Abstract Book

7th Annual International Symposium on the Future of STEAM (Sciences, Technology, Engineering, Arts and Mathematics) Education
10-13 July 2023 Athens, Greece

Edited by
Bala Maheswaran & Olga Gkounta

2023

Abstracts
7th Annual International
Symposium on the Future of
STEAM (Sciences, Technology,
Engineering, Arts and
Mathematics) Education

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(In Alphabetical Order by Author's Family Name)

Preface

This book includes the abstracts of all the papers presented at the *7th Annual International Symposium on the Future of STEAM (Sciences, Technology, Engineering, Arts and Mathematics) Education* (10-13 July 2023), organized by the Athens Institute for Education and Research (ATINER).

A full conference program can be found before the relevant abstracts. In accordance with ATINER's Publication Policy, the papers presented during this conference will be considered for inclusion in one of ATINER's many publications only after a blind peer review process.

The purpose of this abstract book is to provide members of ATINER and other academics around the world with a resource through which they can discover colleagues and additional research relevant to their own work. This purpose is in congruence with the overall mission of the association. ATINER was established in 1995 as an independent academic organization with the mission to become a forum where academics and researchers from all over the world can meet to exchange ideas on their research and consider the future developments of their fields of study.

To facilitate the communication, a new references section includes all the abstract books published as part of this conference (Table 1). I invite the readers to access these abstract books –these are available for free– and compare how the themes of the conference have evolved over the years. According to ATINER's mission, the presenters in these conferences are coming from many different countries, presenting various topics.

Table 1. *Publication of Books of Abtracts of Proceedings, 2017-2023*

Year	Papers	Countries	References
2023	44	22	Maheswaran and Gkounta (2023)
2022	35	24	Maheswaran and Gkounta (2022)
2021	19	12	Papanikos (2021)
2020	31	10	Papanikos (2020)
2019	38	20	Papanikos (2019)
2018	31	16	Papanikos (2018)
2017	31	15	Papanikos (2017)

It is our hope that through ATINER's conferences and publications, Athens will become a place where academics and researchers from all over the world can regularly meet to discuss the developments of their disciplines and present their work. Since 1995, ATINER has organized

more than 400 international conferences and has published over 200 books. Academically, the institute is organized into 6 divisions and 37 units. Each unit organizes at least one annual conference and undertakes various small and large research projects.

For each of these events, the involvement of multiple parties is crucial. I would like to thank all the participants, the members of the organizing and academic committees, and most importantly the administration staff of ATINER for putting this symposium and its subsequent publications together.

Gregory T. Papanikos
President

Editors' Note

These abstracts provide a vital means to the dissemination of scholarly inquiry in the area of STEAM Education. The breadth and depth of research approaches and topics represented in this book underscores the diversity of the conference.

ATINER's mission is to bring together academics from all corners of the world in order to engage with each other, brainstorm, exchange ideas, be inspired by one another, and once they are back in their institutions and countries to implement what they have acquired. The 7th Annual International Symposium on the Future of STEAM (Sciences, Technology, Engineering, Arts and Mathematics) Education accomplished this goal by bringing together academics and scholars from 22 different countries (Albania, Algeria, Austria, Bosnia and Herzegovina, Bulgaria, Canada, Chile, China, Egypt, Estonia, Hungary, Ireland, Israel, Japan, Lebanon, Mexico, Poland, Portugal, Romania, Serbia, Switzerland, USA), which brought in the conference the perspectives of many different country approaches and realities in the field.

Publishing this book can help that spirit of engaged scholarship continue into the future. With our joint efforts, the next editions of this conference will be even better. We hope that this abstract book as a whole will be both of interest and of value to the reading audience.

Bala Maheswaran & Olga Gkounta
Editors

7th Annual International Symposium on the Future of STEAM (Sciences, Technology, Engineering, Arts and Mathematics) Education, 10-13 July 2023, Athens, Greece

Organizing & Scientific Committee

All ATINER's conferences are organized by the <u>Academic Council</u>. This conference has been organized with the assistance of the following academic members of ATINER, who contributed by reviewing the submitted abstracts and papers.

1. Gregory T. Papanikos, President, ATINER & Honorary Professor, University of Stirling, U.K.
2. Bala Maheswaran, Director, Engineering & Architecture Division, ATINER & Professor, Northeastern University, USA.

FINAL CONFERENCE PROGRAM

7th Annual International Symposium on the Future of STEAM (Sciences, Technology, Engineering, Arts and Mathematics) Education, 10-13 July 2023, Athens, Greece

PROGRAM

08.30-09.15
Registration

09:15-10:00
Opening and Welcoming Remarks:
o **Gregory T. Papanikos**, President, ATINER.

10:00-11:30 Session 1

Session 1a	Session 1b
Moderator: Laszlo Kollar, Professor, University of Pécs, Hungary.	**Moderator: Adrian Ionescu**, Professor, Wagner College, USA.
1. **Haiduke Sarafian**, Professor, Pennsylvania State University, USA. *Title: Impact of the Evolution of a Curved Charge Distribution on Electric Field.* 2. **Efrain J Ferrer**, Professor, The University of Texas at Rio Grande Valley. **Vivian Incera**, Dean, College of Sciences, University of Texas Rio Grande Valley, USA & Member of the Board of Directors of the American Physical Society (APS). *Title: Anomalous Electromagnetism in Quark Matter at Intermediate Baryonic Densities.* 3. **Masoud Ghezelbash**, Professor, University of Saskatchewan, Canada. *Title: Black Holes in f(T) Gravity.* 4. **Itzhak Orion**, Professor, Ben Gurion University of the Negev, Israel. **Michael Bettan**, Researcher, Soreq NRC, Israel. *Title: Neutrino-Antineutrino Production In Gamma Ray e− e+ Pair Production: Monte Carlo Viability Study.*	1. **Maria Ryan**, Assistant Professor, Mary Immaculate College, Ireland. *Title: Should I Stay or Should I Go? – Insights into the Impact of Mathematics Anxiety on Undergraduate Students' Engagement with Service Mathematics.* 2. **Andres Tremante**, Professor, Florida International University, USA. *Title: A Methodological Proposal to Assess the Feasibility of Implementing Collaborative Robots in Developing Countries for Power Generation Cycles.*
Discussion	**Discussion**

11:30-13:30 Session 2

Session 2a	Session 2b
Moderator: Haiduke Sarafian, Professor, Pennsylvania State University, USA.	**Moderator: Bala Maheswaran**, Director, Engineering & Architecture Division, ATINER & Professor, Northeastern University, USA.
1. **Janez Cerkovnik**, Professor, University of Ljubljana, Slovenia.	1. **Adrian Ionescu**, Professor, Wagner College, USA.

Title: Synthesis and Reactivity of (PCP) Palladium and Platinum Hydroxy pincer Complexes Towards CO_2.

2. **Laszlo Kollar**, Professor, University of Pécs, Hungary.
Title: Unexpected Selectivities in Carboylation Reactions of a Cavitand Skeleton.
3. **Evangelia Kotsikorou**, Associate Professor, The University of Texas Rio Grande Valley, USA.
Title: An Endocrine Disrupting Chemical can Regulate Allosterically the Androgen Receptor via Binding in the BF3 Surface Binding Site.
4. **Milan Selakovic**, PhD Student, University of Belgrade, Serbia.
Branka Ivkovic, Associate Professor, University of Belgrade, Serbia.
Aleksandar Ivkovic, Lecturer, Academy of Technical Vocational Studies, Serbia.
Mara Aleksic, Full Professor, University of Belgrade, Serbia.
Title: Oxidation and Reduction Processes of Ivermectin.
5. **Ivar Zekker**, Research Fellow, University of Tartu, Estonia.
Title: Nitrogen Removal and its Possible Reuse as Plant Fertilizer.

Discussion

Title: Computer Software for New Runge-Kutta Methods.

2. **Marijana Despotović-Zrakić**, Professor, University of Belgrade, Serbia.
Title: Application of Virtual Reality in Fashion Design.
3. **Gonzalo Dominguez Almaraz**, Professor, University of Michoacan, Mexico.
Title: Ultrasonic Fatigue Tests in the Maraging 300 Steel.
4. **Thomas Fehlmann**, Senior Researcher, Euro Project Office, Switzerland.
Title: Management of Cyber-physical Products.
5. **Mihail Mateev**, Assistant Professor, University of Architecture, Civil Engineering and Geodesy, Bulgaria.
Title: Design and Implementation of Cognitive Digital Twins with Generative AI and ChatGPT.

Discussion

13:30-15:30 Session 3 – A Round-Table Discussion on The Future of Sciences and Engineering Education
Moderator: Gregory T. Papanikos, President, ATINER.

1. **Vivian Incera**, Dean, College of Sciences, University of Texas Rio Grande Valley, USA & Member of the Board of Directors of the American Physical Society (APS).
Title: Challenges and Opportunities of STEM Education in the 21st Century.
2. **Evangelos J. Sapountzakis**, Professor & Vice Rector of Finance, Planning and Development, National Technical University of Athens (NTUA), Greece.
Title: Hybrid Learning: An Integrative Approach Merging Theoretical Background and Market-driven Orientation.
3. **Gonzalo M. Dominguez Almaraz**, Professor, University of Michoacan (UMSNH), Mexico.
Title: Financial Support in Education.
4. **Bala Maheswaran**, Professor, Northeastern University, USA.
Title: Sustainability in Engineering Education.
5. **Duncan Carlsmith**, Professor, University of Wisconsin-Madison, USA.
Title: The Future of Physics and Physics Education.
6. **Masoud Ghezelbash**, Professor University of Saskatchewan, Canada.
Title: Importance of New Discoveries in Science Education.
7. **Adrian Ionescu**, Professor, Wagner College, USA.
Title: Trends in the Computer Science Education and Curriculum in the US Universities.

Discussants
1. **Glen Bright**, Dean & Professor, School of Engineering, University of KwaZulu-Natal, South

Africa.

2. **Mounir Mabsout**, Professor and Chair, Department of Civil and Environmental Engineering (CEE), American University of Beirut, Lebanon.
3. **Nadhir Al-Ansari**, Professor, Water Resources Engineering, Department of Civil, Environmental and Natural Resources Engineering, Lulea University of Technology, Sweden.
4. **Theodore Trafalis**, Professor of Industrial and Systems Engineering & Director, Optimization & Intelligent Systems Laboratory, The University of Oklahoma, USA.
5. **Ampalavanar Nanthakumar**, Professor, State University of New York (Oswego), USA.

15:30-16:30 Discussion + Lunch

16:30-18:00 Session 4
Moderator: Masoud Ghezelbash, Professor University of Saskatchewan, Canada.

1. **Catherine Amelink**, Associate Vice Provost and Affiliate Faculty Department of Engineering, Education and School of Education, USA.
   Todd Nicewonger, Professor, Virginia Tech, USA.
   Title: Organizational Challenges Implementing STEAM Education: Global Themes in Higher Education.
2. **Istvan Daniel Sanda**, Associate Professor, Obuda University, Hungary.
   Ildiko Holik, Associate Professor, Obuda University, Hungary.
   Gyorgy Molnar, Associate Professor, Dean, Obuda University, Hungary.
   Title: The Necessity of Developing Soft Skills in STEM Areas in Higher Education, with Special Focus on Engineering Training.
3. **Aleksa Miletic**, Teaching Associate, University of Belgrade, Serbia.
   Tamara Naumovic, Teaching Assistant, Researcher, University of Belgrade, Serbia.
   Aleksandra Labus, Full Professor, Researcher, University of Belgrade, Serbia.
   Petar Lukovac, Teaching Associate, Researcher, University of Belgrade, Serbia.
   Danijela Stojanović, Researcher, University of Belgrade, Serbia.
   Title: A Data Streaming Architecture for Air Quality Monitoring in Smart Cities.
4. **Gian Carlo Montanari**, Researcher, Florida State University, USA.
   Muhammad Shafiq, Researcher, Florida State University, USA.
   Roger McGinnis, Director Center for Advanced Power Systems, Florida State University, USA.
   Title: Coming Challenges in Electrified Transportation and Impact on Electrical Insulation Reliability: Ships and Aircrafts.

Discussion

18:00-19:30 Session 5
Moderator: Ms. Olga Gkounta, Researcher, ATINER.

1. **Michihiro Sakai**, Professor, Kurume College, Japan.
   Hiroshi Miki, Professor, Kurume College, Japan.
   Shunsuke Nakamura, Professor, Kurume College, Japan.
   Title: Early STEAM Education Practice: Application of Graph Theory through Teaching Assistants.
2. **Mounir Mabsout**, Professor and Chair, Department of Civil and Environmental Engineering, American University of Beirut, Lebanon.
   Title: Higher Learning and the Community: Be Engaged, Stay Relevant…
3. **Gohar Marikyan**, Professor, Empire State University of SUNY, USA.
   Title: Teaching Mathematics with Visuals.
4. **Yawo Ezunkpe**, Assistant Professor, San Jose State University, USA.
   Justin Williams, Master Student, San Jose State University, USA.
   Title: Design of an efficient Turbofan Engine with Afterburners.

Discussion

20:30-22:30
Athenian Early Evening Symposium (includes in order of appearance: continuous academic discussions, dinner, wine/water, music and dance)

Tuesday 18 July 2023

07:30-10:30 Session 6
Old and New-An Educational Urban Walk

The urban walk ticket is not included as part of your registration fee. It includes transportation costs and the cost to enter the Parthenon and the other monuments on the Acropolis Hill. The urban walk tour includes the broader area of Athens. Among other sites, it includes: Zappion, Syntagma Square, Temple of Olympian Zeus, Ancient Roman Agora and on Acropolis Hill: the Propylaea, the Temple of Athena Nike, the Erechtheion, and the Parthenon. The program of the tour may be adjusted, if there is a need beyond our control. This is a private event organized by ATINER exclusively for the conference participants.

11:30-13:30 Session 7
Moderator: Evangelia Kotsikorou, Associate Professor, The University of Texas Rio Grande Valley, USA.

1. **Edgar Pastene**, Professor, University of the Bío Bío, Chile.
   Title: Non-Natural Theaflavins Synthetized from Avocado Peels Polyphenols as Antioxidants and Anti-Bioilm-Agents against Pathogen and Nonpathogens Bacteria.
2. **Relja Suručić**, Assistant Professor, University of Banja Luka, Bosnia and Herzegovina.
   Title: Evaluating the Potential of Punicalin as an Inhibitor of SARS-CoV-2 Spike Protein Interaction with Neuropilin-1 Receptor- In Vitro Study.
3. **Rui Alvites**, Researcher, ICETA UP, Portugal.
   Title: Echographic Landmarks in the Approach to the Common Peroneal Nerve in a Sheep Model Application in Peripheral Nerve Regeneration.
4. **Shaymaa Yahya**, Professor, National Research Centre, Egypt.
   Title: Targeting Cancer Related Genes and Mirnas Using Gene Editing Technology.
5. **Felix Panis**, Researcher, University of Vienna, Austria.
   Title: The Involvement of Tyrosinase Enzymes in the Storage of Organic Carbon in Wetland Ecosystems in the Face of Climate Change.

Discussion

13:30-15:00 Session 8
Moderator: Itzhak Orion, Professor, Ben Gurion University of the Negev, Israel.

1. **Duncan Carlsmith**, Professor, University of Wisconsin-Madison, USA.
   Title: A Computational Curriculum for 1st-year University Physics Students with MATLAB.
2. **Adam Rutkowski**, Associate Professor, University of Gdansk, Poland.
   Title: Necessary and Sufficient Condition of Separability for D-Symmetric Diagonal States.
3. **Ati Moncef**, Associate Professor, University of Ahmed Ben Bella, Algeria.
   Title: Phontons S-value Calculation in Pediatric Nuclear Medicine for Dose Estimation.
4. **Alejandro Ramirez-Rojas**, Researcher, Metropolitan Autonomous University, Mexico.
   Lucía Rebeca Moreno-Torres, PhD Student, Metropolitan Autonomous University, Mexico.
   Title: Behaviour Study of the Entropy Defined in the Natural Time Domain to Characterize of Seismic Activity Prior to the Occurrence of Intense Earthquakes from a Magnitude Time Series Obtained from Seismic Catalogues.
5. **Maciej Zams**, PhD Student, Warsaw University of Technology, Poland.
   Paweł Pieńczuk, PhD Student, Warsaw University of Technology, Poland.
   Sergiusz Łuczak, Associate Professor, Warsaw University of Technology, Poland.

> **Title:** *Novel Applications of MEMS Accelerometers.*
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> **Discussion**

15:00-16:00 Discussion + Lunch

16:00-17:30 Session 9 – A Special Session on Educational Justice
Moderator: Chevelle Hall, Associate Professor, Virginia State University, USA.

1. **Leslie Crocker**, Professor, Virginia State University, USA.
   Title: Sport Management Careers.
2. **Aaron Livingston**, Graduate Coordinator – Sport Administration, Grambling State University, USA.
   Title: The Impact of Diversity in Sport Management Education and Student-Athletes.
3. **Linda Taylor**, PhD Student, Virginia State University, USA.
   Title: Follow the Yellow Brick Road to Presidency.
4. **Marlyn Pierce**, Assessment Coordinator, Virginia State University, USA.
   Title: Strategies for Social-Emotional Learning in Preparation for Transitioning Eighth-Grade Middle into Nineth-Grade High School.

Discussion

17:30-19:00 Session 10
Moderator: Ms. Olga Gkounta, Researcher, ATINER.

1. **Ying-Qiu Gu**, Senior Engineer, Fudan University, China.
   Title: Hypercomplex Numbers and the Origin of Celestial Magnetic Fields.
2. **Rudina Osmanaj**, Lecturer, University of Tirana, Albania.
   Title: Real and Virtual Physics Laboratories in High Schools, Case Study Albania.
3. **Saftoiu Golea**, PhD Student, University of Bucharest, Romania.
   Title: Characteristics of Low Clouds over Bucharest and Cluj-Napoca, Romania.
4. **Nileena Velappan**, Research Technologist, Los Alamos National Laboratory, USA.
   Title: Strategies for Antibody Selection to Non-Traditional Targets: Toxins, Post-Translational Modifications and Lipids.
5. **Cristina Bernardes Monteiro**, Researcher, University of Coimbra, Portugal.
   Title: The PISA Concept: Photon Induced Scintillation Amplifier, for Low Background Dark Matter Detectors.

Discussion

19:00-20:30
Ancient Athenian Dinner (includes in order of appearance: continuous academic discussions, dinner with recipes from ancient Athens, wine/water)

Wednesday 19 July 2023
An Educational Visit to Selected Islands
or
Mycenae Visit

Thursday 20 July 2023
Visiting the Oracle of Delphi

Friday 21 July 2023
Visiting the Ancient Corinth and Cape Sounio

Rui Alvites
Researcher, ICETA UP, Portugal

Echographic Landmarks in the Approach to the Common Peroneal Nerve in a Sheep Model Application in Peripheral Nerve Regeneration

Peripheral nerve injuries are a common occurrence in humans and animals with severe physiological and functional consequences. Despite recent advances in promoting peripheral nerve regeneration after injury, it has not yet been possible to establish an alternative treatment to supplant traditional surgical methods as gold-standard approaches.

Previously, our research group has developed several new therapeutic combinations based on the use of innovative biomaterials and cell-based therapies, which have demonstrated good results when applied in the rat model. The use of a more complex animal model such as the sheep, in a translational and scale-up perspective before application in real clinical scenarios in Veterinary and Human Medicine, is still limited by several challenges. In the past, our group developed a new protocol for the induction of lesions in the common peroneal nerve of a sheep model and a set of functional assessment techniques to monitor nerve recovery after injury. In this work, it was possible to establish standardized protocols for the induction of neurotmesis injuries in the peroneal tibial nerve, to test the application of therapeutic options such as tube-guides and end-to-end sutures, to develop functional assessment methods such as a withdrawal reflex, proprioceptive assessment and gait characterization, and also to obtain default stereological values for the intervened nerves and for healthy ones, which can now be used as control values in new assays.

Nevertheless, some unanswered questions and doubts remain, and in order to maximize the evaluations to be carried out to quantify the level of functional recovery of the animals that underwent surgery and the structural recovery of the nerves subjected to injury, the development and standardization of new diagnostic techniques is essential. The dimensions of the ovine model allow the application of diagnostic techniques closer to those used in animals and humans, such as the evaluation of nerve conductivity and ultrasonography, techniques whose use in these fields of research are still not systematic.

In this work, an echographic evaluation of ten sheep's sciatic nerves and its main branches, the common peroneal nerve, and the tibial nerve, was carried out in order to establish the echographic appearance of these structures in non-intervened nerves. Likewise, the cranial tibial

muscle, the effector muscle of the common peroneal nerve, was evaluated in terms of its echographic characteristics and dimensions. Subsequently, the registered features may be used as control values in comparative studies with peroneal common nerves subjected to controlled injuries and with cranial tibial muscles that have suffered a consequent atrophy due to denervation, maximizing the number of parameters to be evaluated in the intervened animals and ensuring a better determination of the performance of the applied therapeutic options.

Catherine Amelink
Associate Vice Provost and Affiliate Faculty Department of Engineering, Education and School of Education, USA
&
Todd Nicewonger
Professor, Virginia Tech, USA

Organizational Challenges Implementing STEAM Education: Global Themes in Higher Education

In order to address complex problems facing society institutions of higher education are creating new programs that bring together sciences, technology, engineering, arts and mathematics (STEAM) so that students can understand and apply various frameworks to address socio-technical challenges. These approaches are transdisciplinary in nature suggesting multiple disciplines working collaboratively in the discovery and learning process, integrating knowledge and approaches so that students make connections across concepts and experiences, and direct community engagement in the identification of problems and solutions. While literature discusses approaches to STEAM Education and the efficacy of transdisciplinary approaches, fewer studies have examined the organizational infrastructure that is needed to successfully implement curricular reform.

This paper will share findings that have been gathered through collaborative work with individuals engaged in implementing transdisciplinary programs in higher education. Perspectives include faculty, administrators, and policy makers from various higher education organizations in Australia, the United States, Europe, and Africa. While individual programs vary in their approach to curriculum reform and range from regional, institutional, program, and individual course level key themes emerged using a case study approach to examine factors that facilitate success and challenged sustainability. The case study approach methodology used in-depth documentation of 11 distinct programs and analysis of written participant reflection on their lived experiences. Factors underscore the importance of faculty led communities of practice, financial support, invested institutional leadership, measuring student outcomes, and organizational infrastructure that need to be in place to support long-term success in implementing transdisciplinary educational programs. Results of this work highlight compelling reasons for institutions to continue to exchange lessons learned through international forums so that

innovation in STEAM education at scale can move forward informed by data and best practices.

Cristina Bernardes Monteiro
Researcher, University of Coimbra, Portugal

The PISA Concept: Photon Induced Scintillation Amplifier, for Low Background Dark Matter Detectors

This abstract describes the challenges in detecting dark matter (DM) particles and proposes a new concept called the Photon Induced Scintillation Amplifier (PISA) for photoelectron signal amplification in gas photomultipliers (GPMs). The current generation of noble liquid DM detectors is limited by the radioactivity from the detector materials, mostly from the especially radio-clean photomultiplier tubes (PMTs), contributing to the background at ~80% level. To effectively discriminate de recoiling events from the background, it is crucial to have the highest possible photosensor gain and sensitivity to single photon detection, being the main reasons to use PMTs. However, PMTs have less than full active photocathode area, ~70%, and they are costly, which limits their application. Therefore, a new detector concept is proposed that is more affordable and allows for significant improvements in detection sensitivity and background rejection. The PISA concept employs a true photon-multiplier, where the secondary scintillation produced in the charge avalanches inside the holes of the micropattern electron multiplier is read out by suitable photosensors like SiPMs. This will allow for a significant increase in detection sensitivity and background rejection, as well as for a breakthrough in radiopurity, as the kapton foils, the SiPMs, the GPM fused silica window, and the metal case can be obtained with reduced radioactivity levels. The PISA is cost-effective, and the SiPMs can be distributed in a 2D array with a pitch suitable for the needed position resolution. This presentation will show the PISA concept and the experimental results obtained for a first prototype equipped with a GEM or a MHSP in terms of the total number of scintillation photons produced in the charge avalanches. The PISA is a promising new concept that can be used in the search for DM particles and could lead to ground-breaking consequences for our knowledge of the foundations of particle physics and the nature of the Dark Universe.

Duncan Carlsmith
Professor, University of Wisconsin-Madison, USA

A Computational Curriculum for 1st-Year University Physics Students with MATLAB

It is widely recognized that 21st-century physics undergraduates require exposure to scientific computing. I describe an approach to infusing computation in an accelerated 2-semester introductory sequence for 1st-year physics students using interactive MATLAB Live Scripts as a foundation for threading computation throughout the undergraduate physics curriculum. Live Script tutorials illustrate increasingly sophisticated computational methods for data analysis and simulation often applied to public data from online sources such as LIGO, CERN, and NASA missions. Additional Live scripts are templates for students to analyze their own data in both traditional and non-traditional hands-on laboratory experiments. This integrated computational science thread augments a traditional survey of classical physics, and no prior coding exposure is required. While basic syntax and coding structures are developed and illustrated, the emphasis is on what computational methods enable, and on exploring science and motivating intermediate-level mathematics, rather than on building coding skills. Ultimately, students organically produce their own Live Scripts describing their reasoning, commenting their code, and presenting and interpreting their results. The Live Script approach thusly facilitates the development of computational thinking and communication skills while minimizing time-consuming code writing.

This interactive script approach could be implemented with Python. The affordances of MATLAB include extensive web-based documentation, downloadable examples, cloud computing, a mobile phone app for accessing mobile phone sensors, as well as freely available courses and codes, both open and supplied by MathWorks, as well as Python interoperability. Students begin with MathWorks "MATLAB on-ramp" online course, work through an introductory tutorial, and are already well on their way. The tutorial and lab exercises are deployed through the CANVAS learning management system. The Live Scripts are self-documenting, and extensively hyperlinked to MATLAB documentation and to external resources such as publications and fun videos. The tutorial scripts are automatically assessed based on a student's ability to respond to embedded "Try this" suggestions. Student-generated Live Scripts are evaluated via CANVAS Speed Grader based on such products as pub-ready plots with

superposed models and extracted parameter estimates. Assistance from fellow students and instructors is provided through a PIAZZA online forum. The instructors should be familiar with or learn MATLAB syntax to assist students but there is minimal additional teaching and assessment burden.

Janez Cerkovnik
Professor, University of Ljubljana, Slovenia

Synthesis and Reactivity of (PCP) Palladium and Platinum Hydroxy Pincer Complexes towards CO_2

{2,6-Bis[(di-*tert*-butylphosphino)methyl]phenyl}palladium and platinum hydroxides, ^{tBu}(PCP)M−OH (M = Pd, Pt), react with CO_2 even at low temperatures within minutes to form the bicarbonate complex ^{tBu}(PCP)M−O$_2$COH. This reactivity is orders of magnitude higher than the corresponding (with the same ligand system) insertion into a Pd−C bond, which requires 48 hours of heating. For comparison, the palladium hydroxy pincer complex also reacts with CO to form a mononuclear hydroxycarbonyl complex, ^{tBu}(PCP)M−COOH, which decomposes at higher temperatures with loss of CO_2 to form a hydride complex, ^{tBu}(PCP)M−H. This complex further reacts with CO_2 to form the formate complex, ^{tBu}(PCP)M−OCHO, in a normal insertion reaction. Interestingly, both hydroxy pincer complexes react very similarly with carbonyl compounds such as acetone and acetylacetone. The reaction of the carbonyl compounds and the formation of the ^{tBu}(PCP)M−carbonyl complexes depend critically on the presence of water molecules, which will be discussed. The ^{tBu}(PCP)M−OH complexes was also tested as catalysts in a Michael condensation reaction of acetylacetone with β-nitrostyrenes.

The pincer hydroxides were prepared from the corresponding chloride complexes via the nitrate complexes. All complexes were isolated and fully characterized by ^{31}P and ^{1}H NMR spectroscopy, elemental analysis and X-ray crystallography. There seems to be a general reactivity trend for ^{tBu}(PCP)M−OH complexes when it comes to insertions. Since they have only one open coordination site, they react preferentially with substrates that can be directly electrophilically attacked without precoordination, such as CO_2.

Leslie Crocker
Professor, Virginia State University, USA

Sport Management Careers

NOT AVAILABLE

Marijana Despotović-Zrakić
Professor, University of Belgrade, Serbia
Katarina Šikman
Graduate Student, University of Belgrade, Serbia
Marija Vrljanac
Graduate Student, University of Belgrade, Serbia
Milica Simić
Teaching Associate, University of Belgrade, Serbia
&
Marko Suvajdžić
Director, UF Blockchain Lab, University of Florida, USA

Application of Virtual Reality in Fashion Design

The application of immersive technologies is slowly taking its place in the everyday life of society, but also in various industrial branches. It is noticeable that there is an increasing application of virtual reality in the fashion industry. The greatest attention is paid to its application in fashion design, making the old process of creating designs on paper to be replaced by software for developing 3D fashion designs. The goal of this article is to present one approach to designing a 3D model of a fashion design object, using techniques and tools for 3D modelling, as well as a business model that relies on the proposed virtual design. The approach is based on the application of non-fungible tokens and blockchain technology.

Gonzalo Dominguez Almaraz
Professor, University of Michoacan, Mexico

Ultrasonic Fatigue Tests in the Maraging 300 Steel

Ultrasonic fatigue tests were performed on the maraging 300 steel under five conditions: 1) as received from supplier, 2) after aging heat treatment at 490° C for 6 hours, 3) under imposed temperature of 200° C during testing, using a self-designed and constructed induction heating machine, 4) specimens loaded at 293 MPa without failure, and 5) specimens tested after pre-corrosion process. The ultrasonic fatigue endurance of the five modalities were plotted and discussed in regard the crack initiation inclusion, the heat treatment, the pre-corrosion process and the testing conditions. Crack initiation and propagation under this fatigue testing modality was analyzed; revealing that ultrasonic fatigue endurance is related to internal TiN-inclusions and its parameters of size, shape and orientation. Numerical simulations were carried out to investigate the stress concentration of an ellipsoidal void of 150 □m (longer radius), and a TiN ellipsoidal inclusion of same dimensions. In addition, SEM (Scanning Electron Microscope) analysis was carried out on the fracture surfaces to determine the crack initiation and propagation zones, together with the evaluation of the number of cycles in the crack propagation stable zone, for specimens of type 3, with crack initiation at the surface.

Yawo Ezunkpe
Assistant Professor, San Jose State University, USA
&
Justin Williams
Master Student, San Jose State University, USA

Design of an Efficient Turbofan Engine with Afterburners

In this paper we examine ways to potentially improve the overall efficiency of a turbofan engine with afterburners. A design similar to a turbofan engine used mostly in today's general commercial aviation aircraft was considered and a study was performed on its components individually using GasTurb and MATLAB software packages.

The study revealed that the pressure and the temperature are the two main parameters which affect the overall efficiency of the turbofan engine with afterburners. In addition, the study showed the validation of the analytical results numerically using MATLAB and then visually using GasTurb. Finally, GasTurb was also used to perform the analysis of the 3-D plots that allowed for a complete understanding of how the efficiency of the turbofan engine was affected. As a result, different performance values were found, and showed that a turbofan engine with an afterburner can be made more efficient by increasing the pressure and the temperature in the combustion chambers.

Thomas Fehlmann
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Management of Cyber-physical Products

Cyber-physical products are software-driven systems that use sensors and actuators to interact with the physical world. Contrary to traditional tools under the full control of humans, part or all of the control is driven by software, including artificial intelligence. Examples include autonomous cars, advanced driving assistance systems, smart medical systems. These systems possibly are able to learn from own experiences, or from experiences of connected similar systems. While designing and constructing such products today is feasible with the current state of the art in software and systems engineering, there are many questions open such as liability in case of fault or failure, and consumer's trust.

The first problem domain to address is safety. Actuators might interfere with the physical world and cause damage. Avoiding damage might cause sensible decision-making difficulties, and sometimes the moral principles behind such systems is questioned. Indeed, cyber-physical systems need a value profile that helps them when difficult decisions must be made. The ISO 16355 standard addresses such decisions, but automating them is far from straightforward. Nevertheless, software metrics as defined in the ISO/IEC 19761 standard allow for automating such decisions and should be considered for defining the "moral" of cyber-physical systems.

The next problem area is confidence. In a recent survey, German consumers have expressed less trust in autonomous vehicles than in those guided by humans, although humans can be nervous, confused, angry, or even get sick while driving. The only way of addressing this issue is creating trust by measuring safety and security, and make such measurements available and understandable to consumers. Autonomous Real-time Testing (ART) is a means to do testing in a way similar to humans and certify cyber-physical systems products for safety and security by continuous testing, even while in operations. Trust is created by showing the results of such tests to consumers and customers. Suitable metrics are needed to do that, and the certification authorities need to set standards, allowing competitors to compare their products.

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&
Vivian Incera
Professor, The University of Texas at Rio Grande Valley, USA

Anomalous Electromagnetism in Quark Matter at Intermediate Baryonic Densities

In this talk, the anomalous electromagnetism that can be generated in the spatially inhomogeneous phase of dense quark matter known as the Magnetic Dual Chiral Density Wave (MDCDW) phase will be reviewed. I will discuss several anomalous electromagnetic effects that can take place in this phase at low temperatures and intermediate baryonic densities. I will present the axion electrodynamics characterizing this phase. Then, going beyond mean-field approximation, I will show how linearly polarized electromagnetic waves that penetrate the MDCDW medium mix with the phonon fluctuations to give rise to two hybridized modes of propagation called axion polaritons. I will discuss how the formation of axion polaritons in the MDCDW core of a neutron star can add mass to the star via the Primakoff effect, which eventually can trigger the star collapse under the bombardment of gamma-ray bursts. This mechanism can provide a possible solution to the missing pulsar problem in the galactic center.

Masoud Ghezelbash
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Black Holes in f(T) Gravity

We find the non-extremal rotating charged black holes in f(T) gravity are holographically dual to two different hidden conformal field theories. The two conformal field theories can be merged to find a very general hidden conformal field theory, which is generated by the SL(2,Z) modular group. We also carry out the calculation to the extremal limit of the black holes, and find the corresponding dual quantities. Contrary to the existence of two different dual conformal field theories for the extremal rotating charged black holes in Einstein gravity, we find only one dual theory exists for the extremal rotating charged black holes in f(T) gravity.

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Characteristics of Low Clouds over Bucharest and Cluj-Napoca, Romania

Atmospheric aerosols influence indirectly the climate acting as cloud condensation nuclei and modifying the cloud microphysics, radiative properties and lifetime. The aim of the study is to understand the cloud occurrence frequency and characteristics of low clouds over two sites in Romania (Bucharest and Cluj-Napoca) using satellite data collected from 22 years (2000-2022). We used a statistical cloud classification model based on data on cloud optical depth and cloud top pressure. We also analyzed the annual distribution of types of low clouds (thin, medium and thick). We found the thin clouds appear with a high frequency (58.57%), and are followed by the less frequent medium clouds (35.85%) and thick clouds (5.57%) out of the total number of clouds detected over Bucharest. For Cluj-Napoca, the percentage was 52.38% for thin clouds, 43.63% for medium clouds and only 3.97% in the case of thick clouds. In particular, in 2019 the number of hours related to persistence of thin and medium clouds has decreased for both sites, while for thick clouds an increase has been observed for Cluj-Napoca.

A series of macrophysical and microphysical low clouds parameters (cloud cover fraction, cloud top pressure, cloud optical depth, liquid water path, cloud water radius) were extracted from the Clouds and the Earth's Radiant Energy System (CERES) database for Bucharest and Cluj-Napoca, two sites of Romania with polluted, respectively cleaner clouds. The annual variations of these cloud parameters were investigated and compared for both sites. Since 2013 the cloud droplet effective radius has increased, reaching the median value (11.7 µm) in 2019, which means a cleaner atmosphere for Cluj-Napoca. We observed bimodal distributions of cloud water radius for medium clouds, with a median mode value of 11.4 µm and of 6.5 µm, indicating the presence of a more dispersed cloud droplets for

Bucharest than for Cluj-Napoca, in 2019. The low cloud albedo was calculated using a parameterization currently used in the climate models and the comparison reveals that the lowest median value of cloud albedo was 0.18 (Cluj-Napoca) and 0.26 (Bucharest) for thin clouds.

The low clouds characteristics help us to better understand the climatology of these low clouds and their life cycle, which are indirectly related to presence of aerosols in atmosphere.

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Hypercomplex Numbers and the Origin of Celestial Magnetic Fields

The origin and evolution of the celestial magnetic field remains an unsolved mystery. Many hypotheses have been proposed to explain the origin, but each hypothesis has some insurmountable difficulties. Currently, the widely accepted theory by the scientific society is the dynamo model, which believes that the motion of the magnetic fluid inside a celestial body can overcome the Ohmic dissipative effect and generate a continuous weak electric current and then produce the macroscopic magnetic field. However, the model requires an initial seed magnetic field, and there is no stable solution for a wide range of fluid motion. Moreover, the model is difficult to explain the correlation between the magnetic field and the angular momentum of the celestial objects. By Clifford algebra in the formalism of hypercomplex numbers, the author calculated the interaction between the particle spin and the gravitational field of a rotating body. We find that there is a pseudo-vector field Ω^a, which is coupled with the spin of the charged particles by $S_a\Omega^a$. Ω^a is similar to the dipole magnetic field, and the charged particles are then arranged regularly along the force line of Ω^a, which induces a macroscopic dipole magnetic field. The calculation shows that the strength of Ω^a is proportional to the angular momentum of the celestial body, which explains the correlation between the magnetic strength and the angular momentum. Thus, the celestial magnetic field is a relativistic effect, and the physical laws should be better described by hypercomplex numbers.

Adrian Ionescu
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Computer Software for New Runge-Kutta Methods

This paper gives an overview of the evolution of the Runge-Kutta methods over the past decades. We focus on the classical Runge-Kutta methods of orders 3, 4 and 5 and their evolution and applications over time. We will discuss both the autonomous and non-autonomous methods and the new developments, and the updated software.

In particular, this work uses the standard autonomous form

$$y_0 = f(y); \ y \in R^n;$$
$$y(x_0) = y_0; \ x_0 \in R; \ y0 \in R^n;$$

which implements some new Runge-Kutta method: the new Goeken-Johnson methods used to solve autonomous ordinary differential equation initial-value problems. The novel feature of this approach is the replacement of evaluations of f by approximations or evaluations of f_y. (As noted, we also address the non-autonomous case.)

New C-software covering the new method developments has been written extending the available techniques.

László Kollár
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Unexpected Selectivities in Carboylation Reactions of a Cavitand Skeleton

In this lecture two types of highly selective homogeneous carbonylations of 2-methylresorcinol-based cavitands will be discussed.

1) The tetrakis(4-iodophenyl) moieties on the upper rim of the cavitand, obtained in a simple Williamson-type ether synthesis reacting tetrabromocavitand with 4-iodophenol, was aminocarbonylated in palladium-catalysed reaction using various primary and secondary amines as *N*-nucleophiles. High 'tetra-selectivity', regarding both mono- vs. double carbonylations resulting in tetracarboxamides and tetrakis(2-ketocarboxamides), respectively, as well as using two different amines as nucleophiles was observed.

2) Platinum- and rhodium-catalyzed hydroformylation reactions were performed on tetra(vinyl)cavitand skeletons. (The substrate was synthesized in Stille reaction.) Instead of obtaining a statistical mixture of products in hydroformylation, the reactions proceeded with high 'tetra-selectivities', that is, all four vinyl groups were either hydrogenated or transformed to the branched (Figure below) or linear aldehydes via hydroformylation. Based on these exceptionally high chemo- and regioselectivities, considering also the results obtained with those obtained with styrene, a cooperation between all the four catalytic reaction centers was supposed.
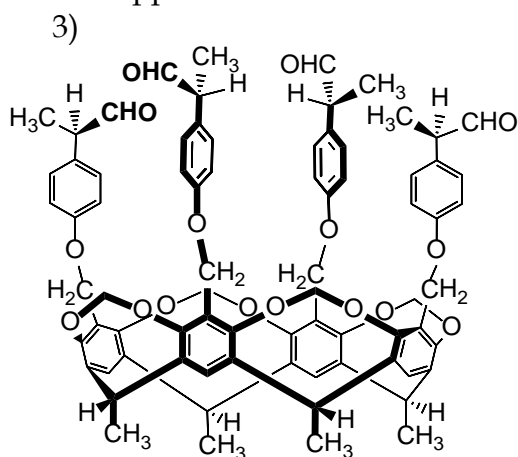
3)

Evangelia Kotsikorou
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An Endocrine Disrupting Chemical Can Regulate Allosterically the Androgen Receptor via Binding in the BF3 Surface Binding Site

Endocrine disrupting chemicals (EDCs) disrupt the function of the androgen receptor (AR) leading to developmental problems for embryos and health problems for adults. The purpose of this work is to describe a mechanism for allosteric regulation of the androgen receptor by an EDC. Currently, it is widely considered that EDCs bind in the steroid binding pocket, inducing altered receptor conformations, thus disrupting AR function; however, this may not be the only way EDCs interfere with the receptor. Molecular dynamics (MD) simulations of the AR/steroid complex are used in the presence and absence of DDE (an EDC related to the pesticide DDT) in the BF3 surface binding site to assess whether it can allosterically the dynamic behavior of the AR/steroid complex. Microsecond-long MD simulations combined with random accelerated MD and steered MD simulations in conjunction with principal component analysis are used to examine the dynamic behavior of the receptor, find egress routes for the steroid, and calculate the free energy for the unbinding of the steroid in the presence and absence of DDE in the BF3 site. It was found that a) the receptor samples three conformational substates (CSs): closed, intermediate and open, and in the presence of DDE the receptor fluctuates between the intermediate and the closed conformations whereas in the absence of DDE it mostly samples the closed conformation, b) the free energy of unbinding of the steroid was decreased for the egress routes studied in the presence of DDE in the BF3 site, and c) an allosteric pathway extending from BF3 to the steroid binding site is proposed. Androgen receptor dynamics are affected by the presence of DDE in the BF3 surface binding pocket and the stability of the bound steroid is reduced leading to lowered energy requirements for steroid expulsion and hence disruption of the AR function.

Aaron Livingston
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The Impact of Diversity in Sport Management Education and Student-Athletes

NOT AVAILABLE

Mounir Mabsout

Professor and Chair, Department of Civil and Environmental Engineering, American University of Beirut, Lebanon

Higher Learning and the Community: Be Engaged, Stay Relevant...

NOT AVAILABLE

Gohar Marikyan
Professor, Empire State University of SUNY, USA

Teaching Mathematics with Visuals

Many scholars have researched how students learn mathematics and devised various teaching methodologies for word problem solving. My research shows that common sense plays an important role in learning introductory mathematics. Teaching mathematics using common sense can also be effective for any level of school students who may use their naturally existing common sense if taught to do so. My research shows that some adults do not use their naturally existing common sense in learning mathematics. Therefore, a similar methodology cannot be equally effective in teaching mathematics to that population of adult learners. There is a need for creating a methodology that will encourage adult students to start using their common sense in learning mathematics. The well-devised methodology can be embedded in teaching introductory mathematics. Moreover, teaching introductory mathematics methodology can be devised so that will develop analytical thinking. Therefore, one of the purposes of teaching introductory mathematics can be teaching students to use their common sense in solving word problems. The habitual use of common sense will lead to the development of logical thinking. The net effect of such methodology will be the use of their analytical thinking in solving all kinds of problems in mathematics, business, life, etc.

Luminita Marin

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Bioactive Nanofibrous Mats of Quaternized Chitosan/Chitosan: An Approach towards Biomaterials for Tissue Engineering and Regenerative Medicine

Chitosan based nanofibers are emerging biomaterials with a plethora of applications, especially in medicine and healthcare. In this study, binary quaternized chitosan/chitosan fibers are reported for the first time. They were obtained by electrospinning of a ternary chitosan/quaternized chitosan/poly(ethylene glycol) solution followed by the selective removal of poly(ethylene glycol). The successful preparation of the binary fibers was demonstrated by FTIR and NMR spectroscopy and thermogravimetric analysis. The fiber morphology was investigated by scanning electron microscopy, X-ray diffraction and polarized light microscopy. The performances of the new binary fibers, in terms of solubility, biodegradation, swelling, vapor water sorption, mechanical properties, bioadhesion/muchoadhesion, antimicrobial activity and in vitro and in vivo biocompatibility, were investigated according to standard protocols and discussed in detail comparing with other systems or biomedical devices. It was concluded that the combination of chitosan with quaternized chitosan into nanofibers led to biocompatible and biodegradable biomaterials with properties suitable for tissue regeneration, wound healing and drug delivery systems.

Mihail Mateev

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Design and Implementation of Cognitive Digital Twins with Generative AI and ChatGPT

Digital Twins (DT) is one of the essential technologies in Industry 4.x and 5, Most of modern solution for Industrial Automation and IoT includes different implementation of Digital Twins concept. During the last several years researchers and engineers from different industries have worked on the case how to make possible Digital Twins to improve itself using the information, collected from the original system. Digital Twins, that learn by themselves and can predict the future and act in accordance with made predictions are also known as Cognitive Digital Twins (CDT)

Artificial Intelligence and especially Generative AI and ChatGPT bring new opportunities to create Cognitive Digital Twins. This research is focused on creation of concept and reference architecture for CDG, based on ChatGPT, cloud computing *Microaoft Azure), Power Virtual Agents and Azure Digital Twins Service.

This research presents also ontology / data model, used in the Cognitive Digital Twins framework.

The article includes metrics about cost saving and time reduction when using Generative AI for implementation of CDT in different industries with focus on construction industry.

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A Data Streaming Architecture for Air Quality Monitoring in Smart Cities

This paper aims to present a modeling approach for the seamless data streaming process from smart IoT systems to Apache Kafka, leveraging the MQTT protocol. As a distributed event store and stream-processing platform, Apache Kafka offers robust capabilities for handling high-volume and high-velocity data streams. On the other hand, MQTT protocol serves as a middleware between the smart IoT system and Apache Kafka, facilitating efficient and reliable machine-to-machine communication.

The paper begins by discussing the concept of real-time data streaming, emphasizing the need to transfer data from IoT/edge devices and sensors to Apache Kafka in a timely manner. It highlights the challenges associated with gathering data from resource-constrained networks with limited bandwidth, wherein MQTT protocol emerges as a relevant solution due to its lightweight and standards-based messaging capabilities. The literature overview will show the analysis and systematization of different types of architectures in the broad sense of crowdsensing, followed by specific architectures in regard to edge and cloud computing. Finally, an overview of existing principles and methods of connecting Apache Kafka with MQTT protocol will be presented.

The integration of Apache Kafka with MQTT protocol is explored as a means to streamline the data streaming process. The authors present a step-by-step methodology for connecting the edge devices and systems to Apache Kafka using MQTT, enabling seamless data transfer in a structured format such as JSON. The authors seek to develop an infrastructure for collecting data from edge devices through data streaming, transforming gathered data for easier manipulation and

analysis, and feeding it via MQTT protocol to Apache Kafka centralized server. The proposed infrastructure will be tested in a smart environment based on air quality, collecting various data types, including carbon monoxide, particulate matter, nitrogen dioxide, and others.

The proposed integration approach offers several advantages, including efficient and scalable data streaming, real-time analytics, and enhanced data processing capabilities. By leveraging the power of Apache Kafka's distributed architecture and MQTT protocol's lightweight nature, the smart system for measuring air quality can achieve reliable and real-time data delivery, enabling prompt decision-making and effective air pollution interventions.

The paper concludes by highlighting the significance of the presented infrastructure and integration approach and its potential impact on advancing smart environment systems. It also emphasizes the need for further research and implementation to validate the proposed methodology and explore additional use cases and optimizations.

Ati Moncef

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Phontons S-value Calculation in Pediatric Nuclear Medicine for Dose Estimation

This study presents pediatric absorbed fraction and s-value in nuclear medicine imaging (NMI) and consequently to internal absorbed dose calculations. Geant4/Gate Monte Carlo (MC) simulation method was used to simulate different types of radiation and their interaction with matter and for a real biological radiopharmaceutical distribution in patient organs. The pediatric phantom of 5 year old of 256 x 256 x 500 mm3 is considered as the patient with real anatomical geometry. We calculated S-value for several source-target organs in a unit of (Gy/Bq.s), under different simulation runs for an energy range of 10 Kev to 1000 keV for photon irradiations and 10 Kev to 700 for beta-particles. The results were compared with literature pediatric phantoms. We note that for SAF value there was no significant difference between Xcat phantoms and phantoms in case of the source and target were identical. However, a significant difference was noted in the case of target and source was different.

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Coming Challenges in Electrified Transportation and Impact on Electrical Insulation Reliability: Ships and Aircrafts

The irreversible trend of electrified transportation is to replace the AC transformers with power electronics, with the purpose of improving efficiency, specific power, multifunctionality and dynamics of supply and distribution systems. An example is the hybrid grid paradigm: power converters/inverters can provide the type of the supply power which could be needed, case by case, to optimize the operation of the asset, from AC modulated to DC voltage.

On one hand, increasing the specific power and efficiency means raising the operating voltage, modulation frequency and temperature, besides the reduced switching time, which can lead to increased electrical and thermal stress in the insulating materials and systems. In such conditions, insulation systems might suffer with the accelerated intrinsic electrothermal and extrinsic aging. This must drive new design criteria, improved quality and commissioning test procedures, and efficient diagnostic and condition-based maintenance approaches.

This paper illustrates some of the research activity carried out at the Center for Advanced Power Systems (CAPS) of Florida State University, focusing on innovative and reliable design of insulation systems for ship, aircrafts, and space infrastructures. Reliability can be achieved innovating the concept of equipment design and operation. As regards the former, an insulation system must be designed as free from the extrinsic aging, e.g. partial discharge (PD) free, and using a reliability redundance concept which aims that besides being free from extrinsic aging, materials that can withstand such aging, if and when occurring, should be used. For the latter, condition monitoring systems, fully automatic and unsupervised, must be developed to guarantee the availability of prompt information about the potential failure risks. The innovative three-leg approach has been proposed for an extrinsic-aging free insulation design, which will be reviewed in this paper, and a new

automatic software is being developed to detect and monitor the PDs, as well as to achieve a straightforward information about the condition (dynamic health index) of the electric asset component. Examples of PD detection at the atmospheric and reduced pressure, using the automatic and unsupervised approach, are presented, referring both to test objects that are able to simulate typical defects triggering PD and the full-size insulation systems (as generator bars and printed circuit-boards).

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Neutrino-Antineutrino Production in Gamma Ray e− e+ Pair Production: Monte Carlo Viability Study

An alternative Feynman diagram for electron-positron pair production, in which neutrinos and antineutrinos are also produced on the same pathway, is introduced. In the proposed pair production process, only a portion of the momentum is carried by neutrinos and antineutrinos, allowing the rest of the momentum to be used for the electron-positron pair. In the current study, simulations to inspect this pair production process were conducted using the EGS5 Monte Carlo code system.

Simulated liquid Xenon detector was then positioned in the path of various mono-energetic photon beams ranging from 2.6 to 12 MeV. These simulations were intended to inspect the detectability of the alternative pair production effects on radiation measurements to assess the detection conditions. Simulation results provide a basis for comparison between the original pair production process and the proposed pair production processes. Spectral results showed that changes in the region around 1 - 2 MeV and in the photopeak region were significant, therefore detectable. Based on these findings, further experimental research is recommended.

Moreover, the proposed pair production process led to production of a larger flux of neutrinos from gamma radiation. In the event that additional neutrino and antineutrino flux is produced by gamma radiation from stars, as a result of the proposed pair production process, the neutrino average number density would be higher by several orders of magnitude. Hence, a larger portion than is currently estimated of the total estimated non-baryonic dark matter density may be contributed by neutrinos.

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Real and Virtual Physics Laboratories in High Schools, Case Study Albania

Laboratories play a very important role in the teaching modalities, in middle and high schools. In physics, they seem to be even more important, because help students to better understand what happen, how nature works. In the physics curricula of the high schools in Albania, laboratories are part of the lessons and using them, teachers derive to what they want to teach and explain to the students. But, the question is: It really works like this? How laboratories are implemented in the teaching modality? Real of virtual experiments are used most? What's their impact to the student performance? In this work, we present some results taken in the high schools of some principal cities in Albania, regarding the laboratories infrastructure, the use of real and virtual laboratories and the role of them in learning and understanding physics. We have performed a survey, in 10 different cities, in 40 high schools and then analyze the results. The main idea is to expand this attempt in more high schools and then make a proposal for the Ministry of Education, Sports and Youth for reforms in the actual curricula.

Felix Panis
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The Involvement of Tyrosinase Enzymes in the Storage of Organic Carbon in Wetland Ecosystems in the Face of Climate Change

Over the last millennia, wetlands have been sequestering carbon from the atmosphere via photosynthesis at a higher rate than releasing it and, therefore, have globally accumulated 550×10^{15} g of carbon, which is equivalent to 73% of the atmospheric carbon pool. The accumulation of organic carbon in wetlands is effectuated by phenolic compounds, which suppress the degradation of soil organic matter by inhibiting the activity of organic matter degrading enzymes. The enzymatic removal of phenolic compounds by bacterial tyrosinases has historically been blocked by anoxic conditions in wetland soils, resulting from waterlogging. Bacterial tyrosinases are a subgroup of oxidoreductases that oxidatively remove phenolic compounds, coupled to the reduction of molecular oxygen to water. The biochemical properties of bacterial tyrosinases have been investigated thoroughly in-vitro within the last decades, while investigations focused on carbon fluxes in wetlands on a macroscopic level have remained a thriving yet separated research area so far. In the wake of climate change, however, anoxic conditions in wetland soils are threatened by reduced rainfall and prolonged summer drought. This potentially allows tyrosinase enzymes to reduce the concentration of phenolic compounds, which in turn will increase the release of stored carbon back into the atmosphere.

To offer compelling evidence for the novel concept that bacterial tyrosinases are among the key-enzymes influencing carbon cycling in wetland ecosystems first, bacterial organisms indigenous to wetland ecosystems that harbor a TYR gene within their respective genome (tyr^+) have been identified, which revealed a phylogenetically diverse community of tyr^+ bacteria indigenous to wetlands based on genomic sequencing data. Bacterial TYR host organisms covering seven phyla (Acidobacteria, Actinobacteria, Bacteroidetes, Firmicutes, Nitrospirae, Planctomycetes, and Proteobacteria) have been identified within various wetland ecosystems (peatlands, marshes, mangrove forests, bogs, and alkaline soda lakes) which cover a climatic continuum ranging from high arctic to tropic ecosystems. Second, it is demonstrated that (in-vitro) bacterial TYR activity is commonly observed at pH values characteristic for wetland ecosystems (ranging from pH 3.5 in peatlands and freshwater swamps to pH 9.0 in soda

lakes and freshwater marshes) and towards phenolic compounds naturally present within wetland environments (p-coumaric acid, gallic acid, protocatechuic acid, p-hydroxybenzoic acid, caffeic acid, catechin, and epicatechin). Third, analyzing the available data confirmed that bacterial host organisms tend to exhibit in-vitro growth optima at pH values similar to their respective wetland habitats. Based on these findings, it is concluded that, following increased aeration of previously anoxic wetland soils due to climate change, TYRs are among the enzymes capable of reducing the concentration of phenolic compounds present within wetland ecosystems, which will potentially destabilize vast amounts of carbon stored in these ecosystems. Finally, promising approaches to mitigate the detrimental effects of increased TYR activity in wetland ecosystems and the requirement of future investigations of the abundance and activity of TYRs in an environmental setting are presented.

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Non-Natural Theaflavins Synthetized from Avocado Peels Polyphenols as Antioxidants and Anti-Bioilm-Agents Against Pathogen and Nonpathogens Bacteria

Biofilm-producing bacteria can form a mechanical barrier of high stability. This feature confers resistance to harsh environmental conditions and antibiotic's resistance. In this work propose to use avocado peels to prepare phenolic and thiol flavan-3-ol adducts from proanthocyanins (PAcs). After depolymerization of PACs with different nucleophiles, semi-synthetic flavan-3-ol adducts were subtracted by chromatographic methods (CPC, HPLC) and the remaining reactants were recovered after extrusion. Afterwards, a library of non-natural theaflavins was prepared via enzymatic (Polyphenol oxidase) and non-enzymatic (DPPH radical) oxidation of semisynthetic flavan-3-ol adducts in presence of epicatechin-pyrogallol moiety. Isolation of these compounds was performed by CPC and preparative HPLC and their structures were elucidated by MS and NMR experiments. Biofilm inhibitory properties of these products were tested using pathogen and non-pathogen bacteria with crystal violet and resazurin assays. Thiol-derived adducts displayed antimicrobial properties and inhibit biofilm

formation in a concentration-dependent manner, particularly in *Listeria monocytogenes* (ATCC 7644), *Staphylococcus aureus* (ATCC 9144), *Escherichia coli* (ATCC 11775) and *Salmonella enterica* (ATCC 13076). Interestingly, biofilm formation was promoted in *Escherichia coli* 25922, *Limosilactobacillus fermentum* UCO-979C and *Lacticaseibacillus rhamnosus* UCO-25A. Remaining reactants (knock out extract) and exhausted avocado peels were used to prepare carbon-dots and nanoparticles. Regarding nitrogen and sulfur co-doped carbon dots, we observe interesting per se antimicrobial and antioxidants activities. With the aim to assess its toxicity, all compounds were tested in different ell lines (AGS, Caco-2, MCF-7). ADME-TOX properties and molecular docking upon diadenylate cyclase and diguanylate cyclase enzymes were also evaluated. Therefore, avocado peels can be used as cheap starting material to produce new drug candidate and materials to be used as adjuvant for modulate biofilm production (Grant N° Fondecyt 1211119).

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Strategies for Social-Emotional Learning in Preparation for Transitioning Eighth-Grade Middle into Nineth-Grade High School

This proposed study aims to evaluate the post-Pandemic strategies of Eighth grade School Guidance Counselors responsible for helping to develop Social Emotional Learning support and parental collaboration to address students' behavior before ninth grade, a source of the ability to benefit from education as a life-long journey. Evaluate the Pre-Pandemic Social Emotional Learning strategies and parental collaboration addressing eighth graders' behavior issues, compared to those strategies used Post-Pandemic. To address the possibility of either period of program support not affecting changes in eighth-grader student behavior before transitioning to high school. Comparing data to determine the best period of positive behavior outcomes. Quantitative Method will address the rationale for this research objectives. A moderate sample of eighth-grade Public Middle School Guidance Counselors and eighth graders' parents will be surveyed electronically, and one-on-one interviews will be conducted to address the questions: (a.) How have students' behavior changed (if at all) post-COVID? (b.) What strategies are effective in developing students' SEL? (c.) Why possibly developing new Post-Pandemic SEL strategies effective in developing students' successful behavior issue outcomes? Public School District - Middle School SEL implementation policies and commitment addressing eighth-grade student behavior outcomes and their ability to benefit from either period for a life-long journey. Post-& Pre-COVID-19 will be used interchangeably with Post and Pre-Pandemic.

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Behaviour Study of the Entropy Defined in the Natural Time Domain to Characterize of Seismic Activity Prior to the Occurrence of Intense Earthquakes from a Magnitude Time Series Obtained from Seismic Catalogues

Seismic catalogs are a particular case of the so-called point processes, because the interevent time between events is unevenly. For this type of stochastic processes, there exist some tools to analyze them, for example, the Allan Factor that allows characterizing only fractal properties, however its applications are not wide enough. In order to identify other types of hidden dynamic properties in punctual processes, new methods have been developed in which it is possible transform a point process to a sequence of events. Currently, the method is well known as Natural Time Analysis (NT) that it was introduced by Varotsos et al. (2001). This method allows transforming specific processes as time series, introducing the concept of natural time and serving as an index to identify the occurrence of the k-th event of an ordered sequence. In recent years, this method has been very useful for study signals obtained from systems from various fields. One of the systems where NT has been very useful is the case of seismic sequences, and specifically by studying the behavior of fluctuations of entropy defined in the natural time domain. In this work, an analysis of the entropy in the natural time domain is presented and it is shown that it has been possible to identify a possible precursor of the great earthquake that occurred on September 7, 2017 in Mexico.

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Necessary and Sufficient Condition of Separability for D-Symmetric Diagonal States

For multipartite states, we consider a notion of D symmetry. For a system of N qubits, it coincides with the usual permutational symmetry. In the case of N qudits ($d \geq 3$), the D symmetry is stronger than the permutational one. For the space of all D-symmetric vectors in $(C\_d)^{\otimes N}$, we define a basis composed of vectors which are analogues of Dicke states. The aim of this paper is to discuss the problem of separability of D-symmetric states which are diagonal in this basis. We show that if N is even and $d \geq 2$ is arbitrary then a positive partial transposition property is a necessary and sufficient condition of separability for D-invariant diagonal states. In this way, we generalize results obtained by Yu [Phys. Rev. A 94, 060101 (R)(2016)] and Wolfe and Yelin [Phys. Rev. Lett. 112, 140402 (2014)]. Our strategy is to use some classical mathematical results on a moment problem.

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Should I Stay or Should I Go? – Insights into the Impact of Mathematics Anxiety on Undergraduate Students' Engagement with Service Mathematics

International evidence shows that mathematics anxiety exists among learners at all levels of education and among the general public. Mathematics anxiety is characterised by feelings of apprehension, tension and fear in respect of doing mathematics, and it affects learners of mathematics in a variety of ways. But, at a high level it can lead to panic around mathematics and avoidance of mathematics. In higher education, if students have high levels of mathematics anxiety, they will try to avoid studying programmes with mathematics content. However, where undergraduate programmes have mandatory service mathematics modules (i.e. where mathematics is not the main discipline of study, but an essential component of the programme, e.g. Mathematics for Engineering), students must engage with the mathematics content to meet the programme learning outcomes. The presence of a service mathematics module may come as a surprise to the new undergraduate student; and if the student has high mathematics anxiety, their engagement with service mathematics coursework may be adversely impacted.

Mathematics anxiety is a complex construct, and contributes to a negative disposition towards mathematics. At a high level, mathematics anxiety has a debilitating impact on the undergraduate student, affecting their feelings about and approach to mathematics, leading to a largely negative impact on motivation, performance and achievement in service mathematics. This can lead to potential negative consequences for future educational and career pathways; indeed, students with very high mathematics anxiety prefer to avoid engagement with mathematics completely, and in this regard, many educational and career opportunities are closed to them.

A combination of factors contributes to mathematics anxiety and these can be best understood by looking into a student's engagement with mathematics throughout their life. Significant incidents with mathematics throughout the student's life contribute to the level of mathematics anxiety experienced by the student; examples include the student's experience of how mathematics was taught; the treatment of failure in mathematics by the teacher; and the value placed on mathematics both in the home and educational contexts. An

understanding of what has happened in a student's past experiences with mathematics can enhance the understanding of how the student feels about and engages with service mathematics, and can inform the lecturer's planning and practice for service mathematics.

This paper explores how a knowledge of undergraduate students' mathematics stories can inform the teaching and learning of service mathematics in the higher education context. Using mathematics life stories collected over a five-year period from first year undergraduate students who study a service mathematics module, the paper investigates what are the most significant factors that contribute to undergraduate students' feelings about and engagement with mathematics. The variety of incidents that make up the mathematics life stories demonstrates that the impact of undergraduate students' experiences can remain with students long after they have occurred, with perceived negative incidents having long-lasting effects and potentially causing the student to engage at a procedural rather than a conceptual level with service mathematics.

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Early STEAM Education Practice: Application of Graph Theory through Teaching Assistants

In the age of Society 5.0, which is the concept of a future society developed by the Japanese government, STEAM human resources with the skills to grasp things from multiple perspectives and solve problems will be required. Furthermore, Society 5.0 indicates that the National Institute of Technology (KOSEN) will become STEAM centers for elementary and junior high school students as part of the efforts to establish a system that supports STEAM education. Since 2019, we have practiced STEAM education as part of "Liberal Arts Special Lectures" for 4th year students of the main course (1st year of the undergraduate course). In these lectures, teachers of liberal arts subjects present themes by making use of their own specialties, such as mathematics, debate, and economics. Collaborative learning between students from various departments led them to deep learning that was a fusion of knowledge and creation. However, there are few opportunities to give back to society, especially a platform to disseminate the acquired mathematics ability. Therefore, we aimed to realize early STEAM education and give back to society by creating STEAM teaching materials on graph theory in open courses for junior high school students by utilizing teaching assistants.

Graph theory is a mathematical theory about figures consisting of a set of vertices and edges and has one of its origins in 1736, when Leonhard Euler solved the "Königsberg problem" which is closely related to the single stroke. It can be applied for studying physics, chemistry, computer science, linguistics, and the social sciences. In addition, since a graph is easily understood visually and little prior knowledge is required to grasp it, it is suitable as a STEAM learning material for a wide number of generations.

The open course in 2022 was divided into three parts: an introduction to graph theory, including the Königsberg problem and single stroke; applications to social networks; and applications to maximum flow and minimum cut problems. Findings revealed that the

junior high school students provided high survey ratings while the teaching assistants had the invaluable opportunity to give back to society by making use of their acquired skills. The questionnaire demonstrated that our course was effective for learners and showed potential as a STEAM teaching theme. Moreover, the teaching assistants were able to study graph theory in depth due to the lectures, obtain new results, and successfully present their research at the 28th KOSEN Symposium in 2023.

Finally, we describe STEAM teaching materials for use in the future. Knot theory is easy for beginners to understand since it is not necessary to know its background well and there are various teaching materials in which they can learn visually. Knot theory is associated with various fields, such as quantum field theory in physics and molecular design in chemistry and DNA in biology. In the future, we wish to create STEAM teaching materials related to them.

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The Necessity of Developing Soft Skills in STEM Areas in Higher Education, with Special Focus on Engineering Training

One of the challenges of higher education today is to prepare students for the demands of the labour market. A goal becoming ever more important is that, in addition to the so-called hard skills (knowledge obtained from textbooks), the development of soft skills (inter- and intrapersonal skills) also be emphasised.

It is a particularly important question in the field of STEM (science, technology, engineering, mathematics), and especially in engineering education, which abilities and skills are essential for new graduates on the labour market.

The aim of our questionnaire survey, conducted in 2022, was to map the specifics of soft skills among engineering students. The following research questions were formulated:

Which soft skills do students consider the most important for success in the workplace?
To what extent are they characterized by specific, non-professional skills?
In what areas do they wish to develop?

A total of 208 engineering students filled out our online questionnaire.

We examined the characteristics of soft skills based on a list of 39 items. The 5 soft skills considered most important were problem-solving, reliability, resilience, communication and independent work. Students regarded themselves as most characterized by reliability, problem solving, independent work, responsibility and cooperation. The biggest gap between the skills required in the world of work and the current skills of our surveyed students were in self-confidence, communication, stress tolerance, self-assertion and resilience. These are the areas in which development is the most necessary.

The surveyed students would most like to learn negotiation and reasoning techniques, time management, stress management and communication skills during their university studies.

Our research results drew attention to the importance of developing soft skills, especially social skills. In engineering education, we promote the development of soft skills by courses that provide opportunities for cooperation, open and honest communication and the development of empathy in small groups, which contribute to the development of a positive self-image and realistic self-evaluation.

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Impact of the Evolution of a Curved Charge Distribution on Electric Field

Theoretically it is plausible to assume for a chosen charge distribution the electric field can be calculated. However, in practice depending on the geometry of the distribution one faces mathematical challenges. In this research-oriented project, we select a set of related familiar 2D geometric curves addressing the mathematical issues. Specifically, we consider a family of curves that are evolved via step-by-step "evolution." Evolution that begins from a segment of a circular arc to a complete circle. The electric fields are formulated, evaluated, and graphed. Accomplishing these objectives relied heavy on utilizing a Computer Algebra System (CAS), specifically *Mathematica*. The CPU expensive runtimes are circumvented introducing mathematical procedure.

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Oxidation and Reduction Processes of Ivermectin

At the start of the Coronavirus Disease 2019 (COVID-19) pandemic, before any recognized effective treatment or the approved vaccine therapy we have today was available, an urgent need to re-evaluate existing drugs for the treatment of SARS-CoV-2 virus infection has arisen. When Ivermectin (IVM), a member of the avermectin family, has shown antiviral potential against the virus, there has been a spike of interest in IVM and numerous attempts to repurpose it for treating COVID-19. Electrochemical methods have a low cost, high speed, and ease of execution, and most importantly, can be used to better understanding the redox behaviour of the molecule, as well as to predict potential transformations during interactions with other electroactive biomolecules. Electrochemical characterization of IVM was done using cyclic (CV), differential pulse (DPV) and square wave voltammetry (SWV) with a glassy carbon electrode (GCE) as working electrode, a Ag/AgCl as reference electrode (3 M KCl), and a Pt wire as auxiliary one. Voltammetric behaviour of IVM was investigated using different buffer solutions in the pH range 2–10. The results confirmed that IVM is electroactive in the entire studied area with the appearance of three different peaks. The shape of the peaks in acquired voltammograms suggested that all the processes are irreversible.

The main oxidation peak is visible at a potential of around + 1.0 V. Both peak potential and peak intensity are pH dependent. The shift of the peak potential towards less positive values with increasing the pH, indicates that protonation step precedes the electron transfer. The slope of about 30 mV/pH, suggests the ratio of proton/electron consumption during the oxidation is 2:1. Maximum oxidation peak current is obtained in the pH interval 5.0 to 7.0. The second oxidation peak appears at a potential of around + 0.3 V and is not visible in the first, but appears in the second and third scan, indicating it originates from the oxidation of the previously reduced form of the drug. The peak

does not change with the successive scans. Peak potential is pH dependent and is shifted towards less positive values with the increase in the pH, while the peak current intensity is not pH dependent. The only reduction peak appears at a potential of around – 0.3 V and does not change with the successive scans. The reduction peak is visible at pH values greater than 3.5, meaning that reduction does not occur in extremely acidic solutions. The nature of the oxidation and reduction process was studied by following the effect of the rate of the potential change on the peak current. According to I_P *vs.* $v^{1/2}$ and I_P *vs.* v dependencies which, respectively showed linear plots for oxidation and reduction processes, it may be concluded that the oxidation process is a diffusion-controlled one, while the reduction process is dominantly controlled by adsorption. The acquired CV data were confirmed by the results obtained with more sensitive DPV and SWV methods.

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Evaluating the Potential of Punicalin as an Inhibitor of SARS-CoV-2 Spike Protein Interaction with Neuropilin-1 Receptor - In Vitro Study

This study aimed to evaluate the potential of punicalin, a natural compound derived from pomegranate, as a therapeutic agent against SARS-CoV-2. The investigation focused on assessing the ability of punicalin to prevent the interaction between the spike protein of the SARS-CoV-2 virus and the neuropilin-1 receptor, thus impeding virus internalization.

To examine the inhibitory effects of punicalin on the interaction between the spike protein and neuropilin-1 receptor, a series of *in vitro* experiments were conducted. Various concentrations of punicalin were utilized in the study to evaluate its capacity to impede the interaction between the spike protein and neuropilin-1. The methodology employed a 96-well plate coated with specific antibodies and utilized a colorimetric reaction to evaluate the binding interaction between the SARS-CoV-2 spike protein and neuropilin-1 receptor. By measuring the resulting color change and its intensity at a wavelength of 450 nm, valuable insights were obtained regarding the formation of the spike protein-neuropilin-1 complex, facilitating the assessment of potential inhibitors or regulators of this interaction. Notably, the study revealed that the most concentrated sample of punicalin exhibited a significant inhibitory effect, demonstrating a noteworthy reduction of 63.96% in the interaction between the spike protein and neuropilin-1 receptor. These findings suggest that punicalin has the potential to interfere with the initial stages of SARS-CoV-2 infection by preventing the binding between the spike protein and the neuropilin-1 receptor. By inhibiting this interaction, punicalin may impede the internalization of the virus into host cells, presenting a potential therapeutic approach for combating SARS-CoV-2. This study highlights the significance of exploring natural compounds as potential therapeutic agents against COVID-19, particularly those with the ability to prevent crucial interactions between viral proteins and host cell receptors.

Further investigations are warranted to elucidate the precise mechanisms by which punicalin interferes with the spike-neuropilin-1 interaction.

These findings contribute to the growing body of knowledge on the development of novel therapeutic strategies against COVID-19 and

provide a foundation for further research on punicalin and its potential applications in combating viral infections.

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Follow the Yellow Brick Road to Presidency

NOT AVAILABLE

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A Methodological Proposal to Assess the Feasibility of Implementing Collaborative Robots in Developing Countries for Power Generation Cycles

This paper presents a new methodology to assess the feasibility of implementing collaborative robots (*cobots*) in a small and medium enterprise (*SME*), located in a developing country. The proposal takes into consideration a range of factors crucial for the cobot implementation success. To that intent, three multidisciplinary pillars will be evaluated: The capacity of the human resource that will be involved in the implementation and operation of the equipment, how convenient it would be to include a cobot in the manufacturing process, and the financials constraints behind a potential application. The reason behind this proposal is that developing countries and/or societies involved in long term socio-political crisis that negatively affect their manufacturing industry, tend to have conditions that are not suitable for this type of implementation. Therefore, the need to carry out an integral feasibility analysis in order to avoid economic losses and competitive disadvantages that could be critical for the company's wellbeing; particularly to those with the capacity of an SMEs (*Small and medium-sized enterprises*). This might not be the case in industrially developed countries; where the human resources with the skills and experience exist, and there is a widespread availability of robotic manufacturing solutions. There are also capital markets and public policies that help mitigate investment risks. In such nations a straightforward implementation study typically suffices. The proposed methodology is applied to a practical case-study in the power generation field, which was evaluated through detailed activities developed for such a purpose, using field collected data.

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Strategies for Antibody Selection to Non-Traditional Targets: Toxins, Post-Translational Modifications and Lipids

Antibodies are large Y shaped proteins of our immune system that identify and neutralize foreign objects, including bacteria and viruses. Monoclonal antibodies are effective therapeutic agents and can be used as a highly valuable and ubiquitous biomedical research reagent. Traditionally, antibodies have been produced by immunizing animals. Nowadays, recombinant naïve antibody libraries used in phage and/or yeast display techniques facilitate in vitro selection of human monoclonal antibodies to full length proteins or protein domains (e.g., spike protein of SARS CoV2). However, isolating highly specific antibodies to small molecules, post translational changes in protein structure, and non-traditional targets such as lipids remains challenging. In this presentation, we will discuss three different antibody selection strategies. First, we will describe techniques used in isolating antibodies that specifically recognize Deoxynivalenol (DON), a mycotoxin produced by *Fusarium sp*, a fungal pathogen in wheat, barley, and corn (maize). The second part of the talk will focus on selecting antibodies specific to post-translational modifications (PTMs) that increase the functional diversity of the proteome. These small chemical modifications to proteins are involved in protein homeostasis as well as interactions with pathogens (e.g., viral replication). In this section, we will present strategies to select antibodies to distinguish between post-translationally modified and unmodified proteins. We will conclude by presenting the challenges and success of antibody selection strategy to bacterial lipids. Neutralizing antibodies that target lipids molecules of pathogenic bacteria have therapeutic potential because cell membrane-associated lipids represent an important functional component of the cell and provide an important venue to target against bacterial pathogens. In vitro selected antibodies have important applications in research, disease diagnostics, and therapeutics. Developing highly specific diagnostic reagents facilitates research that allows a greater understanding of host-pathogen interactions. In addition, antibodies have proven to be a valuable reagent for disease detection in many simple, field-forward diagnostic applications. Finally, antibody-based immunotherapy is an important medical field. For all of these reasons, innovative techniques to identify

and characterize antibodies to non-traditional targets is a critical field of research.

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Targeting Cancer Related Genes and Mirnas Using Gene Editing Technology

Cancer related deaths are increasing annually worldwide. During last decades, extensive researches have revealed many genes and miRNAs that are orchestrating tumor initiation, progression and metastasis. Recently, Gene editing has emerged as one of the recent promising tools for gene therapy. From the most important gene editing enzymes are zinc finger nucleases (ZFNs), homing meganucleases and transcription activator-like effector nucleases (TALENs), and the clustered regularly interspaced short palindromic repeats (CRISPR)/CRISPR-associated nuclease 9 (Cas9). Recently, many studies were conducted to introduce new treatment modalities for cancer treatment using the gene editing technology, either by targeting genes or miRNAs. These targeted therapies will introduce new therapeutics options that are much potent and specific.

The crisper technology was widely applied to introduce therapeutic options in cancer treatment, additionally; it was used in cancer immunotherapy. For example, CRISPR technology has introduced an alternative to the conventional clinical drug, Herceptin, by targeting HER2 in breast carcinoma. Moreover, it was used in CAR-T cell generation and immune cell checkpoint inhibition. Researchers are seeking to fight many hard diseases by the use of CRISPR technology, however, many challenges still exist. Some of these challenges include the requirement of PAM sequence, the possibility of on target deletion or addition, off target effects, Cas9-DSB complex.

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Deammonification Nitrogen Removal and Anodic Biofilms Use in Microbial Fuel Cell Technology

Earlier calculations of the modified Nernst–Monod model have shown the increase of the maximum specific utilization rate (0.30 to 0.38 mmol g^{-1}VSS h^{-1}) in the anammox microbial electrolysis cell being 60% higher than ordinary anammox specific utilization rate (0.18 to 0.20 mmol g^{-1}VSS h^{-1}) (Li et al., 2016). Autotrophic nitrogen removal from wastewater was studied during 2 years in mobile pilot-scale (3 m^3 process tank) reactor configuration -deammonification in biofilm. Biofilms were developed with inoculation of biomass using undiluted liquid effluent of municipal wastewater treatment plant biogas facility. Microbial consortia determined in MBBR biomass by pyrosequencing consisted mostly of anammox *Brocadia* species as well as denitrifiers (*Pseudomonas caeni* <0.1%), both of the organisms have cytochromes on the outer membraane having potential for electron transfer in microbial fuel cell (MFC). Anammox species abundance achieved in deammonification biofilm reactor was 4% (0.9% out of them being *Brocadia* species). Among ammonia oxidizers 2.4% belonged to *Nitrosomonas europaea* and 0.5% to *Nitrosomonas eutropha* being absent in the *inoculum*. The highest total nitrogen removal rate (TNRR) was achieved in the deammonification biofilm reactor (0.33 kg-N m^{-3} d^{-1}). The biofilm from deammonification biofilm reactor was then tested in MFC technology in order to understand the electrogenic behavior of it. Two MFCs with carbon felt electrodes with the anammox biofilm (Test) and another one with septic tank mix consortia as a reference (Control) were observed to be capable of generating continuous bio-energy with operating voltage of 262 ± 17 mV and 163 ± 18 mV for Test and Control, respectively. Test anode with anammox biofilm showed almost two times higher (9.5 $W.m^{-3}$) volumetric power density than Control (4.9 W.m-3) with lower internal resistance of 161 Ω than that of Control (386 Ω). The coulombic efficiency was also found to be higher in case of Test (27.5 ± 1.7%) than Control (17.7 ± 1.9%), demonstrating the applicability of anammox in MFC to achieve efficient wastewater treatment as well as higher energy recovery from MFC.

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Novel Applications of MEMS Accelerometers

Due to their outstanding advantages (small dimensions - currently even less than 1 mm, easy integration with electronics, high shock-resistance, high reliability, satisfactory accuracy, low power consumption, low cost), MEMS accelerometers are constantly employed in new applications. Few examples of such applications are presented and discussed in the paper. They are related mostly to single- or dual-axis tilt measurements under static or quasi-static conditions. The paper describes and illustrates examples of such measurements in various fields, like diving (scuba diving and freediving) or motorcycle riding, where application of MEMS accelerometers is closely related to human safety. Only applications possible owing to unique attributes of MEMS sensors were considered, where conventional sensors could not be employed, e.g. due to their large overall dimensions. The considerations regard both successful commercial implementations, as well as some latest patents pending and publications still lacking a physical realization, which hopefully will appear in the nearest future.

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