individual variability inherent in chronic diseases such as atherosclerosis. In this study, we present a methodology for generating surrogate model virtual populations using an ABM framework tailored to simulate atherosclerotic plaque initiation and progression. The model integrates multicellular dynamics, hemodynamic influences, and tissue remodeling processes at the arterial wall scale. A set of 15 patient-specific vascular geometries was incorporated, each representing distinct anatomical and hemodynamic conditions observed in clinical settings. To systematically explore a broad spectrum of biologically plausible behaviors associated with atherosclerosis progression, we employed Latin Hypercube Sampling (LHS), a stratified sampling technique designed to efficiently cover multidimensional parameter spaces. This approach allowed for the generation of a diverse set of input configurations that span the plausible physiological variability observed across individuals. Specifically, LHS was used to sample five key parameters known to influence atherosclerotic plaque development: (1) the probability of smooth muscle cell (SMC) proliferation in the tunica media, (2) the probability of SMC proliferation in the intima, (3) the probability of lipid infiltration into the arterial wall, (4) the degree of outward remodeling driven by shear stress, and (5) the degree of outward remodeling driven by tensile stress. The sampling ranges for all parameters were rigorously defined based on empirical data extracted from peer-reviewed experimental, histological, and imaging studies, ensuring that the generated values remained within physiologically and clinically credible bounds. By integrating LHS within the ABM framework and applying it across 15 distinct patient-specific vascular geometries, we created a high-resolution landscape of virtual individuals, each exhibiting unique pathophysiological trajectories. The resulting virtual populations revealed a rich spectrum of disease phenotypes, from stable plaques with compensatory remodeling to rapidly progressing lesions with vulnerable features. This enabled the identification of critical parameter interactions and emergent behaviors not readily discernible through traditional univariate sensitivity analyses. Furthermore, the methodological pipeline developed here offers a scalable platform for virtual population generation, supporting hypothesis testing, biomarker validation, and therapeutic response prediction *in silico*. It bridges the gap between mechanistic modeling and clinical application, enhancing the translatability of computational models for precision medicine. By combining anatomical variability, parameter uncertainty, and biological fidelity, our approach contributes a robust foundation for model-informed clinical trial design, biomarker discovery, and therapeutic strategy evaluation.

Keywords: agent based models, virtual population, latin hypercube sampling, atherosclerosis, artificial intelligence.

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DIABETES MELITUS AND AI - CLINICAL PRACTICE

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Abstract

One of the most widespread diseases in the world is a diabetes which, according to statistical data, affects 10.5% of the world's population, and it is believed that the numbers will be higher. This disease can present a great danger, that is, a factor of mortality and morbidity worldwide, which affects different demographic groups. First of all, we have to know the topic of the disease that we are researching and pay more attention to the individual, because the effect of therapy differs among people. One of main causes for the development of this disease is genetics itself, as well as our environment. Today, both technology and drugs are developing greatly, which help us overcome the disease and monitor its course. Diabetes occurs in two forms, the first is T1DM (the diabetes type 1), which is an autoimmune disease in which some of the external factors (microbial, chemical or dietary) initiate an autoimmune reaction in a genetically susceptible person. While type one is caused by genetics, the diabetes type two (T2DM) is rarely caused by genetics, it occurs due to irregular insulin secretion (beta cell disfunction occurs).

Keywords: diabetes, technology, pancreas, beta cells, insulin, AI.



MACHINE LEARNING BASED PREDICTION OF A CELL DEATH AFTER SILVER NANOPARTICLE TREATMENT

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Abstract:

Silver nanoparticles (AgNPs) are increasingly applied across biomedicine due to their antimicrobial and anticancer properties. However, concerns about their cytotoxicity to both cancerous and non-cancerous cells call for predictive tools that can accurately model their biological impact. In this study, we applied machine learning models to predict cell viability in response to AgNPs exposure using human umbilical vein endothelial cells (HUVEC) and breast adenocarcinoma epithelial cells (MDA-MB-231) as biological models. Experimental data were collected at 24 h and 72 h post-treatment using a standard MTT assay. These data were used to train two machine learning models: Support Vector Regression (SVR) and Random Forest (RF). We, then, used each model to predict viability at 48 h and 96 h intervals not included in the training and evaluated performance on unseen samples. SVR achieved RMSE of 1.61% at 48 h and 1.57% at 96 h outperforming RF (5.96% and 2.92%, respectively). Both models successfully generalized to unseen data and longer exposure durations. These results demonstrate the feasibility of using machine learning for nanotoxicology assessments enabling faster and more accurate predictions of cytotoxicity. These insights can significantly advance the safety evaluation of nanomaterials and support the development of safer nanoparticle based therapeutics.

Keywords: silver nanoparticles, machine learning, cytotoxicity prediction, support vector regression (SVR), nanotoxicology.

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RECOGNIZING PATTERNS OF EMERGING CHRONIC OBSTRUCTIVE PULMONARY DISEASE IN HEART FAILURE PATIENTS THROUGH THE USE OF MACHINE LEARNING TECHNIQUES

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Abstract:

Heart failure is one of the most prominent medical conditions worldwide, and is one of the main contributors to the reduced life expectancy and reduced quality of life in patients in whom it develops. The diagnosis of heart failure depends on multiple criteria in biomarkers gathered from multiple different data acquisition modalities. Some of these criteria include pulmonary crackles, peripheral oedema, dyspnoea on exertion and fatigue. Chronic obstructive pulmonary disease is often associated with and sometimes mixed up with heart failure due to them sharing pathogenic mechanisms. In this paper, we utilized clinical data gathered from heart failure patients and patients suspected of having risk of developing heart failure in tandem with machine learning approaches to classify patients based on their risk of developing chronic obstructive pulmonary disease. The dataset contained 3 classes which denoted if the patient definitively had the disease, had the possibility of developing the disease in the near future, or was healthy. The dataset used within the study contained multiple datasets of different data modalities, including physical examination findings, blood biomarkers, patient disease history, symptoms, echocardiography findings and electrocardiogram findings. Since not all the data were available for every patient, we utilized an ensemble model approach to train multiple models, capable of classifying patients based on the data available for them. For classification purposes, multiple random forest models were trained with different combinations of data modalities. The best results were obtained for the combination of a patient's disease history, symptoms and echocardiography. This model achieved the classification accuracy of 87% and F1 score of 91% for the high-risk class. Other models followed with accuracy scores between 78% and 85% and F1 scores between 86% and 89% for the high-risk class.

Keywords: classification, random forest, ensemble model, heart failure, chronic obstructive pulmonary disease.

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BENEFITS OF USING GENETIC ALGORITHMS IN ESTIMATION OF PARAMETERS OF A NUMERICAL MODEL FOR PREDICTION OF CANCER PROGRESSION

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Abstract:

In vitro cell culture models are commonly used in experiments to analyze the effect of various treatments on cancer cells. In order to gain more insight into the quantitative effect of the analyzed treatments on the cells, numerical simulations have proven to be quite useful. In this paper, a hybrid multi-scale numerical model is used to simulate the progression of cancer cells. This hybrid model enables modeling of cell cycle dynamics at the cellular level (using agent-based model (ABM)) and the distribution of nutrients at a higher scale (using lattice Boltzmann method (LBM)). Naturally, these two scales are coupled, as the nutrient concentration is affecting the cell cycle. This model contains several numerical parameters, such as the duration of apoptosis and necrosis, consumption of nutrients, etc. These parameters are difficult to calculate experimentally and hence an estimation procedure must be applied for the calculation, by minimizing simulation errors in comparison to experimental data.

In this paper, several estimation procedures, including genetic algorithms, Nelder-Mead simplex optimization algorithm and sequential quadratic programming (SQP) method and their combinations are compared in terms of efficiency. The parameter for efficiency comparison was the least squares error of the simulated number of viable, apoptotic and necrotic cells, compared to the experimentally measured number of cells. It was concluded that the most efficient approach is to first use a genetic algorithm to find the region of the global minimum of the estimation function and then to use the Nelder-Mead simplex optimization algorithm to more closely determine the minimum. As a stand-alone method, the genetic algorithm has demonstrated the highest efficiency.

Using this estimation procedure, it is possible to estimate the numerical parameters for various experimental setups and thus provide additional quantitative insight into the effect of the considered treatments on cancer cells and its progression.

Keywords: multi-scale cancer modeling, agent-based model, lattice-Boltzmann model, parameter estimation.



HARNESSING ARTIFICIAL INTELLIGENCE FOR THE DESIGN OF NEW POTENTIAL INHIBITORS OF THE LIPOXYGENASE

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Abstract:

Nitrogen-containing heterocyclic compounds are a well-known group of organic compounds that have many different structures and a wide range of biological effects, including anticancer, antibacterial, antiviral, anti-inflammatory, antioxidant, antidiabetic, etc. The pyrazole and pyrimidine units are also present in many biomolecules and many compounds containing these moieties are already approved by Food and Drug Administration (FDA) and used as drugs against various diseases. These heterocyclic rings simultaneously provide a platform for different types of pharmacophoric groups to interact with receptors and enzymes. One such important biological target is the lipoxygenase (LOX) enzyme family, which catalyzes oxygenation of polyunsaturated fatty acids to create lipid mediators that promote inflammation. Overexpression or dysregulation of LOX is associated with inflammation, cancer, and neurodegenerative diseases, making it a valuable therapeutic target. Since LOX inhibition is crucial to prevent diseases, many nitrogen heterocycles have shown good ability to inhibit LOX, making them possible options for creating anti-inflammatory and anticancer drugs. Therefore, understanding their interaction with LOX at the molecular level offers significant opportunities for rational drug design. A recently synthesized compound 5-((4-fluorophenyl)(5-methyl-3-oxo-2,3-dihydro-1*H*-pyrazol-4-yl)methyl)-6-hydroxypyrimidine-2,4(1*H*,3*H*)-dione (**L**) will be used for future studies related to rational drug design by employing Artificial intelligence (AI). In this study, we utilized deep learning models for binding affinity prediction. We employed the Chemically Reasonable Mutations (CReM) web-server to generate a series of **L** derivatives. CReM is an open-source Python framework that utilizes a fragment-based approach for chemical structure generation. This strategy led to the successful modification of **L**, resulting in the generation of 50 synthetically acceptable derivatives. To identify viable candidates among the generated compounds, we screened all derivatives towards LOX receptor. Initial derivatives were subjected to virtual screening and docking using artificial intelligence implemented in the MolAICal software. After screening, ten **L** derivatives with lower binding energy values are selected for further analysis. The free energy of binding (ΔG_{bind}) is calculated for all chosen ligands and lower values indicating better binding affinity. The results demonstrate that **L** and some of its derivatives, particularly derivatives **L1** and **L2**, exhibit stronger binding affinity to the LOX receptor. Following molecular docking analysis, the investigated compounds underwent a comprehensive evaluation of their pharmacokinetic properties through ADME screening utilizing a Python. Using lipophilicity as a criterion, four compounds were identified as drug-like structures. It is notable that all selected derivatives comply with the Lipinski Rule of Five, as well as other drug-likeness criteria outlined in the Python script. This suggests that these compounds could potentially serve as inhibitors of LOX and warrant further investigation for their therapeutic potential.

Keywords: LOX, **L**, derivatives of **L**, artificial intelligence, virtual screening, molecular docking.



SMARTER THAN MUTATION: AI-BASED DRUG MODIFICATIONS AGAINST PHARMACOLOGICAL RESISTANCE

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Abstract:

Pharmacological resistance stands as a significant challenge in modern medical treatment, especially in oncology, infectious diseases, and anticoagulation therapies. Conventional approaches to overcoming resistance frequently depend on a laborious process of trial-and-error modifications or the creation of completely new drug frameworks, both of which demand significant resources and time. This study introduces an innovative framework that leverages artificial intelligence to facilitate the rational redesign of current medications, aiming to address resistance at the molecular level. This research combines fragment-based generative algorithms, such as CReM, with molecular docking and machine learning models to predict ADMET properties. The aim is to systematically create and assess new derivatives of well-known therapeutic agents, such as Ciprofloxacin. A deep learning pipeline is utilized to prioritize candidates by assessing their predicted target affinity, potential to circumvent resistance, and advantageous pharmacokinetic properties. Highlighted case studies encompass the innovative redesign of Ciprofloxacin derivatives to enhance their efficacy against fluoroquinolone-resistant *Escherichia coli*. The methodology outlined here underscores the remarkable ability of AI to not only speed up the drug design process but also to fundamentally change the approach to addressing pharmacological resistance—by outsmarting the very mutations that challenge us.

Keywords: topoisomerase IV, DNA gyrase, ciprofloxacin, AI driven drug design.

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LEVERAGING DEEP LEARNING AND WORD EMBEDDING FOR FINANCIAL SENTIMENT ANALYSIS WITH CHATGPT-BASED DATA AUGMENTATION

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Abstract

Artificial Intelligence (AI) has a wide range of applications in business and finance, including the analysis of textual and unstructured documents and data. Financial Sentiment Analysis (FSA) is crucial for understanding the emotional tone and attitudes expressed in financial data presented in textual form. Financial sentiment classification models enable the automatic analysis of large market data volumes, identifying sentiment to recognize potential risks and opportunities, and can be useful tools for decision support for investors, managers, and traders. This study explores the effectiveness of combining word embedding techniques, such as Word2Vec and FastText, with deep learning architectures, including Bidirectional Long Short-Term Memory (BiLSTM) and Bidirectional Gated Recurrent Unit (BiGRU), to improve financial sentiment classification accuracy. A key challenge addressed is class imbalance in the financial sentiment dataset. To mitigate this, ChatGPT is used for data augmentation, generating synthetic samples to balance the dataset and enhance model performance. The proposed methodology is tested using the Financial PhraseBank dataset, where the class imbalance ratio between negative, positive, and neutral classes is 1:2.24:4.75. Simulation results suggest that augmenting the class with the fewest instances improved model performance. The cosine similarity between the actual and augmented samples is 0.908. The best results are achieved using a model based on Word2Vec vectorization with a BiGRU architecture, trained on both original and augmented data. The accuracy is 0.81, and the macro average F1 score is 0.79. The average F1 score for the minority classes increased by 12.2% compared to the model trained on the original data.

Keywords: financial sentiment analysis, deep learning, word embedding, data augmentation, ChatGPT.

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THE ROLE OF ARTIFICIAL INTELLIGENCE IN MARKETING STRATEGIES: OPPORTUNITIES AND CHALLENGES

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Abstract:

Artificial Intelligence (AI) has rapidly emerged as a transformative force across various industries, with marketing being no exception. Its integration into marketing strategies has enabled businesses to enhance efficiency, personalize customer experiences, and make data-driven decisions. This paper explores the growing role of AI in modern marketing practices, focusing on its impact on consumer engagement, audience targeting, and strategic decision-making. Using advanced technologies such as machine learning, data analytics, and predictive algorithms, AI empowers marketers to gain deeper insights into consumer behavior, anticipate trends, and develop highly personalized campaigns. The study highlights key benefits of AI-driven marketing, including improved customer segmentation, content personalization, and resource optimization. However, the adoption of AI also introduces challenges and ethical concerns, particularly in areas such as data privacy, algorithmic transparency, and potential bias. To examine these aspects, the study includes qualitative data gathered through interviews with 25 marketers operating in the Republic of Serbia. Their insights were analyzed using the statistical software SmartPLS4. Through this research, the paper underscores AI's growing significance in shaping marketing strategies and its dual role as both an enabler of innovation and a source of new complexities. The findings suggest that, while AI offers significant competitive advantages, its responsible implementation remains crucial for long-term success in the digital marketing landscape.

Keywords: artificial intelligence, marketing strategies, consumer behavior, personalization, data analytics, ethical considerations, digital marketing.



ALGORITHMIC DEPENDENCIES AND REGULATORY GAPS: JOURNALISM IN THE AGE OF AI

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Abstract:

Artificial intelligence (AI) is increasingly integrated into journalistic workflows, reshaping how information is produced, curated, and distributed. In doing so, it redefines foundational principles such as editorial independence, accountability, and the epistemic authority of journalism. These transformations are not neutral: AI technologies, often framed as a driver of efficiency and personalisation, are embedded within global platform infrastructures with their processes of optimisation, data extraction, and user engagement - often misaligned with democratic values and public interest goals. This tension is particularly pronounced in smaller media systems such as Slovenia, where limited resources in a small media market and technological dependencies expose structural vulnerabilities of journalism. In response to digital developments, the European Union has introduced a number of regulatory instruments including the Digital Services Act (DSA), the European Media Freedom Act (EMFA), and the Artificial Intelligence Act (AIA) aiming, among others, to ensure algorithmic transparency, protect editorial autonomy, and foster democratic oversight of digital media infrastructures. However, significant tensions persist between the ambition of these frameworks and the realities of their implementation. These include disparities in enforcement capacities among Member States, unclear normative boundaries regarding AI's role in editorial processes, and ongoing asymmetries of power between national regulators and transnational technology providers. This paper critically examines the evolving EU regulatory landscape through the lens of journalism's structural vulnerabilities in AI-mediated environments. Particular emphasis is placed on the position of small EU member states, which often serve as regulatory testing grounds while lacking the capacity for systemic enforcement. The analysis draws on document analysis of relevant EU regulation and national regulatory frameworks of Slovenia to assess their scope, coherence, and enforceability. In doing so, the paper contributes to a broader debate on how to develop resilient, pluralistic, and democratically anchored media governance in the age of AI to safeguard journalistic autonomy and strengthen the role of journalism as a democratic institution.

Keywords: artificial intelligence, media regulation, editorial independence, journalistic autonomy, EU digital governance, infrastructural dependency.



WILL AI REPLACE HUMANS IN STRATEGIZING COMMUNICATIONS? ETHICAL CONSIDERATIONS

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Abstract:

The propulsive development of digital media and widespread Internet penetration exponentially increased the scope and scale of strategic communication, making it a critical function in addressing the need for immediacy - instantaneous and widespread information dissemination. Due to the complexities of modern society, advancements in technology, and the necessity for organizations and individuals to effectively manage their reputation, strategic communication became a critical pillar of organizational development. The recent emergence of generative AI opened a new dimension of human-AI interaction: the capability of machines to imitate human behavior and responses goes to the extent of building parasocial relationships between humans and machines. Nowadays, users often develop a sense of attachment or familiarity with voice-activated assistants, interacting with them like humans. These relationships can extend to AI-driven chatbots or virtual friends, specifically designed to engage users in personalized conversations that mimic human interaction. Moreover, virtual influencers on social media platforms foster connection by interacting with followers through AI-generated content that creates an illusion of intimacy. At the same time, AI-powered solutions are widely used when creating communication strategies. Advanced tools for data analysis, audience segmentation, and content personalization are applied in strategic communication. Through natural language processing and machine learning algorithms, AI can analyze the data from social media, customer feedback, and market trends, and generate additional insights. This allows strategic communicators to tailor their messages more effectively, targeting specific segments with personalized content. Further, AI-powered sentiment analysis enables gauging public opinion and adjusting the strategies in real-time, enhancing the organizational ability to respond swiftly to new circumstances and maintain positive stakeholder relationships. In this context, the research aimed to identify ethical aspects of human-AI interaction in outlining and executing communication strategies. A systematic review of the available literature (N=72 articles) indicated that AI could take over the majority of strategic communication planning and even perform a significant portion of the technical and operational actions of strategic communicators. Technically, AI will soon be capable of replacing humans in strategizing communication. However, ethical context needs to be considered: synergy between humans and AI is expected. In this process, it is critical to ensure the application of UNESCO and IPRA AI ethics principles: doing no harm, accuracy, and human oversight as crucial for the successful development of human-AI synergy in strategizing communication.

Keywords: strategic communication, artificial intelligence, disruptive technology, AI ethics.



THE INTERPLAY OF ARTIFICIAL INTELLIGENCE AND INTERNATIONAL PUBLIC LAW: PRINCIPLE OF NON-INTERVENTION

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Abstract:

The swift incorporation of Artificial Intelligence (AI) into legal and regulatory systems prompts essential inquiries regarding its contribution to fulfilling international commitments, particularly in vital areas such as protection of human rights and promotion of self-determination. This paper begins by synthesizing findings from three interconnected prior studies that examine the applications of AI in the process of European Union (EU) accession, reproductive healthcare, and both collective and individual self-determination. The first study focuses on Serbia's commitments under the EU Stabilisation and Association Agreement (SAA), highlighting the concept of *bona fides* (good faith) in meeting accession requirements. Though there is no direct textual requirement for AI implementation, Serbia's obligation to achieve results, such as initiating judicial reforms in accordance with the European Convention on Human Rights (ECHR), implicitly pressures the nation to adopt AI technologies. For example, AI-enhanced judicial systems could alleviate case backlogs and align with ECHR standards, remedying Serbia's shortcomings in priority sectors like the rule of law. The findings suggest that neglecting to implement cost-effective AI solutions, when such technologies are accessible, may violate the principle of good faith under international law.

The second study assesses AI's impact on reproductive healthcare, especially concerning embryo selection systems. While AI improves diagnostic accuracy, it raises issues regarding reproductive autonomy by adding opaqueness to decision-making processes. Regulatory frameworks such as the EU's General Data Protection Regulation (GDPR) and the Artificial Intelligence Act require a level of transparency, insisting on elucidations of algorithmic processes to maintain informed consent. Nevertheless, varying national guidelines on acceptable embryo selection criteria, such as genetic conditions, complicate adherence evaluations. This analysis supports the development of AI systems that align with regional human rights standards, ensuring compliance with Article 8 ECHR, which protects personal life and health. The third study regards AI as a powerful instrument for enhancing both collective governance (e.g., Serbia's alignment with the EU) and individual rights (e.g., reproductive autonomy). In collective scenarios, AI facilitates the harmonization of legislation by pinpointing inconsistencies between national laws and EU *acquis*, while predictive analytics promote public involvement in ethnically diverse countries such as Bosnia and Herzegovina.

Together, these studies highlight the dual capability of AI to act as both a facilitator for legal harmonization and a disruptor of entrenched rights. This calls for intricate regulatory methods and offers us a solid foundation to further explore the relationship between AI and some of the core principles of International Public Law—specifically, the Principle of Non-intervention. This principle is firmly established in international law, particularly in Article 2(7) of the UN Charter, which forbids UN involvement in domestic affairs unless authorized under Chapter VII for enforcement. The 1986 *Nicaragua v. USA* ICJ case reaffirms this as a binding customary law, underscoring that coercive intervention in sovereign choices (such as political systems) is illegal. Current issues, including cyber-attacks, the manipulation of payment systems (like SWIFT), and the use of information technology and AI, pose significant challenges in terms of how to delineate and regulate digital intervention.

Keywords: artificial intelligence, international public law, principle of non-intervention



SELF-DRIVING DILEMMAS: THE COLLISION OF TECHNOLOGY AND LEGAL RESPONSIBILITY

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Abstract:

As autonomous vehicle (AV) technology rapidly advances, it raises a range of legal, ethical, and safety concerns—particularly regarding road accidents. Self-driving cars, once a futuristic concept, are now being tested and deployed by major companies such as Tesla, Waymo, Uber, and Xiaomi. These vehicles operate at varying levels of autonomy, from driver-assistance systems (Level 2) to fully autonomous navigation (Levels 4–5). As adoption increases, so too does the frequency of incidents involving these technologies, raising pressing questions about liability and accountability when accidents occur. Several high-profile real-world cases illustrate the complexities of these issues. In 2018, an Uber autonomous test vehicle struck and killed a pedestrian in Tempe, Arizona. The vehicle was in autonomous mode but had a human safety driver onboard, who was later found to be distracted at the time of the accident. This incident marked the first recorded pedestrian fatality involving a self-driving car and triggered widespread debate on the legal responsibility of both the human operator and the company. Similarly, Tesla vehicles operating under its Autopilot and Full Self-Driving (FSD) systems have been involved in multiple fatal crashes, including a 2021 collision in Fontana, California, and a 2023 head-on crash in South Lake Tahoe. Investigations revealed that Autopilot was engaged during these accidents, but questions arose over the driver's attentiveness and the adequacy of Tesla's safety features. More recently, in 2025, a Xiaomi SU7 vehicle using its Navigate on Autopilot system was involved in a fatal crash in China, prompting regulatory scrutiny and backlash over the marketing of autonomous capabilities. These cases expose a critical gap in current legal frameworks. Traditional liability models struggle to accommodate the nuances of autonomous systems, particularly when decision-making is driven by artificial intelligence rather than human judgment. Legally, AI systems themselves cannot currently bear responsibility, as they are not recognized as persons or entities under the law. Instead, accountability typically falls on one or more of the following parties: the human driver (if present), the car's owner, the manufacturer, and potentially third-party software or infrastructure providers.

For semi-autonomous vehicles (Levels 2 and 3), drivers are generally expected to remain alert and capable of taking control at any moment. Failure to do so may constitute negligence, making the driver liable in the event of an accident. However, when the vehicle is operating under full autonomy

(Levels 4 and 5), the situation becomes more complex. If a software failure or sensor malfunction leads to a crash, the manufacturer may be held responsible under product liability law, especially if due diligence in design, testing, or safety warnings was lacking. Some legal scholars and policymakers have floated the idea of assigning limited legal personhood to AI systems, which would allow them to bear a degree of responsibility. However, this concept remains controversial and has not been implemented in practice. Current legal systems continue to rely on human or corporate accountability, often leaving room for ambiguity, especially when fault is shared between multiple actors, including human drivers, software developers, and road maintenance authorities. As self-driving technology continues to evolve, so too must the legal frameworks that govern it. Addressing these challenges will require collaboration between lawmakers, technology companies, insurers, and the public. Establishing clear definitions of accountability, updating liability laws to reflect new technological realities, and ensuring transparency in AI decision-making will be critical steps in building trust and safety in the future of autonomous transportation. The goal of this paper is to provide an overview of the current state of the legal frameworks governing autonomous cars, including examples of some of the real-world cases of traffic accidents in which autonomous cars were involved.

Keywords: autonomous vehicles, AI liability, legal frameworks, responsibility, driver negligence.



INTERNATIONAL SCIENCE OLYMPIADS IN ARTIFICIAL INTELLIGENCE: A PASSING TREND, OR HERE TO STAY?

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Abstract:

International Science Olympiads (ISOs) for secondary school students have a history exceeding half a century. Initially focusing on formal and natural sciences, such as mathematics (International Mathematical Olympiad – IMO), physics (International Physics Olympiad – IPhO), and chemistry (International Chemistry Olympiad – IChO), these competitions have expanded significantly into diverse fields, including competitive programming (International Olympiad in Informatics – IOI) and even social sciences. Following this trend, the past year marked the debut of two distinct ISOs dedicated to Artificial Intelligence (AI): the International Olympiad in Artificial Intelligence (IOAI), held in Burgas, Bulgaria, and the International Artificial Intelligence Olympiad (IAIO), held in Riyadh, Saudi Arabia. Despite sharing the fundamental theme of AI, these events differ substantially in organization, approach, and execution.

While both Olympiads primarily target students with advanced formal education backgrounds and emphasize theoretical rigor through complex mathematical concepts, formal methodologies, and algorithmic problem-solving, their implementation strategies notably diverge. Each consists of two rounds—scientific and practical—but the specifics and evaluation criteria of these rounds significantly differ. Organizational frameworks further accentuate these distinctions, with each Olympiad reflecting its unique vision and institutional relationships.

This presentation, given from the perspective of a national team leader, provides a detailed comparative analysis of both AI Olympiads. It examines objective distinctions alongside subjective insights. Specific examples of competition tasks and problems will be showcased to illustrate contrasts clearly. The criteria and processes involved in national pre-selection and qualification will also be discussed comprehensively. Lastly, predictions regarding their sustainable integration into the global STEM education ecosystem will be explored. The conclusion suggests that substantial evolution and adaptation are necessary if either Olympiad aspires to transcend being a mere passing trend and secure a lasting position alongside established international science competitions.

Keywords: international science olympiads, artificial intelligence, comparative analysis, STEM.



ECONOMIC EVALUATION OF HEART FAILURE STRATEGIES IN THE STRATIFYHF PROJECT

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Abstract:

The STRATIFYHF project addresses the pressing global challenge of heart failure (HF), which affects an estimated 26 million people worldwide, including 15 million people in Europe. HF is a complex, chronic condition associated with impaired heart function, high healthcare costs, and poor quality of life. Current approaches to risk stratification and early diagnosis in clinical settings are limited, often leading to delayed or inaccurate diagnoses, missed treatment opportunities, and unnecessary healthcare expenditures.

STRATIFYHF proposes a transformative solution in the form of an AI-based Decision Support System (DSS). The system will integrate patient-specific data—demographics, clinical records, genetics, lifestyle factors, and socio-economic conditions—with state-of-the-art AI algorithms and computational modeling. This integration will support three core modules: risk stratification, diagnosis, and disease progression prediction.

This study evaluates the cost-effectiveness of using an AI-enhanced electrocardiogram (AI-ECG) to screen for asymptomatic left ventricular dysfunction in patients in Serbia, as part of the STRATIFYHF project. It utilizes decision analysis through a decision tree and Markov model to compare outcomes with and without screening. The findings indicate that screening at age 65 costs approximately \$23,351 per quality-adjusted life year (QALY) gained—below the commonly accepted willingness-to-pay threshold of \$30,000—suggesting that it is cost-effective. Similar assessments for ages 55 and 75 yielded costs of \$28,649 and \$32,072 per QALY, respectively. The analysis reveals that cost-effectiveness is highly sensitive to test performance, disease progression probability, and screening costs.

Overall, the results support the potential value of AI-ECG screening in this population. However, further research into the natural history of asymptomatic left ventricular dysfunction, available treatment options, and external validation of the AI algorithm is necessary to enhance the robustness of these findings within the STRATIFYHF project.

Keywords: heart failure, effective cost, machine learning, ECG, DSS, QALY.

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GAMIFYING RISK MANAGEMENT: A GENERATIVE AI-DRIVEN TETRIS-INSPIRED SIMULATION FOR ENHANCED DECISION-MAKING

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Abstract

This paper presents an expanded exploration of a Generative AI-enhanced gamification approach to risk management (RM) through a Tetris-inspired simulation model. By integrating real-time risk assessment and mitigation strategies, the system offers an interactive decision-support tool applicable to cybersecurity, disaster response, and financial risk analysis. The core innovation lies in combining dynamic scenario generation and interactive learning through the use of generative AI. The proposed framework utilizes large language models (LLMs), such as ChatGPT, to simulate complex risk narratives, adapt to varying difficulty levels, and provide feedback during gameplay, effectively mimicking the uncertainty and responsiveness of real-world risk management (RM) environments. A functional prototype was developed in Python and evaluated in cybersecurity and risk management. Results indicate improved engagement, faster decision-making, and a deeper understanding of interdependent risks. This paper contributes to the field by demonstrating how Generative AI can transform risk education into a scalable, immersive, and adaptive experience, offering a new paradigm for training in volatile and high-stakes domains.

Keywords: gamification, generative AI, risk management, simulation, decision-making, education, large language models.



A COMPARISON OF SIX SELECTED COMPUTING PARADIGMS

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Abstract:

This presentation compares six selected computing paradigms from the points of view of speed and complexity, in the context of intelligent algorithms. We are here concerned with applications based on some sort of integration, which is frequent in decision-making processes, from simplest didactics to the most complex defense – pieces of information first get accumulated, and then the decision is made to react one way or another. In didactics, a decision is made on the grade to be given to a pupil or a student, while in defense, a decision is made to redirect a missile left or right, up or down.

The speed comparison of different computing paradigms is easily obtained in the time domain. When it comes to complexity comparison, if digital paradigms are compared, the gate count is relevant. If digital and analogue paradigms are compared, the transistor count is relevant. However, if digital/analogue paradigms are compared with novel ones based on advances in physics/chemistry, the comparison becomes an issue. A possible approach could be based on the implementation cost, but such an approach may not satisfy a serious scientific rigor.

In general, integration could be done using digital signal processing, but it could also be done using some kind of analogue or semi-analogue approaches. Due to the importance of the integration process for a number of emerging AI applications, the comparison to follow is based on the integration process. No matter how different the possible approaches are in their general philosophy and specific implementation, all of them boil down, as already indicated, to the same two major issues: speed and complexity.

The paradigms to be compared are: (A) Integration based on software for an Intel microprocessor, (B) Integration using the control flow multiprocessing approach, as in [Milutinovic1986], (C) Integration using the Silicon-based data flow approach, as in [MilutinovicSalomVeljovicKorolija2017], (D) Integration using the GaAs-based data flow approach, as in [FortesMilutinovic1986], (F) Integration using a novel approach based on the synergy of GaAs and data flow, inspired by [Babovic2024], and (G) Integration using the Mika Alas integrator, which carries potentials for a lot faster reaction, given proper conditions, and definitely having a lot smaller complexity with a much lower implementation cost.

The major conclusions of this research are: The approach utilizing the synergy of GaAs and data flow is by far the most effective one of all semiconductor based approaches, while a further research, to include physicists and chemists, could show whether a lot more effective implementation could be obtained from the Mika Alas integrator, and what would be its potentials and limitations.

Keywords: intelligent algorithms, computing paradigms, high-performance computing architectures.



A RAPID REVIEW ON ARTIFICIAL INTELLIGENCE ALGORITHMS IN THE STUDY OF BENTHIC ECOSYSTEMS: APPLICATIONS, PERFORMANCE AND FUTURE TRENDS

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Abstract:

The development of Artificial Intelligence (AI) algorithms over the last two decades has benefitted different fields of study, including benthic ecology. The constant technological advances have facilitated the exploration of ocean seabed; however, some AI techniques are more suitable than others. In the present literature review, we classified the existing AI algorithms to study benthic ecosystems into three categories: traditional machine learning models, data-driven deep-learning models and combination of physical models and AI. The results of the meta-analyses show that the latter two categories are still in their infancy. Despite its infancy, data-driven deep-learning performed better for Species Distribution Modelling (93% accuracy) and Image Recognition tasks (90% accuracy), while it did not show significant differences for habitat mapping with any of the other algorithms. Nevertheless, traditional machine learning algorithms offer interesting applications in combination with remote sensing techniques. Furthermore, the combination of physical model with AI still need further developing, but its combination with emerging technology such as marine robotics, benthic observatories and blockchain platforms (a decentralize technology that records transactions in a transparent and tamper-proof way) is promising for the near future.

Keywords: benthic, conservation, marine environment, artificial Intelligence, image recognition.



SOFTWARE ARCHITECTURE FOR STRATIFYHF: HEART FAILURE RISK STRATIFICATION AND DIAGNOSIS

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Abstract:

The STRATIFYHF platform is a cloud-based, artificial intelligence-powered Decision Support System (DSS) designed for early detection, risk stratification, and progression prediction of heart failure (HF) in both primary and secondary care settings. The system integrates a modular software architecture that includes risk assessment, predictive analytics, visual analytics, and real-time patient monitoring. The platform is conceptualized on a multi-tiered cloud infrastructure, ensuring scalability, security, and real-time processing capabilities. The architecture follows a microservices-based design, with independent, but interconnected modules responsible for different functionalities: data management and preprocessing, machine learning modules for early diagnosis, risk stratification and disease progression based on clinical data, voice-based early diagnosis, computer modeling for disease progression, and interactive visualization. The workflow is managed by a centralized module, which coordinates the execution of AI-based predictions, data validation, and visualization pipelines. User interaction with the platform occurs through a web-based interface designed for cardiologists and general practitioners. The dashboard provides real-time access to patient records, critical alerts, and machine learning modules. The clinician can input clinical data manually or through batch uploads, enabling automated preprocessing and predictive analysis. Additionally, the platform supports multimodal data integration, incorporating ECG, echocardiography, cardiac MRI, and novel biomarkers, including AI-based voice processing. The platform's design supports future advancements in predictive modeling.

Keywords: decision support system, heart failure, software architecture, risk stratification.

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HEART FAILURE DISEASE PROGRESSION ASSESSMENT IN PATIENTS THROUGH THE USE OF TRADITIONAL MACHINE LEARNING APPROACHES

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Abstract:

Heart Failure (HF), characterized by the heart's inability to pump a sufficient amount of blood, represents one of the major global health challenges. The diagnosis of HF relies on a combination of clinical assessments and biomarkers derived from various diagnostic tools and data sources. These biomarkers, including those from blood tests and physical examinations, are crucial for identifying patients at risk of developing HF. Accurate identification of individuals at risk of developing HF is essential for timely intervention and management, which can help slow disease progression and significantly improve patient outcomes. In this paper, we present a methodology for classifying patients into three distinct classes: (1) those who have HF at the baseline appointment, (2) those who will develop HF within the next five years, and (3) those who will develop HF within the next ten years. The dataset used in this paper consists of blood biomarkers and physical examination data. After applying several machine learning models including logistic regression, support vector machine, decision tree, gradient boosting decision tree and random forest, we found that the ensemble model gradient boosting decision tree (GBDT) achieved the best results. After performing 5-fold cross-validation, the accuracy was 0.95, and the F1-score was 0.94. We also extracted key features that are strongly associated with patient outcomes, such as NYHA class, CK-MB, total cholesterol, BMI, heart rate, diastolic pressure, creatinine, and NT-proBNP. Additionally, we used SHAP and LIME to improve the model's interpretability, as explainable machine learning models are easier to implement in real clinical practice. By using these methods, the transparency of the model decision process is enhanced, allowing clinicians to better understand the predictions and make more informed decisions.

Keywords: heart failure, gradient boosting decision tree, ensemble model, classification.

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IMPACT OF DIFFERENT BIOMARKERS ON THE PREDICTION CAPABILITIES OF MACHINE LEARNING MODELS IN THE DIAGNOSIS OF HEART FAILURE

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Abstract:

One of the fundamental principles in machine learning (ML) is that large high-quality datasets are essential for building predictive models. However, assembling such datasets can be challenging and expensive, particularly in healthcare, where patient numbers are limited, data privacy is crucial, and screening procedures are costly. This is why we conducted research on evaluating the impact of various biomarkers on different ML models for diagnosis of heart failure (HF), showcasing that ML models can achieve high accuracy even with limited diagnostic data. Heart failure is a global health issue characterized by the heart's inability to pump sufficient blood. In order to diagnose HF, medical professionals utilize a combination of different biomarkers derived from various diagnostic tools and data sources.

The dataset used in this paper comprises data from the following data sources and screening procedures: Patient history, Symptoms, Physical examination, Electrocardiogram (ECG), Echocardiogram (Echo) and Blood work. This data was accompanied by labels corresponding to the diagnosed heart failure (HF) in the patient (present/absent). After applying several ML algorithms (Decision Tree, Random Forest, K-nearest neighbors, Multi-Layer perceptron, eXtreme Gradient Boosting), we found that it was not necessary to use all of the biomarkers in order for model to achieve accuracy over 80%. Namely, after only using a combination of data from patient history, symptoms and physical examination, all of the models achieved high accuracy scores, with XGBoost attaining the highest at 84.77%. Unsurprisingly, the inclusion of Echo data resulted in a minor improvement of XGBoost's accuracy to 85.17%.

These results indicate that it is possible to achieve reliable HF diagnosis results using ML models with only basic biomarkers, without having to utilize information from expensive or invasive procedures such as ECG, Echo, or Blood work. This research shows the potential of simplified data use in effectively diagnosing HF using ML models.

Keywords: biomarkers, early diagnosis, feature importance, heart failure, machine learning.

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PREDICTION OF DIFFERENT SYMPTOMS EMERGENCE IN HEART FAILURE PATIENTS USING MACHINE LEARNING APPROACHES

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Abstract:

Heart failure (HF) as one of the most common diseases worldwide is affecting millions of patients each year. With its remarkably high mortality rate, HF exhibits a wide range of different symptoms affecting patients' quality of life. By observing these symptoms, together with other screening procedures, doctors are able to diagnose patients with HF. Conversely, we hypothesized that it is possible to predict the emergence of these symptoms, alongside HF, by using data gathered from screening procedures. In this study, we utilized a dataset consisting of physical examination data and blood biomarkers to predict the following symptoms: Dyspnea at rest/activity, Orthopnea, Tiredness at rest or light activity, Peripheral oedema, Orthostasis, Chest pain, Palpitations, Claudication, Coughing (>3 months per year), Frequent phlegm, Pulmonary crackles, Pleural effusion, Pretibial edema. All symptoms were classified into two classes depending on whether they are present or absent. For classification purposes, the best results were achieved using the Extreme Gradient Boosting tree method. On average, our models predicted the presence of symptoms correctly in 88.79% of cases. Notably, the highest accuracy score was achieved predicting Pretibial edema (98.47%), while the lowest accuracy was achieved in the prediction of Dyspnea at rest/activity (74.16%). These results indicate that it is possible to predict whether a patient will experience certain HF related symptoms by assessing the severity of HF and current biomarker values.

Keywords: symptoms, binary classification, heart failure, gradient boosting, ensemble model.

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ASSESSMENT OF MORBIDITY IN PATIENTS WITH HEART FAILURE USING TRADITIONAL MACHINE LEARNING TECHNIQUES

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Abstract:

In terms of morbidity and reduction in patients' quality of life, heart failure stands as one of the most striking examples. Patients with heart failure experience increased exertion and troubles breathing even when performing light and menial tasks. Morbidity and severity of this disease are most commonly evaluated through the use of New York Heart Association (NYHA) classes. In this paper, we conducted a study to classify patients into four morbidity classes using non-invasive data. Our dataset consisted of data obtained from physical examination, symptoms and patients' disease history. The target classes were marked from zero to three, where zero denoted low to no impact on life quality and three denoted very high impact on life quality. The main goal of the study was to imitate the use of NYHA classes. For classification, we used random forest, decision tree and supported vector machine classifiers. The random forest model performed the best, achieving a classification accuracy of 79.2%, while the decision tree and supported vector machine achieved accuracy scores of 46% and 44%, respectively.

Keywords: classification, random forest, NYHA class, heart failure, morbidity.

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RISK OF DEATH ASSESSMENT IN PATIENTS SUFFERING FROM HEART FAILURE USING REGRESSION ANALYSIS TECHNIQUES

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Abstract:

Heart failure is one of the most life-threatening diseases of the modern era, with some of the highest global mortality and morbidity rates. Due to the severity of the disease, there is a need for long-term outcome prediction. One emerging approach for predicting the probability of patient death is MAGGIC Risk Calculator for Heart Failure. This calculator uses patient data to predict disease outcomes in the next 3-5 years, such as blood pressure, age, sodium concentration, heart rate, and presence of chronic obstructive pulmonary disease. In our study, we created several regression models in order to predict the magic score without using standard parameters. We utilised heart failure dataset consisting of physical examination remarks, blood biomarkers, EKG and ultrasound findings. Regression analysis was conducted using various methods, including polynomial regression, support vector regression and random forest regression. The best results in terms of error minimization were achieved using the random forest regression, which had a root mean square error value of 6.37. Considering that magic score ranges from 0 to 91 and risk brackets fluctuate every 4-5 points, this result enables a highly precise assessment of the risk of death in the next 3 to 5 years.

Keywords: risk prediction, early diagnosis, regression analysis, heart failure, machine learning.

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PREDICTION OF CONTROLLED DRUG RELEASE FROM INTRAOCULAR LENS USING A GENETIC ALGORITHM

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Abstract:

Cataracts, an opacification of the crystalline lens, are the leading cause of blindness worldwide, affecting about 25% of individuals over 65 and resulting in significant vision impairment. Surgery is the primary treatment, but complications such as posterior capsule opacification can arise, especially in children, necessitating the use of intraocular lenses (IOLs) to restore vision. The intraocular lens was designed using SolidWorks® Premium 2022, ensuring its dimensions matched those found in literature. A master model was created and saved in STL format, followed by the preparation for 3D printing using Chitubox software, which defined essential printing parameters. The lens was fabricated using PDMS, with a controlled curing process in a vacuum chamber and an oven to enhance its mechanical properties and optical transparency. IOL was impregnated with hydrophobic solutions of chloramphenicol in concentration of 10 mg/ml. Spectrophotometry was used to monitor drug release over time at the wavelength at which chloramphenicol shows absorption. Based on measured concentration, we used the Genetic Algorithm (GA) method for creating a computation model for in silico testing. Based on these results, we can conclude that the GA method shows excellent potential for accurate estimation. Its performance in modeling the current dataset indicates strong predictive capabilities. Therefore, it can be considered a useful tool for estimating drug release at other concentrations as well.

Keywords: intraocular lens, 3D printing, PDMS, chloramphenicol, genetic algorithm.



RANDOM-FOREST RISK CLASSIFICATION IN HYPERTROPHIC CARDIOMYOPATHY PATIENTS

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Abstract:

Machine learning (ML) techniques offer new insights into the molecular basis of hypertrophic cardiomyopathy (HCM). In this study we applied supervised and unsupervised ML to integrate biological, genetic and clinical variables in HCM patients, aiming (i) to identify the strongest contributors to disease progression and risk and (ii) to build a predictive model for early detection of high-risk individuals.

Expression profiles of 15 apoptosis-, redox- and pathogenesis-related genes (e.g., CASP3, CASP8, BAX, BCL2, HIF1A, MYH7, MYBPC3) were obtained from whole blood samples in 93 HCM patients and binned into three categories (up-, down- and non-expressed). For risk stratification we first trained a k-nearest neighbors (KNN) classifier and a Random Forest ensemble on genetic features alone (class 0 = low risk; class 1 = high risk). The performance was modest, confirming that isolated transcriptomic signals are insufficient for a reliable prediction.

When clinical parameters (NYHA class, NT-proBNP, LVOT gradient, septal thickness, etc.) were added, the overall accuracy improved markedly; after optimizing gene-expression inputs by value grouping, the Random Forest achieved 92 % accuracy. Feature-importance analysis placed BCL2 expression and NT-proBNP among the top contributors, underscoring the benefit of combining molecular and routine clinical data.

These findings demonstrate that careful preprocessing of gene-expression data and multimodal feature integration are critical for robust ML-based risk assessment in HCM. Future work should expand patient groups and refine data-optimization workflows to further enhance predictive precision and facilitate deployment of individualized treatment approaches.

Keywords: random forest, cardiomyopathy, machine learning, gene expression, clinical parameters.



EXPLAINABLE AI FOR CONTINUOUS GLUCOSE MONITORING DATA

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Abstract:

Continuous Glucose Monitoring (CGM) devices generate high-resolution data that can be leveraged to improve diabetes management through predictive modeling. However, the clinical integration of such models is hindered by the lack of interpretability. In this study, we present a machine learning framework that combines predictive modeling with explainable AI (XAI) techniques to forecast blood glucose levels and provide human-understandable insights. Using timestamped CGM data collected from the FreeStyle Libre 3 sensor during gestational diabetes, we preprocess and engineer features based on recent glucose trends. A Random Forest regression model is trained on these features, achieving a mean absolute error (MAE) of 0.11 mmol/L. To enhance model transparency, we apply Local Interpretable Model-Agnostic Explanations (LIME) and SHapley Additive exPlanations (SHAP), both of which identify the most influential past glucose readings for each prediction. The results demonstrate that recent glucose values are consistently the strongest contributors to future estimates, aligning with clinical expectations. Visual explanations from LIME and SHAP provide both local and global insights, increasing trust in the model's decisions and supporting its potential for use in personalized care. This work bridges the gap between predictive performance and interpretability, offering a step toward more transparent and actionable AI solutions in glucose monitoring.

Keywords: continuous glucose monitoring, CGM data, explainable artificial intelligence, model interpretability.



ENHANCING ROBOTIC GRASPING WITH ATTENTION MECHANISM AND SLAM-BASED IN THE DYNAMIC GRASPING SCENARIO

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Abstract:

With the increasing application of robots, the requirements for vision-based robotic arm grasping have risen accordingly. In open and unstructured grasping scenarios, traditional Simultaneous Localization and Mapping (SLAM) systems demonstrate a certain level of stability in static environments. However, in dynamic grasping environments with interference from moving objects and people, mapping accuracy significantly decreases, which severely impacts localization precision and mapping performance. This paper proposes an enhanced visual SLAM system designed for robotic arm grasping tasks in dynamic environments, providing robust environmental mapping in such scenarios. The system is based on the DynaSLAM algorithm, incorporating the Convolutional Block Attention Module (CBAM) attention mechanism into its Oriented Fast and Rotated Brief (ORB) feature extractor to enhance the feature extraction process. This aims to improve the robustness and accuracy of feature extraction, enabling the system to achieve more reliable target recognition and tracking in dynamic scenes. Experimental results demonstrate that the proposed system achieves higher accuracy in terms of Absolute Trajectory Error (ATE) and Relative Position Error (RPE) compared to previous methods, validating the effectiveness of the CBAM attention mechanism in dynamic detection and SLAM.

Keywords: visual grasping, visual SLAM, CBAM, ORB feature extraction.



MULTIPURPOSE WEARABLE SENSORY DEVICE FOR HEART FAILURE DIAGNOSIS AND BIOMARKER MEASUREMENT

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Abstract:

Heart failure remains one of the most prevalent and clinically significant medical conditions in the world, majorly affecting patients' life expectancy and quality. With its progressive and discreet nature in early stages, heart failure is often challenging to detect until symptoms become severe enough to require hospitalization. Traditional diagnostic methods often require expensive equipment, trained personnel, and hospital visits, leading to delays in detection and treatment. Additionally, the growing prevalence of cardiovascular diseases demands portable, user-friendly, and cost-effective solutions that can facilitate widespread screening. In order to address these challenges, we propose a multi-purpose sensory device for heart failure diagnosis, integrating electrocardiogram (ECG), photoplethysmography (PPG), accelerometry (ACC), oxygen saturation (SpO₂), and bioimpedance (BioZ) measurements into a single, compact device. Designed for ease of use, the device connects to a laptop or smartphone, allowing medically untrained individuals to perform self-assessments with minimal guidance and gather important data for further medical visits. The collected physiological data is processed in real-time by a signal processing algorithm. By combining multi-modal sensing with machine learning, our proposed device enhances diagnostic accuracy while reducing dependency on specialized medical staff for measurements. Its portability and automated analysis lay a foundation for future development and implementation in the fields of remote monitoring, home healthcare, and telemedicine, potentially improving early intervention and reducing healthcare costs.

Keywords: heart failure, ECG, PPG, bioimpedance, portable medical device, biomedical signal processing.

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