THE ATHENS INSTITUTE FOR EDUCATION AND RESEARCH

Abstract Book

12th Annual International Conference on Chemistry
22-25 July 2024, Athens, Greece

Edited by
Evangelia Kotsikorou & Olga Gkounta

2024

Abstracts
12th Annual International Conference on Chemistry

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First published in Athens, Greece by the Athens Institute for Education and Research.
ISBN: 978-960-598-657-5

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www.atiner.gr

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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 *12th Annual International Conference on Chemistry* (22-25 July 2024), 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, 2013-2024*

Year	Papers	Countries	References
2024	78	25	Kotsikorou and Gkounta (2024)
2023	44	22	Sarafian and Gkounta (2023)
2022	35	24	Tratras Contis and Gkounta (2022)
2021	19	12	Papanikos (2021)
2020	31	10	Papanikos (2020)
2019	24	17	Papanikos (2019)
2018	28	14	Papanikos (2018)
2017	16	12	Papanikos (2017)
2016	11	9	Papanikos (2016)
2015	48	18	Papanikos (2015)
2014	23	16	Papanikos (2014)
2013	29	16	Papanikos (2013)

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 field of Chemistry. 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 12th Annual International Conference on Chemistry accomplished this goal by bringing together academics and scholars from 25 different countries (Albania, Algeria, Armenia, Australia, Bulgaria, Canada, China, Colombia, Georgia, Germany, Hungary, Italy, Japan, Jordan, Lithuania, Mexico, Morocco, Peru, Poland, Saudi Arabia, Spain, Taiwan, UAE, UK, 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.

Evangelia Kotsikorou & Olga Gkounta
Editors

12th Annual International Conference on Chemistry, 22-25 July 2024, Athens, Greece

Organizing & Scientific Committee

All ATINER's conferences are organized by the Academic Council. 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, The Athens Institute.
2. Haiduke Sarafian, Head, Natural Sciences Unit, ATINER & Professor of Physics and Endowed Chair of John T. and Paige S. Smith Professor of Science, Pennsylvania State University, USA.
3. Evangelia Kotsikorou, Deputy Head, Natural Sciences Unit, The Athens Institute & Associate Professor, The University of Texas Rio Grande Valley, USA.

FINAL CONFERENCE PROGRAM

12th Annual International Conference on Chemistry, 22-25 July 2024, Athens, Greece

PROGRAM

08.30-09.15
Registration
09:15-10:00
Opening and Welcoming Remarks:

- **Gregory T. Papanikos**, President, The Athens Institute.

10:00-11:30 Session 1

Session 1a – Sciences **Moderator: Dimitris Argyropoulos**, Professor, North Carolina State University, USA.	**Session 1b – Engineering** **Moderator: Adrian Ionescu**, Head, Computer Science Unit, Athens Institute & Professor, Wagner College, USA.	**Session 1c – Educational Justice/STEAM** **Alevtina Goulko**, Chair and Instructor, Chemical Technology Program, Northern Alberta Institute of Technology, Canada.
1. **Igor Zhitomirsky**, Professor, McMaster University, Canada. ***Title**: Advanced Chemical Strategies for Synthesis of Nanoparticles for Electrochemical Energy Storage in Supercapacitors.* 2. **Takafumi Miyanaga**, Professor, Hirosaki University, Japan. ***Title**: Structure of Luminescent Species in Ag-Zeolites Investigated Via X-Ray Absorption Fine Structure.* 3. **Nikolaos Dimakis**, Professor and Chair, Department of Physics and Astronomy, University of Texas Rio Grande Valley, USA. ***Title**: Density Functional Theory Calculations on Erbium and Praseodymium-doped Lithium Tantalate Compounds.* 4. **Mohamed El Morsalani**, Director, Landesbank Baden-Württemberg, Germany. ***Title**: Quantum Souriau*	1. **Serguei Maliar**, Associate Professor, Santa Clara University, USA. **Lilia Maliar**, Professor, City University of New York, USA. ***Title**: Deep Learning: Solving New Keynesian Models.* 2. **Mojtaba Mahdavi**, Senior Researcher, Ericsson Research, Sweden. ***Title**: Multi-Rate Filter Design Using Processing in Memory.* 3. **Sotirios Skevoulis**, Professor, Pace University, USA. ***Title**: Small Scale Interoperable Social Media: A Design Framework for Decentralization.* 4. **Anduel Kuqi**, Assistant Lecturer, Polytechnic University of Tirana, Albania. Title: A Comparison between Traditional Methods and Generative AI for the Optimization of 3D Modeling and Printing.	1. **Michihiro Sakai**, Professor, Kurume College, Japan. ***Title**: Development and Practice of Teaching Materials for Early STEAM Education of Elementary and Junior High School Students Using Tiling.* 2. **Andrzej Sokolowski**, Adjunct Professor, Lone Star College, Houston, USA. ***Title**: Constructing Wave Function Using Parametric Equations.*

Lie Group Thermodynamics: Geometry of Coadjoint Orbits and the Fisher Information Tensor.		
11:30-13:00 Session 2		
Session 2a – Sciences **Moderator: Evangelia Kotsikorou**, Deputy Head, Natural Sciences Unit, Athens Institute & Associate Professor, The University of Texas Rio Grande Valley, USA.	**Session 2b – Engineering** **Moderator: Nikos Mourtos**, Head, Mechanical Engineering Unit, Athens Institute & Professor, San Jose State University USA.	**Session 2c – Educational Justice/STEAM** **Moderator: Corey Bloomfield**, Senior Lecturer, Central Queensland University, Australia.
1. **Shizhang Qiao**, Chair Professor, The University of Adelaide, Australia. ***Title**: Electrocatalytic Refinery for Production of Fuels and Chemicals.* 2. **Edvard Kokanyan**, Head of the Chair of Physics and its Teaching Methods, Armenian State Pedagogical University, Armenia. ***Title**: Ho-doped Lithium Niobate Thin Films: Raman Spectroscopy, Structure and Luminescence.* 3. **Shu-Chun Chu**, Professor, National Cheng Kung University, Taiwan. ***Title**: Selectively Generating Pulsed Laser Cavity Modes with Digital Lasers.*	1. **Lakshmi Sankar**, Regents Professor, Georgia Institute of Technology, USA. **Jechiel Jagoda**, Professor Emeritus, Georgia Institute of Technology, USA. **Dimitri Mavris**, Regents Professor, Georgia Institute of Technology, USA. ***Title**: Engineering Analyses of Retrofitting Existing Helicopters for Urban Air Mobility and Inter-City Applications.* 2. **Jose Fernandez**, Professor, University of Murcia, Spain. **Boglárka G.-Tóth**, Researcher, University of Szeged, Hungary. **Laura Antón-Sánchez**, Researcher, Miguel Hernández University of Elche, Spain. ***Title**: Firm Expansion: Location, Modification and Closing of Facilities.* 3. **Pascual Fernandez Hernandez**, Senior Lecturer, University of Murcia, Spain. **Algirdas Lancinskas**, Researcher, Associate Professor, Vilnius University, Lithuania. **Blas Pelegrín**, Professor, University of Murcia, Spain. **Julius Zilinskas**, Researcher, Vilnius University, Lithuania. ***Title**: Sequential Customer Choice Rules in a Discrete*	1. **Willis Walter,** Dean, College of Education, Virginia State University, USA. **Britine Perkins**, Assistant Professor, Prairie View A&M University, USA. **Chevelle Hall**, Associate Professor, Virginia State University, USA. ***Title**: The Pros and Cons of Diversity, Equity, and Inclusion Positions in America.* 2. **Arifah Goodwin**, Assistant Director of Employer Relations, Virginia State University, USA. ***Title**: Black Women in Leadership and the Complexities of Work Life Balance.*

	Competitive Facility Location Model. (Monday, morning session) 4. **Chiboub Adel**, Teacher, National Preparatory School for Engineering Studies (ENPEI), Algeria. ***Title**: Design Process of Biomechanical Products by Mastering the Knowledge of Geometric Modelling.* 5. **Belkadi Hichem,** Professor, University of Science and Technology of ORAN, Algeria. ***Title**: Influence of Radial Inner Cylinder Deformation on Taylor-Couette Flow with Free Surface.*	
13:00-14:45 Session 3		
Session 3a – Sciences Moderator: Nikolaos Dimakis, Professor and Chair, Department of Physics and Astronomy, University of Texas Rio Grande Valley, USA.	**Session 3b – Engineering Moderator: Lyndon Brown**, Associate Professor, Western University, Canada.	**Session 3c – Educational Justice/STEAM Moderator: Willis Walter**, Dean, College of Education, Virginia State University, USA.
1. **Andrey Krasilnikov**, Professor, Pennsylvania State University, USA. ***Title**: Structural Insights into The Evolution of Catalytic Ribonucleoprotein Complexes.* 2. **Sanaa Sabour Alaoui**, Professor, University Sultan Moulay Slimane, Morocco. ***Title**: Valorization of Margins: Physico-Chemical Characterization and Bactericidal Effect of Vegetable Waters.*	1. **Irakli Chitaia**, Researcher, Ivane Javakhishvili Tbilisi State University, Georgia. **Roland Omanadze**, Professor, Ivane Javakhishvili Tbilisi State University, Georgia. ***Title**: On Some Algorithmic Reducibilities.* 2. **Ambra Korra**, PhD Student, Polytechnic University of Tirana, Albania. ***Title**: Optimizing Inception Architectures for Automated Quality Control in Binary Classification.* 3. **Florian Deeg**, PhD Student, Chair of Reliable Circuits and Systems, Friedrich Alexander University Erlangen-Nuremberg, Germany. ***Title**: Self-locking Domino Logic Pipelined Controller for RISC-V in FPGA.* 4. **Sikha Bagui**, Distinguished Professor, University of West Florida, USA. **Dustin Mink**, Research Faculty,	1. **Scott England**, Professor, University of Maryland Eastern Shore, USA. **Richard Warren**, Professor, University of Maryland Eastern Shore, USA. **Kala Burrell**, Associate Professor, University of Maryland Eastern Shore, USA. ***Title**: Leveling the Board: Mastering Recruitment & Retention.* 2. **Vivian Shannon-Ramsey**, Assistant Professor, Bowie State University, USA. ***Title**: e: Leveling the Playing Field: Social Justice and Inclusion of International Education for Black*

	University of West Florida, USA. **Subhash Bagui**, Distinguished Professor, University of West Florida, USA. ***Title**: Creating a Comprehensive Network Intrusion Dataset Based on the MITRE ATT&CK Framework in the Big Data Environment: UWF-ZeekData22.* 5. **Pavel Ikonomov**, Professor, Western Michigan University, USA. ***Title**: Hybrid 3D Metal Printing Process Optimization Using ML and AI.* 6. **Karen Roberts-Licklider**, PhD Student, University of Oklahoma, USA. **Theodore Trafalis**, Professor, University of Oklahoma, USA. ***Title**: Machine Learning Techniques with Fairness for Prediction of Completion of Drug and Alcohol Rehabilitation.*	*Students.* 3. **Elizabeth Scheer**, Literature Faculty, Bard High School Early College, USA. ***Title**: Inclusive Abstraction: Teaching Eva Hesse in the South Bronx.*

14:45-15:30 Lunch

15:30-17:00 Session 4
Moderator: Sanaa Sabour Alaoui, Professor, University Sultan Moulay Slimane, Morocco.

1. **Rolf Blumentritt**, Professor, University of Applied Science Heilbronn, Germany. The Importance of Knowledge Management in a Digitalized World with Changes in the Workforce due to Retirement.
2. **Poria Fajri**, Associate Professor, University of Nevada, Reno, USA.
   ***Title**: Small-Scale Hybrid Electric Vehicle Testbed as Practical Instructional Tool for Education in Transportation Electrification.*
3. **Katerina Kourentzi**, Research Associate Professor, University of Houston – Chemical & Biomolecular Engineering, USA.
   ***Title**: Development of Translatable Point-of-Care Diagnostics in an Academic Setting and Opportunities for Multidisciplinary Student Training.*
4. **Steve Dunton**, Lecturer, California Polytechnic State University, USA.
   ***Title**: Ducks in Space: Application of Cal Poly's "Learn By Doing" Approach to Mature "Duck" Radios for Future Space Flight.*

17:00-19:00 Session 5 – A Roundtable Discussion on "The Future of Sciences and Engineering Education"
Moderator: Gregory T. Papanikos, President, Athens Institute.

Invited Speakers:

1. **Nikos J. Mourtos**, Professor & Chair, San Jose State University, USA.
   ***Title**: AI In Science and Engineering Education: Friend or Foe?*
2. **Subramaniam Balakrishnan**, Professor Emeritus, University of Manitoba, Canada.
   ***Title**: Challenges In Providing Hands on Experience in Teaching Automation in a Mechanical Engineering Program.*
3. **Towfic Shomar**, Professor, University of Jordan, Jordan and Research Associate, CPNSS–LSE, UK.
   ***Title**: AI and Science: Geeting Humans back to the Picture.*
4. **Nikolaos Dimakis**, Professor and Chair, University of Texas Rio Grande Valley, USA.
   ***Title**: The Future of Online Education in Engineering and STEM.*

5. **Edvard Kokanyan**, Head of the Chair of Physics, Armenian State Pedagogical University, Armenia.
   ***Title**: Some Features of Studying at a Pedagogical (Teacher Training) University.*
6. **Adrian Ionescu**, Professor of Math and Computer Science, Wagner College, USA.
   ***Title**: The Future of Programming in the Computer Science Education.*

Interventions:

1. **Willis Walter**, Dean, College of Education, Virginia State University, USA.
2. **Bala Maheswaran**, Director, Engineering Division, Athens Institute & Professor, Northeastern University, USA.
3. **Lakshmi Sankar**, Regents Professor, Georgia Institute of Technology, USA.
4. **Steve Dunton**, Lecturer, California Polytechnic State University, USA.
5. **Alexander Zestos**, Associate Professor, American University, USA.
6. **Sanaa Sabour Alaoui**, Professor, University Sultan Moulay Slimane, Morocco.
7. **Adam Gadomski**, Professor, Bydgoszcz University of Science and Technology, Poland.

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

Tuesday 23 July 2024

09:00-10:30 Session 6
Moderator: Katerina Kourentzi, Research Associate Professor, University of Houston – Chemical & Biomolecular Engineering, USA.

1. **Towfic Shomar**, Full Professor, University of Jordan, Jordan & Research Associate, CPNSS – LSE, UK.
   ***Title**: Mathematics and Physics.*
2. **Abe Zeid**, Professor, Northeastern University, USA.
   ***Title**: REU Pathways: Pathways for Community College Students to Enrich their Education and Careers.*
3. **Yiyu Zhang**, Researcher, Institute of High Energy Physics, China.
   ***Title**: LLM-Based Physics Analysis Agent at BESIII and Exploration of Future AI Scientist.*
4. **Elena Atrazheva**, Instructor, Northern Alberta Institute of Technology, Canada.
   ***Title**: Students' Involvement in the Development of Greener Organic Chemistry Labs.*

10:30-12:00 Session 7

Session 7a – Sciences **Moderator: Laszlo Kollar**, Professor, University of Pécs, Hungary.	**Session 7b – Engineering** **Moderator: Subramaniam Balakrishnan, Professor Emeritus, University of Manitoba, Canada.**	**Session 7c – Educational Justice/STEAM** **Moderator: Chevelle Hall**, Associate Professor, Virginia State University, USA.
1. **Alexander Zestos**, Associate Professor, American University, USA. ***Title**: Electrochemical Biosensors for the Multiplexed*	1. **Haider Butt**, Professor, Khalifa University of Science and Technology, UAE. ***Title**: 3D / 4D Printed*	1. **Corey Bloomfield**, Senior Lecturer, Central Queensland University, Australia. **Linda Lorenza**, Senior Lecturer, Central Queensland University, Australia. ***Title**: CQUni Connect: Inspiring*

Measurement of Amino Acids and Neuropeptides. (Tuesday) 2. **Adam Gadomski**, Professor, Bydgoszcz University of Science and Technology, Poland. ***Title**: Nonlinearities as Disputed by Ostwald and Boltzmann, with a Novel Interpretation of Chemical Reactions.* 3. **Cacier Zilahy Hadad Arriagada**, Professor, University of Antioquia, Colombia. ***Title**: Understanding the Importance of Computational Chemistry in Experimental Research: Case of Ultra-Brief Solvation of Carbenes.* 4. **Jeremy Good**, Managing Director, Cryogenic Ltd, UK. ***Title**: Cryogen-Free 400 MHz (9.4 T) Solid State MAS NMR System with Liquid State NMR Potential.*	*Multifunctional Nanocomposite Contact Lenses.* 2. **Hongxing Jiang**, P. W. Horn Distinguished Professor, Texas Tech University, USA. ***Title**: MicroLED.* 3. **Jingyu Lin**, P. W. Horn Distinguished Professor, Texas Tech University, USA. ***Title**: Semi-Bulk Hexagonal BN Ultrawide Bandgap Semiconductors.* 4. **Migle Zabielaite-Skirmante**, PhD Student, Vilnius Gediminas Technical University, Lithuania. **Marija Burinskiene**, Professor, Vilnius Gediminas Technical University, Lithuania. ***Title**: Comprehensive Analyses of Vilnius, Oslo, and Amsterdam's Complete Street Design Guidelines.*	*Transitions to Higher Education for Young People in Regional.* 2. **Marlyn Pierce**, School Testing Coordinator / School Counselor Assistant, Suffolk Public Schools, USA. ***Title**: School Counselors Post-Pandemic Support of Eighth-Grade Students with Social-Emotional Learning Challenges.* 3. **Linda Taylor**, PhD Student, Virginia State University, USA. ***Title**: The Politics of Leading: An Analysis of Trustee Decisions to Appoint Women Presidents at Historically Black Colleges and Universities From 2020-2023.* 4. **Nicolas Alberto Dosman**, Assistant Professor, University of California, Davis, USA. ***Title**: The Importance of Arts Education in a Post-COVID World.*
12:00-13:30 Session 8		
Session 8a – Sciences **Moderator: Alexander Zestos**, Associate Professor, American University, USA	**Session 8b – Engineering** **Moderator: Haider Butt**, Professor, Khalifa University of Science and Technology, UAE.	**Session 8c – Educational Justice/STEAM** **Moderator: Elena Atrazheva**, Instructor, Northern Alberta Institute of Technology, Canada.
1. **Laszlo Kollar**, Professor, University of Pécs, Hungary. ***Title**: Selective Functionalization of Skeletons of Practical Importance via Palladium-catalysed Carbonylations.*	1. **Subramaniam Balakrishnan**, Professor Emeritus, University of Manitoba, Canada. ***Title**: Multi-objective Palletization on a Robot Based Manufacturing*	1. **Abdul Rauf**, Assistant Professor, United Arab Emirates University, UAE. ***Title**: Advancing Sustainability Education: A Review of Integrating Life Cycle Assessment (LCA) in Higher Education.*

2. **Evangelia Kotsikorou**, Associate Professor, The University of Texas Rio Grande Valley, USA. ***Title**: Mutations in the BF3 Site Affect Inhibition of Androgen Receptor Activity by DDE.* 3. **Stanimir Manolov**, Chief Assistant Professor, Paisii Hilendarski University of Plovdiv, Bulgaria. ***Title**: Employing Mechanochemistry in Organic Synthesis for Obtaining Biofunctional Hybrid Molecules.* 4. **Cristopher Ramirez-Sandoval**, PhD Student, National Polytechnic Institute, Mexico. ***Title**: Antiproliferative Response of Azole-Derived Compounds on Promastigote forms of Leishmania Mexicana.* 5. **Xianwei Hu**, Professor, Northeastern University, China. ***Title**: The Thermal Stability of KNO3-Nano2-Nano3 Molten Salts: A Raman Spectra Study.*	*Cell.* 2. **Obai Elamin**, Associate Professor, Prince Sattam Bin Abdulaziz University, Saudi Arabia. ***Title**: Numerical Study of the Mixed Convection Inside a Trapezoidal Cavity Loaded with Nanoencapsulated Phace Change Material.* 3. **Xiaomin Wu**, Professor, Tsinghua University, China. **Jingchun Min**, Professor, Tsinghua University, China. ***Title**: Supercooled Water Droplet Freezing and Ice Accretion on Cold Surface.* 4. **Lyndon Brown**, Associate Professor, Western University, Canada. **Ibrahim Allafi**, PhD Student, Western University, Canada. ***Title**: Internal Model Principle-Based Control for Sinusoidal Disturbance Rejection in Field-Oriented Control (FOC).* 5. **Ali Alshahrany**, Associate Professor, Jazan University, Saudi Arabia. ***Title**: Risks Assessment of Petroleum Fires at Elevated Pressures and Temperatures aboard Oil Tankers Using Computer Model.*	2. **Ching-pin Tseng**, Associate Professor, National Sun Yat-sen University, Taiwan. ***Title**: Cooperation and Narrative Sharing: Building a Co-Creative Teaching and Learning Situation through Quasi-Theatrical Teamwork.* 3. **Izabela Stroe**, Associate Professor, Worcester Polytechnic Institute, USA. ***Title**: Integrating Entrepreneurial Mindset and Value Creation in Teaching Physics to Engineering Students for Innovation and Impact.*

13:30-14:30 Lunch

14:30-16:30 Session 9

Session 9a – Sciences **Moderator: Adam Gadomski**, Professor, Bydgoszcz University of Science and Technology, Poland.	**Session 9b – Engineering** **Moderator: Olga Gkounta**, Researcher, Athens Institute.	**Session 9c – Educational Justice/STEAM** **Moderator: Konstantinos Manolidis**, Athens Institute Administration.

1. **Chryssostomos Chatgilialoglu**, Senior Research Associate, Institute of Organic Synthesis and Photoreactivity, Consiglio Nazionale delle Ricerche, Italy & Visiting Professor, Center for Advanced Technologies, Adam Mickiewicz University in Poznań, Poland.
   ***Title**: Oxidative Stress and the Role of Biomimetic Radical Chemistry in Discovery of Biomarkers.*
2. **Anouar Alami**, Professor, Sidi Mohamed ben Abdellah University, Morocco.
   ***Title**: Synthesis, Characterization and Evaluation of Anti-tuberculosis, Anti-HIV, Antimicrobial and Anticorrosive Activities of Heterocyclic Compounds, Derived from Spiro-isoxazoline, Benzimidazole, Triazole, Tetrazole, Pyrazole, and Tryptophan.*
3. **Maria Elena Campos Aldrete**, Professor-Investigator, National Polytechnic Institute, Mexico.
   Cristopher Ramirez-Sandoval, PhD Student, National Polytechnic Institute, Mexico.
   ***Title**: Study of the Multifunctionality of Imidazo Derivatives 2 and 3-Substituted.*
4. **Rana Rais**, Associate Professor, Johns Hopkins University, USA.
   ***Title**: Discovery of Tumor Targeted Glutamine Antagonists vis Prodrug Strategy.*
5. **Antonio Lira**, Professor, Pontificia Universidad Catolica del Peru (PUCP), Peru.
   ***Title**: Time-Differential Correlation between Earthquake Lights and Seismic Ground Accelerations.*

1. **Christoph Karg**, Professor, Aalen University of Applied Sciences, Germany.
   Ralf-Christian Härting, Professor, Aalen University of Applied Sciences, Germany,
   Demian Deffner, Scientific Employee, Aalen University of Applied Sciences, Germany.
   Miriam Kappe, Scientific Employee, Aalen University of Applied Sciences, Germany.
   ***Title**: CyberWuP – A Low-Threshold Cyber-Security Awareness Program for Small and Medium Enterprises.*
2. **Stanislav Selitskiy**, PhD Student, University of Bedfordshire, UK.
   ***Title**: Batch Transformer Architecture: Case of Synthetic Image Generation for Makeup and Occlusion Face Recognition.*
3. **Volodymyr Voytenko**, Professor, Sheridan College, Canada.
   ***Title**: An Iot-Based Smart Home System Prototype with Sensors Management.*
4. **Suzy Zhang**, PhD Candidate, York University, Canada.
   Shengyuan Chen, Professor, York University, Canada.
   ***Title**: High Speed Craft Peak Acceleration Prediction Using Machine Learning Models.*
5. **Thao Vy Nhat Ngo, Graduate Student, The University of Oklahoma, USA.**
   Asaph Matheus

1. **Valeisha Ellis**, Assistant Professor, Spelman College, USA.
   ***Title**: Establishing and Sustaining a Computer Science Ecosystem for Diverse Learners.*
2. **Valerie P. Bennett**, Assistant Professor, Clark Atlanta University, USA.
   ***Title**: Using Adaptive Learning in Teaching for Activism through STEM and the Humanities.*
3. **John Paul Tharakan**, Professor, Howard University, USA.
   ***Title**: Creating the 21st Century Engineer for Sustainable Development and Social Justice.*

	Barbosa, Graduate Student, The University of Oklahoma, USA. **Emubosa P. Emuobosal**, Graduate Student, The University of Oklahoma, USA. **Elaheh Jafarigol**, Postdoc, The University of Oklahoma, USA. **Theodore B. Trafalis**, Professor, The University of Oklahoma, USA. ***Title**: Using Federated Machine Learning in Predictive Maintenance of Jet Engines.* 6. **Li-Qiong Wang**, Distinguished Senior Lecturer, Brown University, USA. ***Title**: Collaborative, Interdisciplinary and Case Study Approaches in Undergraduate Research, Teaching and Learning.*	

17:30-20:30 Session 10
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.

21:00-22:30
Ancient Athenian Dinner

Wednesday 24 July 2024
An Educational Visit to Selected Islands
or Mycenae Visit

Thursday 25 July 2024
Visiting the Oracle of Delphi

Friday 26 July 2024
Visiting the Ancient Corinth and Cape Sounion

Chiboub Adel
Teacher, National Preparatory School for Engineering Studies (ENPEI), Algeria

Design Process of Biomechanical Products by Mastering the Knowledge of Geometric Modelling

A design process is considered as an innovation tool that confirms a real competitive advantage. The choice of a design process adapted to the constraints inherent to the products and its environment represents a strategic stake in the success of the innovation process.

In spite of various different formal representations, all models follow the basic design process framework which results in the four to six usual stages. One important aspect of the design process, which none of the compared models included, is the amount of time being consumed in each phase. Instead, every phase is standardised regarding their temporal length. Few models visualise "optional" aspects such as widening (search, divergent) and narrowing (evaluation, convergent).

Recent process models are usually stage-based or combine a stage-based and an activity based perspective (thus, being more detailed) and propose a problem-oriented approach to design.

Most of the models are very abstract representations of the design process. The high level of abstraction is due to the goal of the authors to propose branch-independent support, which is applicable to a wide range of products and design problems within a discipline.

Changes in design practice during the last decades such as the development of computer-aided tools and products which require more and more intensive collaboration between different engineering disciplines have affected design practice considerably.

Based on a literature review described above, an identified different characteristic of engineering design processes is our objective. They state: "design processes are embedded with multiple interdependencies and interactions between."

Anouar Alami
Professor, Sidi Mohamed ben Abdellah University, Morocco

Synthesis, Characterization and Evaluation of Anti-tuberculosis, Anti-HIV, Antimicrobial and Anticorrosive Activities of Heterocyclic Compounds, Derived from Spiro-isoxazoline, Benzimidazole, Triazole, Tetrazole, Pyrazole, and Tryptophan

The chemistry of the heterocycles constitutes one of the research themes very studied and developed in organic synthesis. Many heterocyclic derivatives are found to exhibit various biochemical, agro-chemical and electrochemical activities. In continuation of our research interest in heterocyclic compounds and those precursors, we report in this conference the latest research conducted in our Laboratory of Organic Chemistry. The research orientations chosen are the following:

- Development of some Spiro heterocyclic compounds, study and prediction of their pharmacological activities. Our molecules are tested against tuberculosis infection and HIV. The comparative study of the virtual POM screening was also realized on spiro-thiourea chromanones derivatives.
- Synthesis and evaluation of the antibacterial and the Anticorrosive Activities of some heterocycles derived from triazole, tetrazole, pyrazole and tryptophan
- Synthesis of new 1,2,3-triazole α-aminophosphonates, bearing a benzimidazole, carbazole or ester in position 4 of the triazole ring
- Exploration of the interest of polytriazoles on some papers described in the bibliography, to synthesize and characterize a new N-tosylated tri-(1, 2,3-triazole) compounds,
- Synthesis of new bi- and tri-heterocyclic systems and evaluation of their anticorrosive activity.

It should be noted that the synthesized compounds were identified and characterized adequately, and to a high standard with high purity by spectroscopic and analytical techniques: 1D NMR (1H, 13C, 31P), 2D NMR (COSY, HSQC and HMBC), Infrared, Elemental Analysis and High Resolution Mass Spectrometry (HRMS).

Ali Alshahrany
Associate Professor, Jazan University, Saudi Arabia

Risks Assessment of Petroleum Fires at Elevated Pressures and Temperatures aboard Oil Tankers Using Computer Model

Due to the serious threats of petroleum fires, which might take place every now and then, in ships (oil tankers), big fuel tanks aboard, oil refineries or conventional petrol stations ashore, which often leave big losses and injuries. Such Fires require big efforts and modern facilities to overcome difficulties with suppression. It becomes an essential issue to conduct research, which might help to understand the nature of such fires, and more important the effective ways of suppression using computer model at different pressures and temperatures.

This paper starts with briefs for effects of elevated pressures and temperatures on risks increase of petroleum fires including auto-ignition phenomenon. The paper then discusses some important parameters in combustion science such as burning velocities, which is a very important factor in risk assessment for any combustible material (fuels, oil products and chemicals) via using computer programs at different initial conditions to evaluate final temperatures of flames in the surroundings. Four different fuels are used in this work. The paper also explains other important issues such as, Flammability limits of such materials and flames instability. Those two parameters help to know and understand flames behaviors and their propagation in the surrounding environment. Flame instabilities are phenomenon, which not well understood in combustion due its complexity and the tremendous changes and fluctuations of physical and chemical states of burned species in flames. This situation makes fire more dangerous and harder to control. Finally, the paper ends with some conclusions.

Elena Atrazheva
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Students' Involvement in the Development of Greener Organic Chemistry Labs

Senior level students were involved in curriculum development of the laboratory component of the first-year organic chemistry course at NAIT. Students tested and evaluated the experiments as part of a special research-focused course. All experiments have been adapted to three-hour lab periods and laboratory conditions at NAIT.

Several green organic chemistry experiments were incorporated into the first-year organic chemistry course, focusing on several areas: replacing unsafe chemicals, decreasing the amounts of materials used, and using green reagents.

One adaptation was the synthesis of 4-bromoacetanilide via electrophilic aromatic substitution. Sodium bromide and acetic acid were used to generate the brominating agent *in situ,* thus avoiding traditional use of bromine and increasing the safety of the materials used.

The isolation of trimyristin from nutmeg by solvent extraction was also adapted to use fewer materials. The reduction in materials used did not affect the product yield, and sufficient product was available for analysis.

The third experiment was the adaptation of the green chemistry extraction of limonene from orange peel, where students used a novel method of extraction using supercritical fluid CO_2, a known green reagent. By replacing the flammable solvent with inert CO_2, the greener extraction method resulted in greater process safety, reduced waste, and improved product purity.

Lastly, the experiment on synthesis of biodegradable polymers was developed using polylactic acid as an example. The degree of polymerization was identified using ^{1}H-NMR spectroscopy. The various degradation conditions for the synthesized polymers were investigated.

Sikha Bagui
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Dustin Mink
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&
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Creating a Comprehensive Network Intrusion Dataset Based on the MITRE ATT&CK Framework in the Big Data Environment: UWF-ZeekData22

With the rapid rate at which networking technologies are changing, there is a need to regularly update network activity datasets to accurately reflect the current state of network infrastructure/traffic. However, there is very little literature, if any, on creating such network datasets in the Big Data environment. This paper outlines how both the cyber range and big data platform are used to create labeled data. The cyber range labs from The University of West Florida's (UWF's) National Centers of Academic Excellence in Cybersecurity designated cybersecurity degree will be presented.

The UWF-ZeekData22 is publicly available at datasets.uwf.edu in three formats: CSV, Parquet, and PCAP. The UWF-ZeekData22 is collected using Security Onion in two formats: Zeek logs and PCAPs. The collected data is labeled using the MITRE ATT&CK Framework, crowdsourced from the cyber range labs from UWF's National Centers of Academic Excellence in a Cybersecurity designated Cybersecurity degree.

Subramaniam Balakrishnan
Professor, University of Manitoba, Canada

Multi-objective Palletization on a Robot Based Manufacturing Cell

A common robot application is palletizing. For applications in which part sizes and quantities are fixed, traditional manual programming is effective. However, for applications wherein part types and quantities are subjected to continuous variation during a production run, an automated path planning method is required. This paper will present a solution to this problem for stacking of objects into a limited volume for shipment or transport to a different part of a facility. Every part produced vary on every batch size and models are presented for automated palletization utilizing a commercial robot. The paper develops a methodology to palletize oversized parts larger than bin boundaries. The model developed is applied to a computerized manufacturing cell wherein industrial roof trusses are fabricated. The work presented will describe modelling, simulation, and implementation on a robot cell. Stability, dense packing of parts while allowing parts to overhang beyond bin boundaries will be considered. To ensure both part and stack stability, a method of stability analysis will be described as well. The combined palletizing/stability method for the industrial case study was simulated in "Unity", and physically tested in a laboratory environment. As this method allows parts to extend beyond the boundaries of a bin, the total volume utilization can exceed the bin volume. To account for this, new volume and density utilization metrics are introduced. It is the standard practice to manually program a robot arm using a teach pendant to create path programs. An alternate solution is to use robot simulation software for creating a path file and then download the program. However, not all automated tasks can be fulfilled using pre-programmed path solutions. Variations in object size, location, quantity, or destination reduce the suitability of preprogrammed path profiles and these profiles may become untenable as potential variation increases. The method proposed will be validated using real world data from a truss manufacturing industry. The results from the study will be presented.

Valerie P. Bennett
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Using Adaptive Learning in Teaching for Activism through STEM and the Humanities

Over the last several years, particularly following the COVID-19 pandemic coupled with civil and social unrest, educational researchers, P-12 practitioners, governmental leaders and policy makers have begun to inquire more deeply into the ways that teachers are uniquely positioned as activists. In this work, the authors posit that STEM and humanities courses should both be recognized as important avenues for introducing P-12 students to social justice and activist work and raising their socio-political consciousness. By reimagining traditional learning spaces, the authors explore transformative possibilities that can emerge when curriculum is approached through a multidisciplinary lens to effectively engage "teaching as activism" in the 21st century and beyond. Extant educational scholarship has largely preoccupied itself with centering social justice and activist pursuits in education through the lens of humanities courses (History, English Language Arts, Civics Education) but a broader view is presented in this work to include STEM (Science, Technology, Engineering and Math). The inclusion of the full spectrum of courses widens the net for the impact of teaching for activism using adaptive learning (AL) platforms. This seemingly oxymoronic application of AL platforms to raise consciousness in teachers and in students is postulated to not only spark action, but has the potential to produce systemic, sustainable change.

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&
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Senior Lecturer, Central Queensland University, Australia

CQUni Connect: Inspiring Transitions to Higher Education for Young People in Regional

Inspiring participation in higher education promotes opportunities to further the educational justice agenda. Aspiration-building programs open the door to education possibilities that have historically been closed to many young people living in regional/rural/remote contexts.

CQU Connect program is an aspiration-building and career-focused initiative targeting students in regional/remote, low SES, and First Nations communities in Australia. The program, spanning from upper primary to Year 12, aims to improve Year 12 university application rates by empowering students with knowledge, confidence, and study skills. In 2023 an enhancement review of the program revealed the need for a comprehensive curriculum review, addressing issues with lesson plans, audience appropriateness, and resource efficiencies.

Framed within a Critical Theory approach to educational justice, this paper reports on the review project's findings using Kirkpatrick's 4 level evaluative model. Considerations were made for the importance of a participatory approach when adapting the program to diverse school environments, considering regional and socioeconomic variations. The project focused on refining content, developing adaptable teaching resources, and incorporating interactive elements to improve engagement. Project staff engaged with key stakeholders in the enhancement phase, including school leaders, program delivery staff, and secondary school students. In addition to the curriculum resource development, emphasis was placed on the significance of professional development for non-educator staff delivering the program and the need for a strategic approach to resource allocation.

This paper seeks to contribute valuable insights to the field of educational outreach and enabling programs, considering leading practice models through collaboration with school stakeholder groups to ensure the importance of tailored education equity transitions for diverse student populations.

Rolf Blumentritt
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The Importance of Knowledge Management in a Digitalized World with Changes in the Workforce due to Retirement

This article deals with the topic of knowledge management and various methods that help to deal with knowledge. In many companies, there is a strong interest in utilising existing knowledge.

Knowledge management is an important component of a company's success, as internal and external knowledge is highly relevant for competitive orientation in the present and future. By establishing comprehensive knowledge management in the company, information can be captured more quickly and internal expertise can be improved throughout the entire organisation.

The generation and exchange of countless data and information between humans and machines is constantly increasing. This raises the question of how an advantage can be generated from this exploding flood of data and information. The digital transformation is becoming increasingly important and therefore also affects knowledge. Digitalisation means that knowledge can be learned and used more quickly and in a more diversified way, which in turn has a positive impact on the company.

In recent years, the fundamental activities of knowledge management have changed significantly. Due to the rapid change in knowledge, methods are becoming increasingly important and must be constantly adapted or react in a more agile manner.

The following content examines how companies deal with the increased volume of data associated with digitalization, the knowledge transfer of departing employees and how this can be achieved as successfully as possible.

Lyndon Brown
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&
Ibrahim Allafi
PhD Student, Western University, Canada

Internal Model Principle-Based Control for Sinusoidal Disturbance Rejection in Field-Oriented Control (FOC)

This research presents results of combining the field-oriented control of motors with a more general Internal Model Principle controller rather than the specific case of integral control. The goal is to have a motor that can remove narrow band disturbances without impacting its performance outside of this specific frequency. This research is motivated by eliminating tremor in human limbs.

We verify our approach by initially implementing the algorithm in Matlab and then conducting experimental trials in our lab using two BLDC motors. The first motor will generate a sinusoidal torque signal on the shaft, while the second motor will utilize our algorithm to cancel this torque. Both motors are connected by a pulley. When Motor one initiates rotation with a sinusoidal torque signal, Motor two driven with our algorithm will freeze the motion in Motor one. Thus, the torque on motor two will match that of motor one. We then add additional broadband torque in Motor one and show that Motor two can still match the sinusoidal torque while ignoring this additional movement. We will investigate the difference between using the encoders from both motors as the driving signal for our control algorithm.

Haider Butt
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3D / 4D Printed Multifunctional Nanocomposite Contact Lenses

Color vision disorders, pose challenges in perceiving and distinguishing specific colors. To address these challenges, technologies such as color-filtering glasses and contact lenses have been developed. However, customization of eyewear for individual patients remains a challenge. In this study we presented the fabrication of tinted contact lenses for color blindness, and several issues related to their mechanical properties and toxicity were reported. Multifunctional contact lenses combining color filtering and pH sensing capabilities for personalized color vision correction were designed and fabricated. A pH-responsive, Neutral red dye-doped hydrogel resin was developed and optimized for the vat photo polymerization-based 3D printing process. The resin also included the well-known HEMA monomer, PEDGE as a cross-linker and TPO as photo-initiator, as key composnents. A novel in-house multimaterial 3D printing technique was employed for printing lenses exhibiting both color filtering and pH sensing capabilities. 3D printed samples contained outer radial rings, made from porous and pH-responsive polymer. The optically tunable dye-doped resin was also applied to the central part of the lenses to achieve customized wavelength blockage. The optical transmission properties of the 3D printed lenses were found to be analogous to those of the commercial CVD glasses, and their water content and wettability properties were better in comparison to some of the commercially available contact lenses used for cosmetic/vision correction purposes. Hence, this work demonstrates the potential of 3D printing multimaterial and multi-functional contact lenses for ocular health management and, more generally, color filtering applications.

Maria Elena Campos Aldrete
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&
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Study of the Multifunctionality of Imidazo Derivatives 2 and 3-Substituted

There was a time in which molecules recognized by various receptors were considered promiscuous and with countless side effects. Currently, the relevance of complex diseases and the need for polypharmacy leads us to the search for multifunctional drugs.

With the information from molecular target recognition (bioinformatics tools), it is possible to design molecules that, properly functionalized, can be recognized by more than one pharmacological target and modulate side effects, potentiating activities related to specific health problems.

The fluorescence property is a quality of some compounds that has been used as a biomarker for the study of signaling, where some molecules of pharmacological interest interact with specific targets. And it should be noted that the imidazopyridine nucleus with different substitutions can be recognized by proteins involved in metabolic processes of certain parasitic species, or act on the membrane as a mechanism of antifungal action. They can also disrupt the proinflammatory cascade, while the substitution of hydroxyalkyl groups generates an electronic effect that gives it fluorescent properties.

Structurally related analogous series of imidazolyl derivatives with multifunctional profile were prepared.

The synthesis of the compounds was carried out from basic raw materials with synthetic routes under the philosophy of green chemistry, obtaining moderate yields of the compounds that were characterized spectroscopically. The evaluation models were in vitro multipanel *Giardia lamblia WG*, MCF7, *Leishmania Mexicana (ATCC 50156)*, determining the viability of enzymatic inhibition with metabolic indicators.

The parameterization was carried out with the help of bioinformatics tools, Molinspiration platforms, PDB, Chem office 17.0,Avogadro1.2., chimera1.16 AutoDock Tools and viewers such as Discovery studio 2021 (Biovia), which allowed establishing the affinity to the drug targets (thioredoxin reductase, COX I, Cox II,)with the molecular docking studies, considering the standard parameters.

The contribution of alkylhydroxylated and aryl groups increased its fluorescent properties, which in turn favor its antimicrobial activity. The contribution of carboxylic acid groups has been shown to increase its anti-inflammatory response, which due to its affinity for these targets. Therefore, can be considered multifunctional.

The electrostatic potential map showed that the coplanarity of the heterofused system has been fundamental for the physicochemical and pharmacological response. Whereas the increase in its lipophilicity was achieved with protection with an ester group, thereby optimizing the anti-inflammatory response in the CNS .While hybridization with other heterocyclic systems, such as benzimidazole, imidazolines, and tiazole, have potentially allowed their antiparasitic response.

Chryssostomos Chatgilialoglu
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Oxidative Stress and the Role of Biomimetic Radical Chemistry in Discovery of Biomarkers

Free radicals are generated in the biological environment as a result of normal intracellular metabolism. Reactive oxygen and nitrogen species (ROS/RNS) function as physiological signaling molecules that participate in the modulation of apoptosis, stress responses and proliferation. ROS/RNS can also have a negative effect by causing damages to biomolecules. Therefore, the estimation of the type and extent of damages, as well as the efficiency of the protective and repair systems, is important subjects in life sciences.

When studying free radical-based chemical mechanisms, it is very important to establish biomimetic models, which allow the experiments to be performed in a simplified environment, but suitably designed to be in strict connection with cellular conditions. The biomimetic modelling approach has been coupled with physical organic chemistry methodologies and knowledge of free radical reactivity, in order to gather substantial knowledge on biological processes relevant to health, such as biological damages and repair, signaling and biomarkers, biotechnological applications and novel synthetic approaches.

By this approach, free radical processes such as lipid geometrical isomerization in cell membranes, cyclopurines formation in nuclear and mitochondrial DNA, and protein desulfurization have been studied in our laboratory, finalizing this research toward biomarker discovery. The lecture will provide an overview of this topic embracing life sciences, from organic chemistry to biological and medical applications.

Irakli Chitaia
Researcher, Ivane Javakhishvili Tbilisi State University, Georgia
&
Roland Omanadze
Professor, Ivane Javakhishvili Tbilisi State University, Georgia

On Some Algorithmic Reducibilities

Computability theoretic reducibilities represent the main tools for comparing algorithmically unsolvable problems. Reducibilities first appeared in the Post's well-known article "Recursively enumerable sets of positive integers and their decision problems." Several new reducibilities have been proposed and studied since Post's article. Among them are conjunctive and Quasi reducibilities and their restricted versions. In this talk we will present some recently obtained results about these reducibilities.

This work was supported by Shota Rustaveli National Science Foundation of Georgia [grant number: ***STEM-22-1837,*** *Recursive Functions and Probabilistic Ontology Engineering].*

Shu-Chun Chu
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Selectively Generating Pulsed Laser Cavity Modes with Digital Lasers

Digital laser, a novel laser system that introduces a spatial light modulator (Spatial Light Modulator, SLM) into the laser cavity. Through the highly controllable characteristics of the SLM in the laser cavity, digital lasers have greatly expanded the dynamic operating characteristics of intra-cavity beam shaping. However, although the flux density tolerance of SLMs has been greatly improved, its limited withstand flux density also directly limits the application of digital laser systems to high peak flux density. This has also led to the fact that since the invention of digital laser, related research has been focused on the field of continuous wave (CW) laser rather than pulsed laser. This study proposes a new digital laser architecture of the dual-cavity laser system. The laser system can directly obtain pulsed laser output with relatively high peak flux density through the SLM under the continuous wave operation with relatively low light peak flux density. At the same time, the experimental results of this study also confirmed that this digital laser architecture can directly select the pulsed laser cavity mode through pure phase modulation of the SLM. This research successfully enables dynamic mode selection of pulsed lasers in digital lasers while reducing the risk of damage to SLMs from direct exposure to high peak pulse flux densities. The proposed digital laser system in this study can be further explored to the enhancement of pulsed laser peak flux density through laser techniques such as mode locking or pulse compression in the future. The results of this research will help in expanding the use of digital lasers in applications requiring high laser peak flux density.

Florian Deeg
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Self-locking Domino Logic Pipelined Controller for RISC-V in FPGA

The paper revisits dual-rail domino logic circuits at the transistor level and compares their structure with the domino logic from look-up tables (LUT) in the field-programmable gate array (FPGA). The original structure can be mapped to the LUT logic. The paper then demonstrates how dual-rail domino logic circuits are applied in the FPGA by constructing a self-locking pipeline as a self-clocked control unit for a RISC-V. RISC-V is a new Instruction Set Architecture (ISA) designed by Berkeley that is gaining popularity. The ISA enables the implementation of a Reduced Instruction Set Computer (RISC) processor with a load-store architecture without requiring royalties. The pipeline includes a pulse circuit at the input that locks after the first pulse and clocks itself until the pipeline has run through once. It is crucial to design the circuit to be function stable to ensure safe and reliable locking. The input is locked and cannot be changed until the pipeline is complete. A Design Rule Check (DRC) was developed in Vivado, which compares the verified LUT assignments for feedback with those used in the current design. The implemented controller is compared to two clocked controllers regarding area, power, speed, and reliability. One controller is realised using low-level primitives, while the other is implemented at a higher level of abstraction. The self-locked pipeline uses more area, but power consumption is reduced because switching only occurs for incoming events. Additionally, the speed is increased because it is not clocked on the slowest path. The machine's self-locking mechanism ensures safety and reliability. Furthermore, the dual-rail implementation and its associated Hamming distance of two provide protection against single events.

Nikolaos Dimakis
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Density Functional Theory Calculations on Erbium and Praseodymium-doped Lithium Tantalate Compounds

Lithium tantalate ($LiTaO_3$) is a stable crystalline material exhibiting exceptional properties such as photoelectric, piezoelectric, and ferroelectric. Doping $LiTaO_3$ with various rare-earth ions is be used to achieve new optoelectronic properties. Here, we present density functional theory electronic and optical properties on lithium tantalate $LiTaO_3$ and its doped configurations with erbium (Er) and praseodymium (Pr) at the lithium (Li) and tantalum (Ta) site. We consider the doping concentrations of 4.167% and 8.334 mol % (single element doping and co-doping). For $LiTaO_3:Er^{+3}$, the generalized gradient approximation (GGA) calculations show that the Er-4f bands appear closer to the conduction band bottom and to the valance band top, for the first and second doped configurations, respectively. This agrees with changes in the imaginary part of the frequency dependent dielectric function between the doped configurations. Similar results are found for the $LiTaO_3:Pr^{+3}$ compounds. There are striking differences between the GGA and the hybrid functional HSE06 calculations for the band structures of the doped configurations. The HSE06 hybrid functional accurately predicts the location in energy for all the lanthanide-4f orbitals/bands: These are now spread in energy and appear above and below the Fermi energy. Our photoluminescence experiments for the doped configurations showed strong f–f emission in the visible and near-infrared regions, in an excellent agreement with the HSE06 electronic calculations. These high accuracy calculations allow the correct modeling of these compounds, which we aim to use them as fire detectors and detectors for surfaces changes (i.e., cracks) for unmanned aerial vehicles.

Nicolas Alberto Dosman
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The Importance of Arts Education in a Post-COVID World

The value of arts education has been called into question for decades. At the height of the COVID-19 pandemic, arts education programs, particularly singing were considered dangerous. Some music education programs continued to exist and operate via zoom while others were eliminated. However, music and the need to create and perform music continued throughout the pandemic. Virtual performances were a temporary means of moving forward with the performing arts. Moreover, creativity had evolved, and new skills were developed to continue with the performing arts and music in society. As the pandemic ended and life returned to normal, the need and value of arts education should have been apparent. However, arts education programs still struggle for its place in the curriculum.

In a post-pandemic world, many arts education programs were able to return but some have never returned. Moreover, economically challenged communities may have experienced more obstacles in restoring arts education programs. STEM rather than STEAM continues to be the focus of secondary and post-secondary institutions as well as law makers. Arts education, even those that have been able to reconstitute themselves and have found the necessary support to do so from their communities, may experience challenges that have lingered since the pandemic. These challenges could be linked to a variety of factors such as post-pandemic fear, inflation, economic challenges, as well as a re-prioritization of resources.

It may be necessary to remind policymakers and decision makers of the value of arts education to society. The arts are a vital part of the human experience. The pandemic in many ways reinforced the need for the arts despite the inability to experience live performances in the same way that had been experienced prior to the pandemic. Music making and performances continued despite the limitations during this period of human history. Given the state of COVID and its ability to be managed, attending a performance, or participating as a performer has returned to pre-pandemic levels. Although audience attendance and performer participation may not have fully returned to pre-pandemic levels in every community, the performing arts have largely recovered at the professional level.

Arts education programs are now in a position to fully thrive, and the case should be made for their importance – especially in

socioeconomically challenged areas. The pandemic has made it clear that human beings are compelled to make art and will continue to do so in the foreseeable future. Evidence of the importance of arts education prior, during, and post-pandemic will make the case for STEAM as a means of moving forward in the 21st century and beyond.

Steve Dunton
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Ducks in Space: Application of Cal Poly's "Learn by Doing" Approach to Mature "Duck" Radios for Future Space Flight

This paper gives an overview of Cal Poly's multi-year collaboration with technology startup *OWL Integrations*, and focusses on Cal Poly's "Learn By Doing" approach to mature *OWL's* technology for a future space flight mission. *OWL Integrations* makes low-cost Duck radios for emergency responders that form mesh networks using *OWL's* Cluster Duck Protocol (CDP). Cal Poly is a top-ranked public university in California that implements Learn By Doing as a deliberate process where students acquire knowledge and skills through active engagement in research and development projects. Since 2019, Cal Poly has characterized and matured Duck radio electronics and firmware, improving throughput, robustness, and supply chain trust. As the co-creator of the CubeSat standard, Cal Poly is a spacefaring university (since 2006) and is evolving Duck radios for space readiness. Student leadership and participation have been critical to both the collaboration's success and student learning. Over twenty students from four different engineering disciplines are currently involved in this research and development effort.

Mohamed El Morsalani
Director, Landesbank Baden-Württemberg, Germany

Quantum Souriau Lie Group Thermodynamics: Geometry of Coadjoint Orbits and the Fisher Information Tensor

Obai Elamin
Associate Professor, Prince Sattam Bin Abdulaziz University, Saudi Arabia
Aissa Abderrahmane
Professor, University of Mustapha Stambouli of Mascara, Algeria
Abed Mourad
Assistant Professor, University of Mustapha Stambouli of Mascara, Algeria
&
Abdeldjalil Belazreg
Assistant Professor, University of Mustapha Stambouli of Mascara, Algeria

Numerical Study of the Mixed Convection Inside a Trapezoidal Cavity Loaded with Nanoencapsulated Phace Change Material

The utilization of nanoencapsulated phase change materials (NEPCM) in thermal energy storage systems has been the subject of discussion among a great number of researchers in recent years. A numerical analysis of the mixed convection of NEPCM was performed in the present work. The analysis was performed inside a lid-driven trapezoidal container that included an elliptical heated cylinder in the middle. In addition to that, the container is subjected to a magnetic field. Both of the side walls of the container are heated, and the top and bottom walls are insulated. The top wall of the container is undergoing uniform motion. Through the use of the Galerkin Finite Element Method (FEM), the equations that represent the system were addressed. The purpose of this study is to explore the influence of several factors, such as the angle at which the heated elliptical cylinder is positioned (0 degrees, 45 degrees, 90 degrees, and 135 degrees) and the intensity of the magnetic field (0, 25, 75, and 100). This article presents and analyzes the influence of these factors on the temperature contours, streamlines, average Nusselt number, and Bejan number.

Valeisha Ellis
Assistant Professor, Spelman College, USA

Establishing and Sustaining a Computer Science Ecosystem for Diverse Learners

The need for educators in Computer Science (CS) has been an on-going battle in our current context. Although many states across the United States have adopted K-12 Computer Science Education standards, educator preparation programs need evidence-based CS curriculum and materials to prepare future educators to implement CS instruction and provide meaningful CS engagement for K-12 students to meet the existing CS education mandate. This research will provide innovative solutions to our K-12 STEM community, address the current challenges of CS workforce diversity, lack of CS career exposure for educators and K-12 students, and heighten CS engagement. This research will have a five-fold impact: K-12 students, STEM Educators/Majors, CS workforce innovation, CS/STEM identity, and increase CS community engagement with K-12 schools and community partners. This culturally relevant K-20 Computer Science community-based scholarship will contribute to the scant research on culturally sustainable CS content, pedagogy, and practices by providing pre-service and in-service educators evidence-based CS professional development on CS strategies, materials, out of school experiences (OST/OSL) that honors the rich STEM practices within CS Education at three Historically Black Colleges and Universities (HBCUs) while developing STEM Global citizens that solve real-world issues.

Scott England
Professor, University of Maryland Eastern Shore, USA
Richard Warren
Professor, University of Maryland Eastern Shore, USA
&
Kala Burrell
Associate Professor, University of Maryland Eastern Shore, USA

Leveling the Board: Mastering Recruitment & Retention

Poria Fajri
Associate Professor, University of Nevada, Reno, USA

Small-Scale Hybrid Electric Vehicle Testbed as Practical Instructional Tool for Education in Transportation Electrification

As the subject of transportation electrification becomes increasingly important, it is essential to educate students and familiarize them with the basic operating principles of electric vehicles (EVs) and hybrid electric vehicles (HEVs). Study of these vehicles requires exposure to a variety of concepts and covers a broad array of topics. In recent years, instructional efforts aiming to educate students in the field of transportation electrification have come in the form of books and research articles describing these vehicles and their components, software packages that can perform advanced simulations of vehicle behaviors, hardware-in-the-loop (HIL) simulations on a test bench, and real vehicle tests.

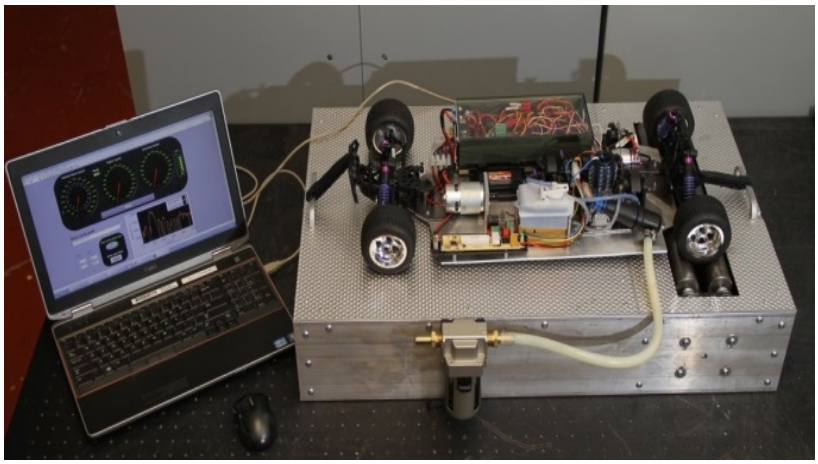
While there are ample books available that provide narrative descriptions of these vehicles and their components, and different software packages have the capability to do advanced simulations, none provide the practical aspects of education. On the other hand, although real vehicle tests and HIL simulations facilitate a hands-on, intuitive, and interactive experience, these methods are very expensive to implement at universities and often require a dedicated and complex system that is difficult to reconfigure for educational purposes. All these make it challenging for electrical engineering departments to offer hands-on educational programs that target transportation electrification.

To provide a viable solution to overcome current limitations in transportation electrification education and at the same time increase student motivation in learning fundamental electrical engineering concepts applicable to this field, the idea of small scale HEV setup is discussed in this presentation. The idea of a small-scale HEV originates from the fact that all the components of a real HEV are available in a smaller scale and by properly combining the parts in the same configuration as a real HEV, a very close model of the actual vehicle can be achieved.

The discussed testbed in this presentation is shown in Figure 1 and not only serves as an academic educational tool to study different aspects of EVs and HEVs, but can also be taken to various schools and community events and be utilized as a demonstration and education

unit, with the aim of generating interest in the pursuit of engineering among younger audiences. The testbed is reconfigurable, safe to operate (low voltage/low currents), and has the flexibility to be easily upgraded with different components such as different battery sizes and chemistries, different electric motor types, and other components commonly used in these vehicles. Due to its reconfigurable and upgradable design, a wide variety of topics can be explored which is otherwise impossible when using a non-reconfigurable platform as a teaching tool.

Figure 1. *Developed Small-scale HEV Test Bench at the University of Nevada Reno*



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Boglárka G.-Tóth
Researcher, University of Szeged, Hungary
&
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Firm Expansion: Location, Modification and Closing of Facilities

When a chain has some budget to expand its presence in a given geographical region, it may (1) open new facilities (2) modify the quality of its existing facilities, up or down, or (3) closing some of its existing facilities in order to allocate the budget devoted to them to other chain-owned facilities (or to the new one, in case it is open). In this paper, a continuous location model is proposed which encompasses all those possibilities. The demand is assumed to be fixed, the attraction function of the customers towards the facilities is given as quality divided by a function of the distance, and the patronizing behavior of the customers is probabilistic. The qualities of the new and the existing facilities are assumed to be continuous variables. The resulting model is a mixed-integer nonlinear programming (MINLP) problem. Most existing solvers for MINLP problems fail at solving even small instances of the model. Only BARON seems to be able to handle it, although it is time-consuming. That is why we propose an exact branch-and-bound algorithm which makes use of interval analysis tools. The new algorithm, which is an adaptation of classical interval branch-and-bound methods for continuous problems to MINLP problems is able solve small to medium instances in a short time. An ad-hoc heuristic and a hybrid method that usually find a near-optimal solution in a fraction of time of the exact method are also proposed. Some computational studies are presented to show the performance of the algorithms.

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Sequential Customer Choice Rules in a Discrete Competitive Facility Location Model

An entering firm wants to compete for market share in a geographic area by opening some facilities selected from a finite set of potential locations. Customers are concentrated in a few demand points, their demand is fixed and known, and the products are essential.

When it comes to purchasing essential items (food, drinks, sanitary products, cleaning items, etc.), customers usually buy them in different establishments in the same area, and their purchasing power is distributed among all of them in proportion to their attraction. But if there are no attractive enough establishments in your area of influence, they usually opt for a single establishment where purchase all the products and that offers a large number of services that make it more attractive to the customer.

In this paper we are going to consider two customer choice rules, but sequentially, that is, first we will apply the proportional rule to all customers for which there are establishments with a minimum attraction threshold set for each one of them, and then, and only for customers to whom the proportional rule cannot be applied, we will apply the binary rule to identify the facility or facilities that will meet their demand.

The first formulation of the model has been proposed as a nonlinear binary programming problem, where different sets of customers and variables have been defined to model the sequential use of the two customer choice rules applied in the model. Then, it is linearized, and a heuristic procedure is applied to approximate the optimal solution using real geographic coordinates and population data of the municipalities of Spain.

Adam Gadomski
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Nonlinearities as Disputed by Ostwald and Boltzmann, with a Novel Interpretation of Chemical Reactions

Friedrich Wilhelm Ostwald and Ludwig Boltzmann, renowned chemists, and physicists, were to some extent accepted as philosophers**.** It was well-recognized that they had many disputes with each other on a survey of topics of mutual interest. Quite unexpectedly, one was on a simple and unquestionable algebraic formula: $(E+W)(E-W)=E^2-W^2$ where E has been assigned to a success (German: *Erfolg*) whereas W, on the contrary, to a certain lack of it (German: *Widerwillen*). A serious problem arose because Ostwald insisted on having the pair (E, W) as not strictly (or, rather freely) defined but Boltzmann heavily opposed it, requesting a non-empty containment of the (E, W), thus expecting a precise content or strict definition of both members of the pair (E, W). On this note, we attempt to fill this gap as well as to extend the dispute by Ostwald and Boltzmann first toward higher nonlinear terms (suggested by Ostwald) and by taking into consideration the addressed nonlinearity as associated with an order of chemical reactions. A so-called (separate) Buddhist view, as proposed by Boltzmann, could suggest an „intermediate“ or non-integer order of the chemical reaction to be introduced on trial. The present note is, in general, on the subject of nonlinearity in chemical physics and its peculiarities and/or special reflections on its bright comprehension.

Jeremy Good
Managing Director, Cryogenic Ltd, UK

Cryogen-Free 400 MHz (9.4 T) Solid State MAS NMR System with Liquid State NMR Potential

Cryogen-free systems are widely used for Electron Paramagnetic Resonance and Dynamic Nuclear Polarisation experiments. Besides the low maintenance costs (especially nowadays with skyrocketing prices for liquid helium due to the ongoing helium supply crisis), the cryogen-free technology presents two other major innovations for NMR. First, the magnet is much more compact. The probe can be inserted from the top of the magnet, that eliminates need to bring the magnet up onto the long legs. Second, the magnetic field in cryogen-free magnets is always ready to be changed. That is opening the possibility to use the same magnet at different fields.

We made a 400 MHz MAS NMR system and measured numbers of liquid and solid state samples to demonstrate the performance of the system. The temporal magnetic field distortion generated by the mechanical nature of the cryogen-free cold head is the reason why this technology is still rarely used for high resolution NMR.

We showed that these distortions can be made smaller than one part per billion with respect to the main magnetic field. That makes the cryogen-free magnets acceptable for solid state MAS NMR and possibly for liquid state NMR as well.

We also showed that the field settling process can be completed within an hour after the field change. That makes possible to change the field in the magnet in a day to day basis without compromising the measurements resolution.

We showed that the cryogen-free magnets have a good potential to replace the conventional liquid helium used magnets with the field up to 750 MHz in near future.

Arifah Goodwin
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Black Women in Leadership and the Complexities of Work Life Balance

Cacier Zilahy Hadad Arriagada
Professor, University of Antioquia, Colombia

Understanding the Importance of Computational Chemistry in Experimental Research: Case of Ultra-Brief Solvation of Carbenes

After discoveries and development of Schrödinger and Heisenberg, Heitler and London and many others, Roothaan's 1951 Molecular Orbitals by Linear Combination of Atomic Orbitals approach and MIT's 1956 Hartree–Fock method revolutionized theoretical chemistry, accompanied by the emergence and development of computers. By 1971 the already existing ab initio calculations expanded to larger molecules. Subsequent outstanding developments in quantum theory (for example DFT theory) and hand in hand with its implementation in algorithms, driven and dependent on the increase in the speed of computers, have made it possible to establish Computational Chemistry as one of the areas of Chemistry, which, in fact, is transversal to all of them. Today it plays a central and growing role in explanatory and predictive research, and in education, especially with its latest impetus given by the rise of AI.

On the other hand, one of the most famous reaction intermediates are carbenes, in which carbon is bonded to only two chemical groups, by single bonds, R-C-R', thus with incomplete octet. It turns out that carbenes can be generated in a given electronic state and their time-dependent transformations recorded by a combination of the short-pulse laser photolysis technique, LFP, coupled to ultrafast spectroscopic detection methods, such as UV-VIS or IR. With this it has been possible to detect and follow over time such subtle aspects as the formation of metastable complexes of carbene-solvent molecules, which persist over very short periods of time. Thus, for example, by means of UV-VIS spectra taken at different times, in intervals of nanoseconds, picoseconds, etc., it is possible to record how the signal corresponding to an isolated carbene disappears to give way to that of the carbene interacting with solvent molecules until it is completely solvated.

The formation and permanence of these chemical species for a short fraction of time, as well as their detection and monitoring, can be modeled by the methods of theoretical and computational chemistry. This is a very good example to illustrate how theoretical chemistry is able to "see" and explain (and predict) molecular details that experimental methods are not able to show. For example, Platz *et. al.* [J. Org. Chem. 79, 2341 (2014)] found that a transient species is formed

between Fluorocarbenoamide (a carbene) and Tetrahydrofuran, THF (a solvent), and that experimental results indicate that in this complex two solvent molecules must be involved in the first solvation sphere. However, the experiments are not able to indicate what the chemical structures are, nor how they are formed. The problem is that there are many possibilities in which 2 solvent molecules (2 THF) and a carbene molecule (1 Fluorocarbenoamide) combine. In a theoretical study [J. Chem. Phys. 142, 094302 (2015)] we reveal the main complex which accounts very well for all the experimental observations. In this work we will expose and explain didactically this last study with a view to highlight the importance of computational chemistry in current research in chemistry. Additionally, we will also show the ability of computational chemistry to predict new systems susceptible to further experimental observation, as is the case of new and unreported solvated species formed by difluorocarbenes.

Belkadi Hichem
Professor, University of Science and Technology of ORAN, Algeria

Influence of Radial Inner Cylinder Deformation on Taylor-Couette Flow with Free Surface

In this work we study numerically by FLUENT SYSTEM PACKAGE and experimentally the effects of modifications of Taylor-Couette system with a free surface for a nominal case then a controlled case by applying a dynamic control on the inner cylinder. The lengths of the cylinders are finite, the inner cylinder is rotating and the outer is maintained fixed. The fundamental system, with a height H=170 mm, a ratio of the inner to outer cylinder $\eta = 0.9$, an aspect ratio $\Gamma = 28.5$ .For the controlled case with a variation of the amplitude deformation from ε=1.6% to ε=4% of the inner radius, It is established that the Taylor Vortex Flow (TVF) is delayed compared to the nominal case.

Xianwei Hu
Professor, Northeastern University, China

The Thermal Stability of KNO3-Nano2-Nano3 Molten Salts: A Raman Spectra Study

Molten KNO_3-$NaNO_3$-$NaNO_2$ mixture is widely applied in the heat storage and transfer industry. The thermal stability of the heat transfer medium is close to the structure of it. Raman spectra is a useful tool for studying the structure of the molten salts.

In the present study, the Raman spectra of the $NaNO_3$-$NaNO_2$ and KNO_3-$NaNO_3$-$NaNO_2$ molten salt systems was recorded, and the thermal stability of them was then analyzed.

The results show that when the temperature is increased to a certain value, equilibrium between the decomposition of NO_3^- and the oxidation of NO_2^- exists in $NaNO_3$-$NaNO_2$ melts. The mole fraction incremental of NO_3^- showed linear relationship with molar fraction of $NaNO_2$. The empirical equations of mole fraction incremental of NO_3^- and molar fraction of $NaNO_2$ were obtained for different temperatures and the optimal compositions were given from the viewpoint of thermal stability of the molten mixtures.

For KNO_3-$NaNO_3$-$NaNO_2$ system, it was thought that the melt contained more $NaNO_3$ showed better thermal stability. The empirical equations of mole fraction incremental of NO_3^- and molar fraction of $NaNO_3$ were obtained. When the molar of $NaNO_2$ was 20%-90%, the molar of NO_3^- in ternary melts was increased, and when the molar fraction of $NaNO_2$ increased and the molar fraction of $NaNO_3$ increased, the changing value of molar fraction of NO_3^- increased. Meanwhile, when the molar of $NaNO_2$ was 10%, the molar of NO_3^- in the ternary melts was decreased, and when the molar fraction of $NaNO_2$ decreased and the molar fraction of $NaNO_3$ increased, the changing value of molar fraction of NO_3^- increased.

Pavel Ikonomov
Professor, Western Michigan University, USA

Hybrid 3D Metal Printing Process Optimization Using ML and AI

Metal additive manufacturing (AM) technologies, also called metal 3D printing, are based on a typical additive process for creating parts layer by layer; furthermore, some use support material. Since the quality parameters, including tolerance and surface finish after the AM process, are not sufficient, the subtractive process (CNC machining) is performed later on a separate machine. 3D Hybrid metal printer developed at Western Michigan University combines two manufacturing methods - additive manufacturing and Computer Numeric Control (CNC) machining. The additive process uses the gas metal arc welding (GMAW) method to deposit each metal layer along a path controlled with CNC. The subtractive machining process is performed on the same CNC-controlled machine. The 3D Hybrid metal printer iterates between these two processes, adding material with welding and then using CNC machining to refine the surface. These additive/subtractive processes are repeated until the final 3D object is complete to achieve the essential geometrical and quality requirements, the same as machining with a typical CNC machine.

Traditional manufacturing processes have been refined for many years to guarantee defect-free parts, while 3D printing often requires manual intervention and might produce imperfect layers. To address these issues, we developed an automated 3D metal printing process using sensors for feedback during the printing process and machine learning/artificial intelligence (ML/AI) algorithms to optimize the printing. This process aims to reduce costs, printing time, and waste while achieving first-time printing success with the same quality as traditional methods.

3D printing provides numerous advantages over traditional methods like complex geometrical designs, on-demand manufacturing, new materials, and reduced material usage. 3D metal printing faces challenges like slow printing speed and inconsistent material structure that prevent broader adoption in the industry. Our research addresses the slow speed and inconsistent material structure limitations of 3D metal printing with smart software based on ML/AI-based optimization techniques.

To improve 3D metal printing quality and prevent defects, a real-time monitoring and control system using multi-sensor fusion (vision,

3D scanning) and ML/AI algorithms. This system aims to identify and correct defects in-process during printing, leading to defect-free layers with optimal properties. Initial experiments using ML/AI were successful, and further refinement is in progress to increase the accuracy. Ultimately, this approach's goal is to reduce costs by preventing the need for reprints due to defects while speeding up production at the same time.

The final product, ready for industrial application, is an integrated 3D metal printing system with three features. First, an automated control system optimizes 3D printing and CNC machining processes. Second, a software optimizer determines the most efficient way to create parts based on their geometry. Finally, an in-process quality inspection system uses 3D scanning and cameras to automatically check parts during printing, ensuring they meet accuracy and finish requirements. Overall, this product aims to streamline and ensure quality control in 3D metal printing for the industry.

Hongxing Jiang
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MicroLED

MicroLED technology was first invented in 2000 by our research group while we were at Kansas State University. Today, the technology is becoming a household name and is one of the fastest-growing technologies in the world as technology giants utilize it on a wide-range of products from televisions and video walls, wearable displays, 3D/augmented reality/virtual reality displays, to light source for neural interface and optogenetics. It is fascinating to witness that scaling traditional light emitting diodes down to micron length scales has created such enormous new research and commercialization opportunities. This presentation will recount how the microLED was invented. The basic III-nitride microLED material structures, fabrication processes and characteristics will be reviewed. The realization of the first 10x10 passive-driven InGaN display as well as the first active-driven InGaN full-sale high-resolution microdisplay in video graphics array format (640 x 480 pixels) capable of delivering *video* graphics images will be described. The development of single-chip high-voltage AC- and DC LEDs based on microLED or mini-LED array technology for general illumination and solid-state lighting applications will be recounted. Recent efforts toward the realization of full color microdisplays will be examined. It is anticipated that the collective R&D efforts worldwide will bring microLED products not only to the mass consumer electronics markets, but also to serve the society on the broadest scale by encompassing sectors in medical/health, energy, transportation, communications, and entertainment.

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CyberWuP – A Low-Threshold Cyber-Security Awareness Program for Small and Medium Enterprises

With the ongoing digital transformation, small and medium Enterprises (SMEs) are exposed to a higher risk of cyber-attacks. The implementation of cyber-security recommendations is a challenging task for SMEs. Especially, small enterprises struggle in this context because of the lack of personnel and financial resources and the absent expertise. In 2022, the Ministry of the Interior of the State of Baden-Württemberg, Germany, funded in cooperation with the Aalen university the research project CyberWuP (Cybersecurity, Economic protection, and prevention for SMEs). The project's main goal is to develop an awareness program for cybersecurity which covers the needs of SMEs, especially the small ones, and is applicable breadthwise in the region of East Württemberg. The paper emphasis on the results and findings which have been achieved by the project. The paper is organized as follows. The first section shows the approach behind the awareness concept together with the goals to be achieved. The second section focusses on empirical studies with SMEs in East Württemberg to determine their knowledge and requirements concerning cybersecurity issues like cybercrime, insufficient equipment, and prevention. Several surveys have been rolled out. The empirical research provides important insights to design an awareness program which fits the needs of smaller enterprises. In particular, specific activities for a more sophisticated cybersecurity level, the time frame for potential consulting meetings (an hour) and the level of knowledge (low) have been derived from survey's data. The studies can confirm the particular importance of a consulting concept, since the most important influencing factor on the perceived threat of cyberattacks depends especially on the prevention measures used. The results clearly indicate that there is a lack of awareness of cybersecurity in small businesses, even among management. In addition, existing

information is not used, which is why the sustainable applicability of a consulting concept and low-threshold access to it are particularly important. The results of the survey, in combination with a systematic literature review, formed the basis for a consulting concept. Section 3 describes the development of the awareness consulting process and the respective information materials. With the involvement of experts and cooperation partners, a process model was created with the four stages "Informal Awareness Raising, Initial Impulse, Initial Consultation, and Integration of a Service Provider. Stage 3 is a central activity of the concept. It represents a low-threshold approach to improving management awareness with respect to cyber-security. The approach includes eight essential cyber-security recommendations which are mandatory to establish a minimal level of security within the enterprise. Supporting media are used, such as checklists, information cards, and IT-tools. Section 4 summarizes the results of a pretest of the awareness concept in the field. The pretest is divided into two phases. The sample size is approx. n = 50 and above the standards for pretests. Finally, in section 5 a conclusion is given with limitations of the concept and a further outlook of the research project.

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Ho-doped Lithium Niobate Thin Films: Raman Spectroscopy, Structure and Luminescence

Lithium niobate (LN) crystals, renowned for their exceptional nonlinear optical, electro-optical, piezoelectric, and photorefractive properties, stand as foundational materials in diverse fields of study and application. While they have long been utilized in frequency converters of laser radiation, electro-optical modulators, and holographic information recording media, LN crystals doped with rare earth ions represent a compelling frontier for modern compact devices. These materials exhibit immense potential as key components in infrared lasers, optical sensors, self-cooling systems, and radiation-balanced laser setups.

In this study, we present the successful synthesis of Ho-doped lithium niobate (LN:Ho) thin films on sapphire substrates employing the Sol-Gel technique. The films exhibit a strong crystallographic orientation along the perpendicular direction to the substrate surface, with X-ray diffraction analysis confirming the predominant alignment of the film's "c" axis, notably evidenced by the intense (006) reflection peak.

Further characterization through Raman spectroscopy, employing a confocal Raman microscope (LabRAM HR Evolution) with exciting wavelengths of 532 nm and 785 nm, unraveled intriguing insights. Under excitation with a 785 nm laser, Raman scattering obeyed selection rules, while employing a 532 nm laser unveiled additional forbidden lines, reminiscent of behaviors observed in bulk LN:Ho crystals. These supplementary lines were attributed to luminescence induced by excitation at 532 nm. Leveraging data from anti-Stokes Raman lines facilitated the disentanglement of luminescence spectra

from the investigated samples. Surface scanning affirmed the uniformity of both structure and luminescence across the thin films.

Notably, despite the robust orientation of the "c" axis perpendicular to the substrate surface, Raman signals indicated a stochastic distribution of "a" and "b" axes, validating the mosaic structure of the films along the mentioned axis.

This study offers valuable insights into the structural properties of Ho-doped lithium niobate thin films, with the observed luminescence behavior holding significant promise for potential applications in optoelectronic devices.

Laszlo Kollar
Professor, University of Pécs, Hungary

Selective Functionalization of Skeletons of Practical Importance via Palladium-catalysed Carbonylations

In this lecture the efficiency of homogeneous catalytic carbonylation reactions toward the functionalization of biologically important skeletons will be discussed.

1. The palladium-catalyzed aminocarbonylation of 3-iodochromone resulted in the formation of two types of products of practical importance in the presence of primary and secondary amines using atmospheric pressure carbon monoxide as carbonyl source. This procedure provided chromone-3-carboxamides and 3-substituted chroman-2,4-diones in selective carbonylations. The formation of the chromane-2,4-diones *versus* the carboxamide counterparts was dependent on the class of amines involved. The reaction proceeded *via* highly chemoselective aminocarbonylation in the presence of secondary amines by using monodentate or bidentate phosphine ligands, while the 3-iodochromone substrate underwent rearrangement to chromane-2,4-diones with primary amines when XantPhos was used as ligand.
2. The sterically highly un-favoured position-7 and position-11 of a steroidal skeleton was functionalised in a reaction sequence of conventional synthetic reactions and palladium-catalysed aminocarbonylation. In the first case, the synthesis was based on the application of chenodeoxycholanic acid, which was transformed to the 7-iodo-6-ene functionality in a five-step reaction sequence, which underwent high-yielding aminocarbonylation resulting in the corresponding 7-carboxamides. In the second case, a spirostane structure was functionalized by transforming 11-oxo functionality to 11-iodo-9(11)-ene in Barton-reaction which was amino- and alkoxycarbonylated toward carboxamides and esters, respectively.
3. The above carbonylations were used for the functionalization of porhyrins possessing bromo or 4-bromophenyl substituents in *meso* positions. A library of mono-, di- tri- and tetracarboxamides of unprecedented structure was provided.

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&
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Optimizing Inception Architectures for Automated Quality Control in Binary Classification

Inception algorithms as part of convolutional neural network architecture are widely used for different computer vision tasks. This research paper aims to present a study on the optimization of Inception architectures for binary classification tasks, with a special focus on automated quality control in processing, simplifying the control phase and increasing accuracy. Traditional quality control methods often rely on manual inspection, which can be time-consuming and prone to human error and inefficiency. The optimization process involves careful consideration of transfer learning techniques, showing the benefits of incorporating dropout layers, fine-tuning and other regularization techniques. The results are expected to contribute valuable insights for advancing the application of the inception architectures in automated quality control processes.

Evangelia Kotsikorou
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&
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Mutations in the BF3 Affect Inhibition of Androgen Receptor Activity by DDE

The androgen receptor (AR) has a central role in the development of the male phenotype and traits. Some diphenyl compounds inhibit AR activity by binding to a surface binding site, BF3. The pesticide 4,4' DDT and its breakdown product 4,4' DDE have a similar diphenyl structure. Previous results showed that DDT and DDE induced the release of bound dihydrotestosterone from the AR ligand binding domain. This suggested that DDT and related compounds may act as endocrine disrupting chemicals by binding to the BF3 site and inducing allosteric changes in the AR structure. Here, an AR reporter system was transiently transfected into HEK293 cells and AR activity was measured using a dual luciferase assay. The system was used to measure the response of the AR protein to varying concentrations of dihydrotestosterone in the presence and absence of DDE. DDE inhibited the activation of AR by dihydrotestosterone under these conditions. Five mutant AR receptors with amino acid changes in the BF3 site were tested for changes in the ability of DDE to disrupt AR activity. The mutations in the BF3 site reduced the ability of DDE to inhibit AR activity. Additionally, molecular docking calculations were used to dock DDE into the BF3 site of the wild type AR ligand binding domain and the five mutant BF3 sites. The energy of interaction between DDE and the BF3 site amino acids was evaluated for the wild type and mutant receptors. The relationship between the energies of interaction and the experimental results for DDE inhibition of the mutant AR activities will be discussed.

Katerina Kourentzi
Research Associate Professor, University of Houston - Chemical & Biomolecular Engineering, USA

Development of Translatable Point-of-Care Diagnostics in an Academic Setting and Opportunities for Multidisciplinary Student Training

The COVID-19 pandemic highlighted the need for sensitive, usable, affordable point-of-care (POC) diagnostics for disease screening and surveillance. Lateral Flow Assays (LFAs) continue to be the preferred format for POC diagnostics because they are rapid, affordable, and user-friendly. Our research group at University of Houston focuses on the development of novel analytical methods for clinical diagnostics, especially tests using novel reporter particles. During this lecture I will discuss examples of our efforts to engineer novel diagnostic technologies using nanoparticles and engineered phage and the resulting opportunities for student learning and training across multiple disciplines.

One example involves the engineering of a new, universal class of LFA reporters by conjugating filamentous M13 phage with antibodies and peroxidase reporter enzymes. M13 phage are stable, non-hazardous, monodisperse, neutrally buoyant, under Darwinian selection for non-aggregation and low nonspecific stickiness, and easy to produce in large quantities. We demonstrated a novel platform technology for highly sensitive LFAs employing M13-based chemiluminescent reporters, read by a smartphone and compatible with clinical samples. Extensive screening of commercially-available antibody pairs led to a limit-of-detection of 100 pg/mL of SARS-CoV-2 nucleoprotein in nasal swab extract when the test was imaged and analyzed by an *in-house* developed smartphone reader. We also demonstrated good performance with positive clinical samples. Beyond COVID-19 diagnostics, the phage LFA platform technology has very broad applicability to the detection of pathogens, protein biomarkers, food toxins, and environmental contaminants at the point of care/need.

More recently, we developed a new approach to simple, inexpensive Lateral Flow Assays (LFAs) of great sensitivity, based on the glow stick peroxyoxalate chemistry widely used in emergency settings and in children's toys. The “Glow” LFA platform using standard fluorescent nanoparticle reporters in an assay format in which optical excitation is replaced by chemical excitation. The one-step chemi-excitation of fluorescent particles produces visible light readable

by an unmodified smartphone, enhancing sensitivity while preserving simplicity and cost-effectiveness. Our Glow LFA detected the common model analyte human chorionic gonadotropin with a limit of detection of 39 pg/mL- over ten times more sensitive than standard gold nanoparticles using the same antibodies. Significantly, multiple fluorescent dyes can be chemi-excited by a single reagent, allowing for color multiplexing on a single LFA strip with a smartphone camera. We also completed a pandemic-driven National Institutes of Health, Rapid Acceleration of Diagnostics (NIH-RADx) effort aimed at developing a Glow LFA diagnostic for COVID-19 infection. We were not able to reach the point of commercialization within the limited time and resources available, but we did achieve strong proof-of-concept and advanced the translational aspects of the platform, including high-performance Glow LFAs (demonstrated limit of detection 100 pg/mL SARS-CoV-2 nucleoprotein and 280 $TCID_{50}$/mL of gamma-inactivated virions in nasal swab extract) reading by iPhone (and an in-house developed app) using only a plastic darkbox with no lens, and convenient dropper-format packaging of excitation liquid.

Andrey Krasilnikov
Professor, Pennsylvania State University, USA

Structural Insights into the Evolution of Catalytic Ribonucleoprotein Complexes

RNA-based enzymes of the RNase P family are ancient enzymes tracing their origins to the Last Universal Common Ancestor (LUCA). In the modern world, the enzymes of RNase P family are found in all three domains of life and show a considerable degree of phylogenetic conservation. These enzymes are composed of a catalytic RNA moiety and a varying number of essential auxiliary protein components. Remarkably, as the evolution progressed, the protein part of the enzymes grew more and more complex, while the RNA component lost some of its peripheral features. Moreover, in eukaryotes the RNase P lineage split into two, given rise to a sister enzyme RNase MRP, which uses the same catalytic mechanism as RNase P, but has evolved to process a distinct and non-overlapping set of substrates: while RNase P is largely involved in the maturation of tRNA, RNase MRP participates in the maturation of rRNA and is involved in the turnover of some mRNAs. Using our biochemical and structural data on RNase P and RNase MRP, we discuss the evolutionary pathways that lead to the shift from mostly RNA to mostly protein ribonucleoprotein enzymes, as well as the mechanisms that allow similar enzymes to diverge to evolve new specificity and functions.

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A Comparison between Traditional Methods and Generative AI for the Optimization of 3D Modeling and Printing

Undoubtedly, 3D field is in constant growth. One such innovation is precisely the combination of generative artificial intelligence (AI) with 3D modeling and 3D printing which offers novel solutions for design optimization and enhanced efficiency. What we will study in this paper is exactly the Generative Algorithm for 3D Printing (GAP). This innovative approach integrates real-time feedback loops, adversarial training, and metrics integration to optimize the 3D printing process. In this paper, we present the results of the comparative analysis of GAP with a simulated traditional 3D printing method, using real data for both scenarios, comparing the performance based on three study elements which are: layer adherence, printing speed, and structural stability.

Jingyu Lin
P. W. Horn Distinguished Professor, Texas Tech University, USA

Semi-Bulk Hexagonal BN Ultrawide Bandgap Semiconductors

III-nitride wide bandgap semiconductors have revolutionized the lighting industry and are poised to make a huge impact in power electronics. In the III-nitride family, the crystal growth and use of hexagonal BN (h-BN) as an ultrawide bandgap (UWBG) semiconductor are much less developed. The development of crystal growth technologies for producing semi-bulk crystals in large wafer sizes with high crystalline quality and low defect density is a prerequisite for utilizing h-BN as an UWBG electronic material. In addition to optoelectronic and electronic device applications, h-BN has another unique application for high efficiency solid-state neutron detectors because of an unusually large interaction cross-section of B-10 isotope with thermal neutrons, which however, also requires the development of thick semi-bulk large crystals. In this presentation, we provide a brief overview and recent progress toward the development of h-BN semi-bulk wafers up to 4-inches in diameter by hydride vapor phase epitaxy (HVPE) and metal organic chemical vapor deposition (MOCVD). Benchmarking the crystalline and optical qualities of h-BN semi-bulk crystals with respect to the state-of-the-art millimeter-sized bulk crystal flakes grown by the high pressure/high temperature together with photoluminescence emission and photocurrent excitation spectroscopy measurements identified that reducing the density of impurities and defects such as oxygen impurities and boron vacancies remains the most critical task for h-BN semi-bulk crystal growth. The performance results of neutron detectors fabricated from 100 mm thick h-BN wafers and the attainment of h-BN thermal neutron detectors with a record efficiency of 60% will be presented. The development of high efficiency h-BN neutron detector technology serves as a stepstone for further advancing the crystal growth technology to produce electronic grade h-BN semi-bulk wafers.

Antonio Lira
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Time-Differential Correlation between Earthquake Lights and Seismic Ground Accelerations

In the last years, not only have videos of seismic lights been recorded in various countries – Mexico (September 7, 2021), Ecuador (April 16, 2016), Mexico (September 8, 2017) and Peru (September 15, August 2007) –, but also clear evidence of a temporal correlation between seismic lights and earthquake accelerations has been found. Likewise, theories have been developed that have tried to explain the origin of seismic lights; however, they have had inconsistencies with the observed experimental data. In this work, an electrostatic theory is presented that is based on the separation of electric charge during the fracturing of the rock in the earth's crust and the induction of surface charges prior to the electric discharge in the atmosphere. Likewise, based on the theory presented here, a calculation is made of the underlying electrical charge in the crust, necessary for the generation of seismic lights. The charge found is of the order of magnitude of the electrostatic charges that form in clouds before a lightning strike.

Mojtaba Mahdavi
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Multi-Rate Filter Design Using Processing in Memory

Finite impulse response (FIR) filters hold immense significance across diverse applications, spanning audio, image, and video processing, along with their integral role in wireless communication systems. The most elementary form of an FIR filter is a *moving average filter*. One notable advantage of the moving average filter is its absence of overshoot, making it particularly favored in signal processing applications where the goal is to filter random white noise while preserving pulse response. Consequently, moving average filters are widely applied across diverse domains such as sensor data processing, biomedical signal processing, weather forecasting, and the analysis of stock prices to smooth data, enhance signal quality, and extract meaningful information.

Digital FIR filters offer a linear phase response and high accuracy, enabling performance levels that surpass what is achievable with analog filter techniques. Analog filters often suffer from drift caused by component variations, a challenge mitigated by the precision of digital FIR filters. However, due to the inherent high computational complexity and substantial memory requirements, designing an efficient and high-performance FIR filter is challenging. This challenge becomes more pronounced when dealing with high-order filters, as they demand a large number of multiply-accumulate (MAC) modules. This necessity calls for advanced methodologies to address these complexities and enhance the overall efficacy of FIR filter designs.

Another challenge in the realm of FIR filters involves the necessity to modify the effective sampling rate, prompting the design of *multi-rate FIR filters*. The multi-rate FIR filters facilitate the processing of signals at varying rates, enabling tasks such as sampling rate conversion, data compression, and efficient utilization of computational resources. While in many cases, this can be achieved by simply altering the sampling frequency to the analog-to-digital converter (ADC) or digital-to-analog converter (DAC), there is often a preference to conduct sample rate conversion after the signal has been digitized.

This paper introduces a new approach for implementation of high-throughput, fully parallel, and configurable FIR filters through the utilization of *processing-in-memory* (PIM) technique. Within this framework, the filter coefficients are programmed into an array of memristive devices, which can perform the essential multiply-

accumulate operations following Ohm's law and Kirchhoff's law. This innovative method not only enhances processing efficiency by reducing the complexity but also underscores the flexibility achieved by leveraging the unique capabilities of PIM in programming filter coefficients within memristors. Moreover, the proposed scheme supports arbitrary filter frequency responses with desired filtering characteristics and filter lengths. Additionally, the proposed PIM-based filtering scheme enables realization of multi-rate FIR filters and allowing variable processing rate, by employing decimation (reducing the sampling rate by a factor of M) and interpolation (increasing the sampling rate by a factor of L) techniques.

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Deep Learning: Solving New Keynesian Models

In a seminal paper, Krusell and Smith (1998) analyzed an incomplete-market heterogeneous-agent neoclassical model (HANC) with production in which the agents save through capital. They discovered that such a model has a remarkable feature of "approximate aggregation", namely, the mean of future capital distribution can be accurately predicted with just a mean of the current-capital distribution. In a companion paper, Krusell and Smith (1997) analyzed a similar model in which agents save through both capital and bonds and they found that such a model also has the property of perfect aggregation. However, the analysis of Krusell and Smith (1997, 1998) does not contain a version of the HANC model in which the agents save only through bonds. A peculiar feature of such an exchange economy is that the mean of the bond distribution is zero by construction, so it cannot be used as a predictor of future variables and hence, approximate aggregation does not hold.

The HANC class of models received a considerable attention in the literature, in particular, Den Haan, Judd and Juliard (2010) edited a special issue of the Journal of Ecnomic Dynamics and Control that s the computational approaches proposed for analyzing such models. The participants of the special issue were invited to solve two HANC models: one with savings through capital and the other with savings through bonds. There were many methods that worked accurately and reliably for the former model but the participants did not succeed in producing accurate solutions to the latter model. In particular, they tried out higher moments and other statistics of the bond distribution such as histogram or fraction of agents facing the borrowing constraint but those statistics did not have sufficient power for predicting the future aggregates. Eventually, the HANC model with savings through bonds was eventually removed from the original JEDC call and it was not studied in the literature to the best of our knowledge.

In the present paper, we use deep learning to solve the model with savings through bonds. The algorithm that we use essentially relies on Krusell and Smith (1998) style simulation. The critical difference is that they approximate decision function of an agent in terms of the

individual state variables of that agent and selected moments of aggregate distributions, while we approximate decision functions in terms of all individual, and aggregate state variables and we let the neural network to choose how the information contained in that distribution can be reduced and condensed into a smaller set of artificial features. For example, in the economy with 1,000 agents, the individual decision function depends on 2,001 state variables while we reduce it to depend on 64 composite features.

Krusell and Smith (1998) were able to guess a composite variable that contains all necessary information for describing the aggregate behavior of the economy which is the first moment but it is more difficult to find such a representation for the model with bonds. However, we show that if we take enough moments, our DL method can still produce an accurate solution. In turn, Krusell and Smith's (1998) method will not be able to produce so accurate solution. The reason is that Krusell and Smith's (1998) method constructs separately the individual and aggregate laws of motion. We show that finding the aggregate law of motion is problematic and the explanatory power of Krusell and Smith's (1998) regression is relatively low. Our DL algorithm does not involve a separate approximation of the law of motion for aggregate variables and an alternation between the individual and aggregate approximations and it does not suffer from that problem. We just simulate the panel of heterogeneous agents and use the resulting distributions to infer the aggregate quantities and prices as the economy evolves over time.

Our DLC method is related to recent papers on deep learning, including Duarte (2018), Villa and Valaitis (2019), Fernández-Villaverde, Hurtado, and Nuño (2019), Azinović, Luca and Scheidegger (2019), Lepetyuk, Maliar and Maliar (2020) and especially, Maliar, Maliar and Winant (2018, 2019), see the latter paper for a discussion of the literature. Recent numerical methods for solving Krusell and Smith's (1998) model include Ahn et al. (2017), Bayer and Luetticke (2018), Boppart et al. (2018), and Fernández-Villaverde et al. (2018). These new developments in solution techniques are primarily motivated by recent interest in modeling the effects of fiscal and monetary policies on distributions. Our DL method differs from the literature in that it requires essentially no simplifying assumptions and can solve the studied class of models both accurately and reliably.

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Employing Mechanochemistry in Organic Synthesis for Obtaining Biofunctional Hybrid Molecules

Mechanochemistry is considered a viable alternative for organic transformations owing to its substrate availability, stability, and reduced reliance on solvents during the reaction process. Its notable efficiency and environmentally friendly attributes have sparked particular interest in the pharmaceutical industry, positioning it as the most promising green alternative for organic synthesis. Employing mechanical energy to induce or hasten chemical changes, mechanochemistry stands out as an effective and eco-friendly method for obtaining organic molecules.

In adopting a novel green and eco-friendly approach—specifically, mechanochemical, solvent-free, and heterogeneous catalyzed—we successfully produced a series of innovative biofunctional hybrid molecules. This method facilitates the rapid and facile generation of novel compounds without the formation of by-products or waste materials.

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Structure of Luminescent Species in Ag-Zeolites Investigated Via X-Ray Absorption Fine Structure

Ag-zeolites are promising candidates of luminescent materials without rare earth elements. The several types of Ag-zeolites (A, X, Y) show various wave-lengths of photoluminescences (PL) around at 500~700 nm after evacuation or appropriate heat treatments. The intensity and the wave-lengh of PL depend on the conditions of heat treatments, amount of Ag ions in the zeolite cavity, and type of zeolite. So the mechanism of the PL from the Ag-zeolites have not been unclear even now.

X-ray absortion fine structre (XAFS) is poweful tool for investigation of local atomic structures in the chemical species. XAFS studies using synchrotron radiation have been performed to reveal the mechanism of PL in Ag-zeolites. For Ag-zeolite A, the PL at 660 nm and 520 nm were observed due to a excitation of 313 nm light. We performed an operand quick scan mode XAFS in which 1 scan takes within 1 min in order to analyze a time resolved phenomenon, where XAFS and PL were simultaneously measured in the process of evacuation. It is found that the intensity of the PL at 660 nm increased under evacuation and Ag clusters were grown which was observed from XAFS. So it was confirmed that the PL at 660 nm was arised from the Ag clusters. Whereas, the intensity of 520 nm PL decreased under evacuation, visa versa, which means that the formation of Ag clusters hinder the 520 nm PL. The mechanism has not been clear yet up to now.

To investigate the mechanism of around 520 nm PL, we analyzed XAFS for Ag-zeolite Y, in which small portion of Ag ion was introduced in the zeolite to prevent from the formation of Ag clusters. Two kinds of Ag-zeolites Y, unheated and heated, were analyzed. The Ag-zeolite Y heated at 673K for 3 hours shows 510 nm PL but the unheated sample does not show any PL.

The X-ray absorption spectra of Ag-*K* edge were measured at NW10A in PF-AR, KEK Tsukuba using transmission mode. We performed careful analysis of Ag-*K* edge XAFS and proposed a following model for luminescene mechanism at 510 nm: According to the appropriate heat treatment, the water molecules were removed from the vicinity of Ag ions and the Ag ions move to center of six-membered ring of zeolite frameworks, in which the Ag ions are coordinated by three oxygen atoms in the ring. Generally, three-oxygen

coordinated Ag ions often show the PL around 500 nm via a electron transition from ligand to metal. We will discuss structure parameters around Ag ions obtained from XAFS and the mechanism of the PL more detail.

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Using Federated Machine Learning in Predictive Maintenance of Jet Engines

The goal of this paper is to predict the Remaining Useful Life (RUL) of turbine jet engines using a linear model within a federated learning framework. Federated learning enables multiple edge devices/nodes or servers to collaboratively train a shared model without sharing sensitive data, thus preserving data privacy and security. By implementing a linear model, the system aims to capture complex relationships and patterns in the engine data to enhance the accuracy of RUL predictions. This approach leverages decentralized computation, allowing models to be trained locally at each device before aggregating the learned weights at a central server. By predicting the RUL of turbine jet engines accurately, maintenance schedules can be optimized, downtime reduced, and operational efficiency improved, ultimately leading to cost savings and enhanced performance in the aviation industry.

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School Counselors Post-Pandemic Support of Eighth-Grade Students with Social-Emotional Learning Challenges

In 2020, the world was forced to adjust to a new normal with the global pandemic. Every nation had to make difficult decisions to protect citizens and save their economy. Leaders of all institutions had to strategize quickly for an unknown future. Many institutions suffered, including education. Social-emotional learning addresses students' positive development of their social relationships, responsiveness, emotional parameters, healthy personalities, personal and joint objectives, alignment, and responsibility in decision-making (Collaborative for Academic, Social, and Emotional Learning [CASEL], 2020). Research data were collected utilizing quantitative research methods and the SPSS analyzing program, allowing social-emotional learning data to be abstracted and analyzed through surveys and one-on-one interviews with eighth-grade school counselors. This education professional must be committed to providing SEL support to assist eighth-grade students with more successful behavior and academics that will benefit their education as a life-long journey. Establishing a more formal SEL Program, policy, and procedure implementation and refining the professional development of educators will be shown and deciphered. Mirroring social-emotional learning and skills to the Virginia Department of Education's goals for improved academic and behavioral results can facilitate the more effective implementation of a stellar SEL program within the school setting. This orderly literature review will examine the relationship between school social-emotional learning programs, education level transitioning, and academic outcomes.

Shizhang Qiao
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Electrocatalytic Refinery for Production of Fuels and Chemicals

Compared to modern fossil fuel-based industrial refineries, the emerging electrocatalytic refinery (e-refinery) is a more sustainable and environmentally benign strategy to convert renewable feedstocks and energy sources to transportable fuels and value-added chemicals. E-refinery promisingly leads to defossilization, decarbonization, and decentralization of chemical industry. Specifically, powered by renewable electricity (e.g., solar, wind and hydro power), oxygen evolution reaction (OER) and hydrogen evolution reaction (HER) can efficiently split water into green hydrogen and CO_2 reduction reaction (CRR) can convert CO_2 emissions to transportable fuels and commodity chemicals.

A crucial step in realizing this prospect is the knowledge-guided design of appropriate reactions and optimal electrocatalysts with high activity and selectivity for anticipated reaction pathways, which dominantly involve cleavage and formation of chemical bonds between H, O and C. In this presentation, I will talk about our recent progress in mechanism understanding and material innovation for some crucial electrocatalytic reactions (OER, HER, CRR, etc.), which are achieved by combining atomic-level material engineering, electrochemical evaluation, theoretical computations, and advanced *in situ* characterizations. A special emphasis is placed on the rational exploration of electrocatalysts for the production of green hydrogen by seawater splitting and chemicals by CO_2 reduction reaction.

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Discovery of Tumor Targeted Glutamine Antagonists vis Prodrug Strategy

The glutamine antagonist 6-diazo-5-oxo-L-norleucine (DON) has been studied for over 60 years due to its remarkable anticancer efficacy; however, its therapeutic potential has been hindered by biodistribution and toxicity issues in gastrointestinal (GI) tissues. Recently, we reported the design and characterization of our lead dual DON-peptide prodrug, isopropyl(S)-2-((S)-2-acetamido-3-(1H-indol-3-yl)-propanamido)-6-diazo-5-oxohexanoate, termed as DRP-104. The prodrug was designed to circulate intact and inert in the body, bioactivating preferentially in the tumor through tumor-enriched proteases, thus averting GI exposure and toxicity.

When administered to C57BL/6/CES1-/- mice bearing EL4 tumors, DRP-104 preferentially distributed to tumors, delivering a remarkable 6- and 11-fold greater exposure of DON to the tumor versus plasma and GI tissue, respectively. In a head-to-head efficacy study in mice at equimolar doses, both DRP-104 and DON caused complete tumor regression. However, DRP-104-treated mice showed a dramatically improved tolerability profile versus DON-treated mice, as assessed by changes in body weight, blood chemistry, and GI histology. Metabolomic analysis in DRP-104-treated tumors demonstrated robust effects on glutamine-utilizing pathways, with the most prominent impact on the tricarboxylic acid (TCA) cycle and purine biosynthesis.In addition to demonstrating robust anti-tumor activity as monotherapy, DRP-104, in combination with anti-PD-1, showed a substantial enhancement of efficacy compared to anti-PD1 treatment alone. The effect of DRP-104 was found to be CD8+ T-cell dependent and resulted in robust immunologic memory. Currently, DRP-104 is in clinical trials for the treatment of solid tumors.

In addition to DRP-104, we synthesized and characterized other ester and amide promoiety combinations to improve solubility, stability, and DON tumor exposure. Our next-gen prodrug, tert-butyl (S)-6-diazo-2-((S)-2-(2-(dimethylamino)acetamido)-3-phenylpropanamido)-5-oxohexanoate (P11), showed excellent metabolic stability in plasma and intestinal tissue (>50% remaining at 1h), improved solubility (>20-fold), and significantly enhanced DON levels.

In conclusion, these studies have presented the design of glutamine antagonist prodrugs with desirable physicochemical and pharmacokinetic attributes.

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Antiproliferative Response of Azole-Derived Compounds on Promastigote forms of Leishmania Mexicana

Pharmacomodulation occurs by inserting or modifying the functional groups of a molecule, to modulate its physicochemical properties. The hydrazone, amino and amide group confer multiple effects on the molecules, ranging from solubility effects, polarity effects, electronic properties and even the acquisition or enhancement of biological activities. Heterocyclic systems, imidazo[1,2-*a*]pyridine and thiazole, have been of interest in the field of research due to their association with multiple biological activities.

The preparation of binders with suitable electronic effects to interact in the signaling pathway that disrupts the defense mechanism of these parasites allowed the obtaining of a series of compounds, which demonstrated antileishmanial activity. To establish the pharmacochemical contribution of the structural variations, the in vitro activity on Leishmania mexicana promastigotes of the N-imidazo[1,2-a]pyridin-yl-hydrazones, 2-amino-4-R-phenyl thiazole and derivatives of benzamides and carbamides series, was evaluated. Which were synthesized and analyzed bioinformatically, allowing their affinity to be established, as well as the patterns that lead to better recognition. Selective substitution has been sought in different positions to obtain molecules that are mostly enhanced on promastigotes of *Leishmania mexicana.*

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Advancing Sustainability Education: A Review of Integrating Life Cycle Assessment (LCA) in Higher Education

Life Cycle Assessment (LCA) is a comprehensive approach for evaluating the environmental impacts of products and services throughout their life cycles. LCA can play a pivotal role in educating future professionals on sustainable practices. This paper presents a review of the integration of LCA into higher education, focusing on its role in fostering sustainability and environmental awareness across diverse academic disciplines. This review explores the various approaches used to integrate LCA into academic curricula and the challenges, benefits and advancement associated with its implementation. The methodology employed in this review involves a comprehensive analysis of existing literature in higher education. By examining the strategies adopted by higher education institutes to incorporate LCA, this paper provides insights into contemporary practices and advancements in LCA education for students. The review finds multiple benefits of integrating LCA into higher education, including promoting interdisciplinary learning, enhancing critical thinking skills, and preparing students for careers that prioritize environmental stewardship. Furthermore, it addresses the challenges faced by educators, including resource constraints, the need for specialized training, and the continuous updating of course materials to reflect the latest developments in LCA methodologies. Additionally, this review highlights the importance of establishing a shared comprehension of teaching LCA concerning its content, literacy levels, and competencies. Finally, this paper emphasizes the need for ongoing research and collaboration among academia, industry, and policymakers to further enhance the integration of LCA into educational curricula and drive sustainable practices in the future.

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&
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Machine Learning Techniques with Fairness for Prediction of Completion of Drug and Alcohol Rehabilitation

The aim of this study is to look at predicting whether a person will complete a drug and alcohol rehabilitation program and the number of times a person attends. The study is based on demographic data obtained from Substance Abuse and Mental Health Services Administration (SAMHSA) from both admissions and discharge data from drug and alcohol rehabilitation centers in Oklahoma. Demographic data is highly categorical which led to binary encoding being used and various fairness measures being utilized to mitigate bias of nine demographic variables. Kernel methods such as linear, polynomial, sigmoid, and radial basis functions were compared using support vector machines at various parameter ranges to find the optimal values. These were then compared to methods such as decision trees, random forests, and neural networks. Synthetic Minority Oversampling Technique Nominal (SMOTEN) for categorical data was used to balance the data with imputation for missing data. The nine bias variables were then intersectionalized to mitigate bias and the dual and triple interactions were integrated to use the probabilities to look at worst case ratio fairness mitigation. Disparate Impact, Statistical Parity difference, Conditional Statistical Parity Ratio, Demographic Parity, Demographic Parity Ratio, Equalized Odds, Equalized Odds Ratio, Equal Opportunity, and Equalized Opportunity Ratio were all explored at both the binary and multiclass scenarios.

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Valorization of Margins: Physico-Chemical Characterization and Bactericidal Effect of Vegetable Waters

Mediterranean countries are known for their olive oil production, which accounts for 97% of global production. Morocco is one of the largest producers of olive oil, and this industry is beneficial for the national economy. In particular, the Beni Mellal-Khenifra region is renowned for this industry, which not only produces olive oil but also generates vegetable water that have a detrimental effect on the environment, including surface and groundwater pollution, as well as emitting unpleasant odors. This study focuses on the valorization of these waste products, whether they come from pressing (traditional) or centrifugation (modern) processes, by characterizing their physicochemical composition and measuring the polyphenols. The obtained values range from 0.8 g/l to 1.17 g/l, highlighting that margines from the centrifugation (modern) process are richer in polyphenols than those from pressing (traditional). Using the solid diffusion method, we determined the sensitivity of four bacterial species to the vegetable water, namely Bacillus megaterium, Escherichia coli, Pseudomonas aeruginosa, and Klebsiella pneumoniae. These bacteria showed sensitivity to the margines, with Gram-positive bacteria being more sensitive. This effect is linked to the bioactive compounds present in the margines, such as polyphenols.

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Development and Practice of Teaching Materials for Early STEAM Education of Elementary and Junior High School Students Using Tiling

In Society 5.0, the concept of a future society developed by the Japanese government, human resources from STEAM with 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 a STEAM center 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 Seminar" to fourth year students in the main course (first year of the undergraduate course). In this seminar, teachers of subjects in liberal arts present themes using their own specialties, such as mathematics, debate, and economics. Collaborative learning of students from various departments led them to deep learning, which is a fusion of knowledge and creation. Nonetheless, there are few opportunities to give back to society, especially as a platform for disseminating acquired mathematical ability. Therefore, we aimed to realize early STEAM education and give back to society by creating STEAM teaching materials on tiling for open courses for elementary and junior high school students by engaging students who studied tiling as teaching assistants in this seminar.

We considered a teaching material on tiling, such as Escher's print, from the perspective of STEAM education as a fusion of art and mathematics. Since the age of ancient Greeks, the tiling problem asks what types of figures can be used for tiling. It is known from these times that any triangle or square can be used for tiling. Because tiling is easily understood visually and requires little prior knowledge to grasp it, it is suitable as a STEAM learning material for a large number of generations.

The purpose of the course was not only to arouse students' interest in mathematics but also to provide them with clues to develop their multifaceted ideas. We introduced a STEAM teaching material on tiling and considered the results of an open course. In the course, we examined what kind of (same-shaped) tiles could cover a plane and sphere. The findings revealed that elementary and junior high school students provided high survey ratings to this course, while teaching

assistants had an invaluable opportunity to give back to society by applying their acquired skills.

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Jechiel Jagoda
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Engineering Analyses of Retrofitting Existing Helicopters for Urban Air Mobility and Inter-City Applications

Megacities around the world suffer from traffic congestion and long commute times, even with availability of public transportation systems. Transportation of materials and goods, delivery of critical supplies, ambulance services, and search and rescue operations are all affected by the traffic gridlock. Affordable, environmentally friendly air mobility systems can play a vital role in alleviating these shortcomings. In some communities, intercity transportation is also impacted by the lack of infrastructure hampering education and commerce opportunities and affecting medical services.

Much of the existing research and development studies have focused on developing brand new VTOL and eVTOL systems from scratch. Such systems face a long lead time in terms of engineering design, flight tests, and certification. Relatively less effort has been made towards retrofitting existing piston and turbine engine-based systems for urban air mobility applications.

In the present work, results are presented for several existing systems (Robinson R-44 and R-22, BO-105, and EC 135), retrofitted with a variety of sustainable propulsion options: battery-powered, hybrid systems, and sustainable fuel-based propulsion systems. Aerodynamic analyses quantifying the impact of these retrofits on the range and endurance of the aircraft. The impact of the retrofit on the system weight and cost are also discussed. A brief economic study is presented assessing the viability of these systems for urban and inter-city operations.

Elizabeth Scheer
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Inclusive Abstraction: Teaching Eva Hesse in the South Bronx

In recent years, "inclusion" has been invoked alongside politically reparative terms like "diversity" and "equity" as language that aims to amend fraught historical trauma and systemic oppression. In the humanities, educators have aimed to "include" texts written by those of varied ethnic, religious and socio-economic backrounds so as to incorporate a range of voices into the literary canon. As scholars have noted, however, the trouble with this definition of inclusion is that it risks preserving the very divisions it purports to ameliorate; to be "included" is to be marked as Other—an outsider conspicuously brought into the fold. This paper draws from my own experience as art history and literature faculty in the Bard Early College Program in the South Bronx, where students in my American Portraiture class have ventured into an intensive study of Abstract Expressionism, finding intellectual rigor and creative kinsmanship in the work of traditional New York School artists like Eva Hesse, Robert Rauschenberg and Jackson Pollock. Using this eleventh-grade class as a case study, my argument is that the inclusion of abstraction as a method of engaging with the world is politically reparative work, precisely because it endows students with new tools for articulating their own subjectivity.

Stanislav Selitskiy
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Batch Transformer Architecture: Case of Synthetic Image Generation for Makeup and Occlusion Face Recognition

A novel Transformer variation architecture is proposed in the implicit sparse style. Unlike "traditional" Transformers, instead of attention to sequential or batch entities in their entirety of whole dimensionality, in the proposed Batch Transformers, attention to the "important" dimensions (primary components) is implemented. In such a way, the "important" dimensions or feature selection allows for a significant reduction of the bottleneck size in the encoder-decoder ANN architectures.

The proposed architecture is tested on the synthetic image generation for the face recognition task in the case of the makeup and occlusion data set, allowing for increased variability of the limited original data set.

Vivian Shannon-Ramsey
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e: Leveling the Playing Field: Social Justice and Inclusion of International Education for Black Students

Despite the positive outcomes of international education, Black students are still underrepresented, comprising less than six percent of U.S. students who study abroad. This disadvantage comes during a decade of an interconnected, rapidly changing world that challenges us to increase intercultural encounters daily (OECD, 2018). This lack of participation in international education has employability implications. For example, when employed, Blacks with a college or advanced degree are more likely than their white counterparts to be underemployed regarding their skill level (Williams et al.; V., 2019). A part of this underemployed status is because many companies are interested in employees with international education experience and often screen job applicants based on whether they have studied abroad (Pietro, 2019).

Employers like to see various experiences, including communication, intercultural, and leadership skills, which are commonly enhanced and developed during study abroad. Growing research finds a connection between studying abroad and the skills contributing to employment and career development in today's workforce (Sanger, 2017). There needs to be increased participation in study abroad to bridge learning opportunities across borders and improve cultural knowledge and employment skills (Shannon-Ramsey et al., 2023). This presentation seeks to share strategies for how institutions can reduce the inequality in access to study-abroad opportunities.

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Mathematics and Physics

This paper is concerned with the great influence of mathematics on theories in physics. Theories set the framework of thinking in certain directions, it forces scientists to discard certain information because it does not fit with the way these theories perceive the world, and hence a huge amount of information is lost. Now, have that information being processed and analysed, we would have been presented with a different version of events, with a different science. History of physics provides us with many examples where theories prevented scientists from advancing in certain ways. Moreover, when we take the whole scientific process as a Phenomenon to be studied, the mathematical formulation plays a major role in specifying the paths that are allowed to be advanced, hence any advancement would not be possible accept from minds that had not yet been poisoned with the mathematical posits. Some of these examples are presented here. Can our understanding to such history help us in solving the current crisis in physics? A discussion of the role of String Theory in theoretical physics might help in giving an answer to such question.

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Small Scale Interoperable Social Media: A Design Framework for Decentralization

The pitfalls of using centralized social media platforms for individuals and institutions have been well documents and analyzed. Those pitfalls led to the rise of decentralized social media platform. Initially, the technical challenges surrounding the developments and maintenance were high. That however has changed significantly with open- source solutions, widely accepted open protocols and the lowering cost of cloud services for infrastructure. This paper explores the design for a social media system for internal institutions and organizations.

Andrzej Sokolowski
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Constructing Wave Function Using Parametric Equations

Transferring structural math knowledge to physics is difficult for students. While various ideas are suggested by the research, enhancing parallelism of algebraic structures used in physics to these studied in mathematics courses seems underrepresented. This presentation suggests an alternative way of introducing wave function as a set of parametric equations. Research shows that the mathematical underpinnings of the mechanical wave function are problematic for students. As seen from the math perspective, there can be several drawbacks in the algebraic form $y(x,t) = Acos\left(\frac{2\pi}{\lambda}x - \frac{2\pi}{T}t\right)$ that likely impede its analysis and interpretation; (a) the function $y(x,t)$ represents a combination of a composite function $x(t)$ and the variable t; such function combination is rarely analyzed in precalculus and calculus courses, (b) the technique of reducing the wave function to one-variable sketchable representations $y(x)$ and $y(t)$ is also not practiced in mathematics courses, (c) There seems to be also a math prerequisite misalignment; in calculus one, that is, the prerequisites to take a university physics course do not cover partial derivatives required to differentiate $y(x,t)$. Therefore, understanding a new mathematical representation and its physical interpretation can be difficult for students. Thus, seeking math concepts that physics students are familiar with from precalculus appeared as a potent idea. During this presentation, the didactics of introducing the movement of energy modeled by two-dimensional waves and study findings on how physics students perceived the usefulness of these math tools to understand that analysis will be discussed.

Izabela Stroe
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Integrating Entrepreneurial Mindset and Value Creation in Teaching Physics to Engineering Students for Innovation and Impact

Worcester Polytechnic Institute is committed to the education and training of engineers for the needs of the 21st century by connecting science content to issues of critical local, national, and global importance. Recent survey done by Kettering University of industry employers shows that a large gap exists between what employers consider the "most essential competencies" for workforce readiness and graduates' proficiency. For example, engineering students were competent in some key scientific and technological areas and were strong at continued learning; however, they lacked key skills, knowledge, and mindset to be successful in innovation with impact. To close the gap, we redesign the physics curriculum to integrate Entrepreneurial Mindset (EM) and Value Creation Framework (VCF) as a tool that empowers each student to connect physics topics to real-world societal problems and to innovate with impact. The integration of EM and VCF as a tool in teaching Physics courses proved to be impactful not only in the upper-level courses, but also in the large introductory physics courses. This is particularly important, as it shows that undergraduate students can learn to innovate with impact from day one in college. Therefore, engineering students better understand the critical needs of society, they are more motivated to learn and innovate, and they are overall more ready to successfully contribute to global partnerships.

Linda Taylor
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The Politics of Leading: An Analysis of Trustee Decisions to Appoint Women Presidents at Historically Black Colleges and Universities from 2020-2023

The purpose of this experimental research study is to garner systematic dynamics and governance understanding of what prohibited and subsequently advanced women's considerations to obtain a presidential appointment at historically black colleges and universities (HBCU) across the United States from 2020 through 2023; and why those appointments increased substantially during that time frame (Baskerville, 2023). Women's representation as presidents appeared dismal from 1837 through 2020 with less than fifty who served in leadership positions (Dillon, 2019).

The question of who is leading the leaders resonates as a directional consideration for researching equity, diversity, and inclusion decisions. A review of the literature revealed that university presidents are selected by governing boards, which historically have been comprised predominantly of males (Bates, 2007). Gender domination could support clarification of why women were rarely selected as presidents of HBCU institutions.

This qualitative study employed a grounded theory approach including a targeted survey with six current board of trustee members from various HBCU institutions. Additionally, case study interviews were conducted with two active HBCU female presidents and two state governors' ranking officials to evaluate patterns, trends, and insights into women's presidential appointment process experiences.

The results of this dissertation demonstrated implications of why women HBCU Presidents increased substantially with grounded theory patterns, trends, and predictions based on gender biases; underrepresentation of women trustees; and societal pressures factors.

John Paul Tharakan
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Creating the 21st Century Engineer for Sustainable Development and Social Justice

Engineering educators bear a profound ethical responsibility as the stewards of the next generation of critical and innovative thinkers. It is imperative that we equip our engineering graduates not only to confront the monumental challenges facing humanity but to be the architects of innovative technologies, products, and processes that directly contribute to achieving sustainable development goals. This entails more than the traditional role of problem solvers; it requires a fundamental shift in the paradigm of engineering education.

The conventional approach, often characterized by chalk-and-talk lectures and limited assessment methods like problem sets and exams, must evolve to meet the demands of the 21st century. In this presentation, we endeavor to showcase tangible strategies for implementing transformative changes within engineering programs. Our goal is to guide educators in updating and upgrading curricular and programmatic approaches, ensuring that their graduates emerge as transformative thinkers and adept problem solvers, well-equipped to navigate the complex landscape of contemporary engineering challenges.

Central to this transformation is a departure from traditional teaching methods. Project-Based Learning (PBL) stands out as a pedagogical approach that immerses students in real-world, open-ended projects, fostering the development of critical thinking, collaboration, and problem-solving skills. PBL not only bridges the gap between theory and practice but also instills a sense of purpose by directly addressing real-world challenges.

Service Learning (SL) is another pivotal element that can be seamlessly integrated into engineering curricula. By engaging students in community-based projects, SL not only enriches their educational experience but also underscores the social responsibility inherent in engineering practice. These projects, ranging from sustainable energy solutions in rural communities to water treatment initiatives, not only provide practical learning experiences but also contribute to the betterment of society.

Open-ended design (OED) thinking is an essential aspect that encourages students to approach problems with creativity and flexibility. OED projects allow students to explore multiple solutions,

fostering innovation and adaptability. By incorporating OED thinking, engineering programs can cultivate a mindset that is attuned to the dynamic and evolving nature of the engineering profession.

Moreover, an integral aspect of this presentation will be an exploration of the ethical dimensions of engineering. Recognizing the profound impact of engineering projects on society, we will emphasize the importance of ethics and social justice considerations. Engineers must be cognizant of the broader implications of their work, ensuring that their solutions are not only technically sound but also ethically and socially responsible.

In conclusion, this paper seeks to be a catalyst for change in engineering education, advocating for a paradigmatic shift that aligns with the needs of the 21st century. Through the integration of PBL, SL, OED thinking, and a heightened awareness of ethics and social justice, we aim to empower engineering educators to nurture a new generation of professionals who will not merely solve problems but transform the world for the better.

Ching-pin Tseng
Associate Professor, National Sun Yat-sen University, Taiwan

Cooperation and Narrative Sharing: Building a Co-Creative Teaching and Learning Situation through Quasi-Theatrical Teamwork

Works of theater arts are produced by associating with artists, dramaturgists, designers and technicians from various professions. Multiple layers of idea exchanging and complex processes of coordination are embedded in the mechanism of creative teamworking. The audience may not fully perceive the realistic dimension behind this creative teamwork. However, also because of the reality of co-creation, dramatic scenarios and rich artistic connotations of theatrical works can be achieved in the team. This paper argues that the generation of dramatic works and the concept of theater are closely related to everyday lives. The course of 'Introduction to Theatre Design' is set to start from shaping appropriate relationship among participants in their real lives. Students can also initiate their learning from the observation of everyday reality to discover theatrical connotations, and further to strengthen the process of narrative sharing and the establishment of cooperative relationships among participants of quasi-theatrical teamwork.

Theater arts is both a practical profession and a research discipline full of rich connotations of human civilization. Due to the classification of teaching expertise in the academy, teaching courses of theater arts often divide into practical work and theoretical knowledge. It results in that the mutually beneficial mechanism of teamworking in creating theatrical works can be difficult to motivate. Moreover, the director is used to be regarded as the most important role in theatrical education and practical world, as well as being authorized to have a dominant power in the decision-making of theatrical production. Therefore, other professional participants would become a secondary or functional role. The reasons for having these phenomena in academy, firstly, is because students may have biased cognition in the cooperative mechanism of theatrical production. Secondly, it may be caused by a premature grouping for students' professional selections and study routes, and thus a diverse identification may be shaped among various professions. Thirdly, practice-oriented students may pay less attention to theoretical knowledge, or theory-oriented students may not have enough practical experiences.

From questioning the traditional unidirectional teaching and learning method, this paper intends to explore how a co-creative team that is formed by students with varied professional ability can build up a base for interdisciplinary understanding. By sharing narratives in the mode of co-working, this research expects that students can incubate their habits of team discussion, exchange and cooperation through telling stories to and sharing experiences with each other. It is thus possible to strengthen the potential for lateral learning from peers. The content and implementation of the course intend to break down the border of classrooms through the notion of 'city as theater', i.e., learning from the university surroundings. By associating with theatrical theories and the idea of 'learning by doing', living scenarios can be integrated with theatrical settings. Under the circumstance of co-creative teamworking, students with varied professional abilities and interests can thus build up compatible and considerate learning situations. Moreover, a co-creative and symbiotic theatrical environment can be established in the future.

Volodymyr Voytenko
Professor, Sheridan College, Canada

An Iot-Based Smart Home System Prototype with Sensors Management

The Internet of Things (IoT) is a network system that enables the connection and remote monitoring of devices through the Internet. Over recent years, the IoT concept has undergone significant development and is presently applied in diverse areas, including smart homes automation system. In our rapidly advancing world, the integration of a smart home can greatly enhance our quality of life by providing increased comfort, convenience, and safety. These smart homes leverage cutting-edge communication and information technologies, employing IoT sensors and devices to continuously monitor our well-being. Our ongoing research is dedicated to developing a responsive smart home system prototype that can promptly detect critical deviations from regular daily activities within a residence. Examples of such situations include scenarios where a refrigerator is inadvertently left open, a stove (oven or element) has been operating for an extended period, a garage entrance door is left ajar, or cooking in the kitchen is left unattended. Our work introduces the system prototype, detailing the implementation how to gather and analyze data from various wireless sensors. The proposed system encompasses the following computing architecture:

- Raspberry Pi with display acts as the central configuration unit and human-computer interaction part for the mobile context module, enabling automatic boot with a direct connection to the home network without requiring any additional authentications.
- Sensors tag manager is capable of managing multiple wireless sensors (up to 40 within a residence) connected to the home network, providing unlimited cloud storage for logged data.
- Wireless sensor designed to sense physical information, including temperature, ambient light, air humidity, angle-based motion data, etc.., and transmit the collected data back to the sensor tag manager, covering a distance of up to 200 meters.
- Wireless tag web service offers unlimited access to sensor tag information stored in the cloud, encompassing all sensor data.

In the event of a notifications, the system is able to notify a user's emergency contacts through SMS services. Additionally, a voice

message (alert) can be delivered via the residence's speaker. On the user side, options include accepting a notification, snoozing it for specific time intervals, or clearing the alert. This multi-modal approach ensures flexibility and responsiveness in addressing critical situations.

In conclusion, proposed smart home system prototype tested with one specific Case Study “My home Guardian”. The main purpose of this study is to monitor sensor data, utilizing this information in decision-making scenarios to bolster support for individuals within their residences.

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Britine Perkins
Assistant Professor, Prairie View A&M University, USA
&
Chevelle Hall
Associate Professor, Virginia State University, USA

The Pros and Cons of Diversity, Equity, and Inclusion Positions in America

Education is a dynamic field that requires educators to be properly trained to navigate the changing demographics and multiple needs of children in the U.S. This presentation will focus on the concept of Educational Justice and the navigation of a pluralistic society that does not always see the students they teach. In addition, how the educational landscape changes and is redefined with the tactics of addressing diversity, equity and inclusion.

Li-Qiong Wang
Distinguished Senior Lecturer, Brown University, USA

Collaborative, Interdisciplinary and Case Study Approaches in Undergraduate Research, Teaching and Learning

This presentation will center on our initiatives to advance collaborative, interdisciplinary, and case study approaches in undergraduate research, teaching, and learning. We will provide examples illustrating the success of these approaches and address both the effectiveness of student learning and the challenges associated with implementing such methodologies, especially in large undergraduate classes.

The case study method, traditionally employed in professional schools of business, medicine, and law, has recently gained popularity in undergraduate colleges and universities. Departing from traditional teaching methods, students engage with real cases by reading literature or news articles and then bring questions for discussion to the class, with the instructor leading the discourse. This teaching method aims to enhance critical thinking and problem-solving skills. The relevance of real-life cases motivates students to learn, and the case study method often incorporates hands-on laboratory activities directly linked to lecture content, further enriching students' learning experiences.

We have successfully implemented a case-study-based approach in our recently created Interdisciplinary course, "Chemistry and Art." This course emerged from collaborative efforts between faculty and undergraduates and has been taught by faculty members from diverse disciplines, including museum curators and professors from the humanities to the sciences. The Brown University Undergraduate Teaching and Research Awards (UTRA) enable outstanding and diverse undergraduates to collaborate with professors in researching and developing innovative teaching materials and hands-on activities. Through this collaborative endeavor, students have not only gained valuable research experiences and critical thinking skills through close interactions with faculty but have also produced highly engaging educational products based on their research findings.

This adaptable model and approach have the potential to be implemented in various other undergraduate institutes, fostering collaboration, interdisciplinary learning, and the effective integration of case study methodologies.

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Xuan Zhang
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&
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Supercooled Water Droplet Freezing and Ice Accretion on Cold Surface

Supercooled water droplet freezing is observed in many engineering fields such as aerospace, power and communication, and cryogenic engineering and refrigeration, so studies on such phenomenon are of practical importance. The macroscopic icing in reality is usually a process that a single supercooled water droplet begins to freeze after interacting with a cold wall and gradually forms an ice layer. To better understand the water freezing characteristics, we have conducted a series of research on supercooled water droplet freezing and ice accretion on cold surface, the present paper introduces some of them, which can be described as follows: (1) The nucleation temperatures of sessile water droplets with different volumes on a cold plate are experimentally studied, and statistical analyses are implemented to obtain the nucleation temperature average values and standard deviations. The results show that a smaller droplet has a lower nucleation temperature and a larger standard deviation. The nucleation rates are fitted using the classical nucleation theory and the results suggest that the nucleation rate increases as the plate temperature decreases and the droplet volume increases; (2) The freezing process of a supercooled water droplet on a cold plate is studied theoretically and experimentally. A model that considers both the supercooling effect on droplet physical properties and the gravity effect on droplet shape is established to simulate the droplet freezing behaviors, it introduces a dynamic contact angle coupled with a slipping velocity to describe the droplet tip singularity formation. The droplet freezing rate and time as well as the droplet profiles given by the model agree well with experimental observations. The calculation results support that the final droplet profile is less dependent on the supercooling degree, and the freezing rate increases but the freezing time decreases with reducing plate temperature; (3) The impacting-freezing dynamics of a

supercooled water droplet on a cold surface is studied experimentally and numerically. A numerical model that considers both the effect of supercooling degree on droplet physical properties and that of dynamic contact angle on contact line motion is built to simulate the droplet impacting-freezing behaviors using the VOF multiphase model and the solidification/melting phase change model. The temporal droplet profile and the spreading factor generated by the simulations agree well with experimental observations. Three different morphologies of full rebound, partial rebound and full adhesion are identified in the impacting-freezing process of a supercooled droplet on a cold hydrophobic surface; (4) A 1D model is developed to describe the ice accretion process on a cold surface, which is divided into the dry and wet mode icing stages. Rime ice forms on the surface skin at the dry mode icing stage while glaze ice grows on the rime ice and water film develops on the glaze ice at the wet mode icing stage. The calculation results indicate that the rime ice property variability and runback water effect are affected by the airflow parameters, which influence the heat conductions in the ice layer and water film and consequently the ice accretion characteristics.

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&
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Professor, Vilnius Gediminas Technical University, Lithuania

Comprehensive Analyses of Vilnius, Oslo, and Amsterdam's Complete Street Design Guidelines

Most European cities have created complete street design principles in place to ensure sustainable mobility and turn streets into public spaces for people to live in. Although the principles of street development have been approved in cities, the number of daily trips made by bicycle varies significantly. The article analyzes three cities where the indicators of daily bicycle trips differ according to the daily bicycle trips and infrastructure design principles. These are Amsterdam, a city with a well-developed bicycle traffic infrastructure, Oslo, as a city aiming to increase the number of daily bicycle trips, and Vilnius, where the share of daily bicycle trips is still very small. The article compares the main technical parameters of bicycle infrastructure, the design principles of intersections. The results summarize the most important design principles that should be applied in cities aiming to increase the number of daily trips made by bicycle.

Abe Zeid
Professor, Northeastern University, USA

REU Pathways: Pathways for Community College Students to Enrich their Education and Careers

Community colleges (CCs) serve as a valuable entry point to many students. These students are characterized as adult students working full time with families, first generation, full-time employees. Or, sometimes they are students who are not sure of a field of study and do not want to commit to more expense higher education. Many of these students are bright, highly motivated, eager to learn, and mature. CCs are typically 2-years versus typical 4-year college education. While the main mission of CCs is to train and educate the USA workforce, many students, more often than not, are interested in transferring to a 4-year college to earn higher degrees for better future. The key is to expose them to the different pathways that facilitate such transfer and navigate through the application process.

Recognizing the importance of this concept, Northeastern University has received a three-year REU (Research Experience for Undergraduates) grant from NSF to establish an REU Site. The site investigates pathways for CC students to help and encourage them to transfer to 4-year colleges. This REU site seeks to support and excite CC students to persist in their STEM education to increase the pipeline for the STEM workforce. Its vision is to provide CC students engineering skills and to excite them about engineering research. The site enables students to spend 10 summer weeks at Northeastern University to increase skills, confidence and learn firsthand about research. Each student will join a research lab, working with faculty and graduate student mentors. Also, students will be mentored after summer to further support their successful graduation and/or transfer to a 4-year institution and beyond. The research theme of the site is smart engineering with four sub-themes: AI/Machine Learning, smart infrastructure, smart materials, and smart health. In addition, each REU student will use a SparkFun kit to implement a design project of their choice. The site is guided by two of the grand challenges of the National Academy of Engineering: personalized learning and scientific discovery. The site supports a cohort of 10 CC students annually. Special emphasis is made on the recruitment of students underrepresented (URM). Unique aspects of the REU site include: a hands-on short course in engineering topics and software tools; formal mentor training including modules for mentoring URM students; daily

student meetings with mentors; extensive professional development seminars; formal research training including daily reflection journals, poster presentations and technical writing with a faculty member; and recruitment from a unique pool of highly talented URM students.

This paper discusses the details of the site, the recruitment process, the students' selection, the program activities, the research accomplishments of students, the results of the formative evaluation of the program and lessons learned so far. Finally, we discuss the adjustments made from the first-year offering based on the program evaluation of the first year.

Alexander Zestos
Associate Professor, American University, USA

Electrochemical Biosensors for the Multiplexed Measurement of Amino Acids and Neuropeptides

Carbon fiber microelectrodes (CFMEs) have been used to detect neurotransmitters and other biomolecules using fast-scan cyclic voltammetry (FSCV) for the past few decades. These assays typically measure small molecule neurotransmitters such as dopamine and serotonin. The carbon fiber is relatively small, biocompatible, and makes minimally invasive measurements at high spatial and temporal resolution. Carbon Fiber Multielectrode arrays have been utilized to measure multiple neurotransmitters in several brain regions simultaneously with multi-waveform application on each electrode. We have extended this work to measure larger molecule neuropeptides such as Neuropeptide Y and Oxytocin, a pleiotropic peptide hormone, is physiologically important for adaptation, development, reproduction, and social behavior. This neuropeptide functions as a stress-coping molecule, an anti-inflammatory agent, and serves as an antioxidant with protective effects especially during adversity or trauma. Here, we measure tyrosine using the Modified Sawhorse Waveform (MSW), enabling enhanced electrode sensitivity for the amino acid and peptide, decreased surface fouling, and codetection with other catecholamines. As both oxytocin and Neuropeptide Y contain tyrosine, the MSW was also used to detect these neuropeptides. Additionally, we demonstrate that applying the MSW on CFMEs allows for real time measurements of exogenously applied neuropeptides on rat brain slices. These results may serve as novel assays for neuropeptide detection in a fast, sub-second timescale with possible implications for *in vivo* measurements and further understanding of the physiological role of neuropeptides such as Neuropeptide Y and oxytocin.

Moreover, we have also developed enzyme modified microelectrodes for the measurement of glutamate (L-glutamic acid), which is an important excitatory amino acids and biomarker for epilepsy along with the inhibitory GABA. Since glutamate is not redox active at carbon electrodes, we modified CFMEs with glutamate oxidase enzyme to metabolize glutamate to hydrogen peroxide, which was then oxidized at carbon electrodes to produce readout cyclic voltammograms (CVs). The enzyme coating was optimized by varying the concentration of enzyme, chitosan binder, solvent, and deposition

time. The coating was further analyzed electrochemically and imaged with scanning electron microscopy (SEM) for thickness and uniformity of surface coverages. Energy-Dispersive Spectroscopy (EDS/EDX) was utilized for chemical surface functionalization analysis. Glutamate oxidation was found to be adsorption controlled to CFMEs and characterized at various scan rates, concentrations, and stability times as well with an approximate 100 nM limit of detection. Glutamate was co-detected in complex mixtures with several monoamines such as dopamine, serotonin, norepinephrine, and others. Glutamate will furthermore be measured in several food samples and *ex vivo* in rat coronal brain slices and *in vivo* in anesthetized and freely behaving animals.

Suzy Zhang
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&
Shengyuan Chen
Professor, York University, Canada

High Speed Craft Peak Acceleration Prediction Using Machine Learning Models

The capability to measure the impact of slams, which occur during high-speed motion of planing watercraft, is critical for the safety of passengers and equipment aboard. Previous studies have employed acceleration data from high-speed crafts to quantify the amplitude and duration of wave impact loads. This research considers several parameters for individual wave impacts: peak acceleration, impact duration, and velocity change. Mathematical models have been developed based on these parameters. This paper focuses on analyzing the characteristics separately in the freefall and impact regions for each wave to predict peak acceleration before the occurrence of a slam. To achieve this, two machine learning methods, Random Forest, and Convolutional Neural Networks, are utilized. The paper presents results from classification and regression models, demonstrating the accuracy of these predictions.

Yiyu Zhang
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LLM-Based Physics Analysis Agent at BESIII and Exploration of Future AI Scientist

The data processing and analyzing is one of the main challenges at HEP experiments, normally one physics result can take more than 3 years to be conducted. To accelerate the physics analysis and drive new physics discovery, the rapidly developing Large Language Model (LLM) is the most promising approach, it have demonstrated astonishing capabilities in recognition and generation of text while most parts of physics analysis can be benefitted. In this talk we will discuss the construction of a dedicated intelligent agent, an AI assistant at BESIII based on LLM, the potential usage to boost hadron spectroscopy study, and the future plan towards an AI scientist.

Igor Zhitomirsky
Professor, McMaster University, Canada

Advanced Chemical Strategies for Synthesis of Nanoparticles for Electrochemical Energy Storage in Supercapacitors

New chemical strategies have been developed for the fabrication of advanced energy storage materials for supercapacitors. A bio-inspired chemical approach was based on the use of chelating capping agents for chemical precipitation and hydrothermal synthesis methods for the fabrication of nanoparticles of individual and complex metal oxides. Different capping agents from catechol, salicylic acid, gallic acid, chromotropic acid, murexide families and other molecules, containing chelating ligands were used. The capping agents facilitated the fabrication of nanoparticles of controlled size and their efficient co-dispersion with conductive additives, such as carbon nanotubes. New redox-active capping agents were developed, which acted as charge transfer mediators and facilitated the fabrication of electrodes with enhanced capacitance and reduced impedance. Agglomerate-free processing of nanoparticles was achieved by the development of liquid-liquid extraction methods for phase transfer of nanoparticles. In this strategy, multifunctional capping agents-extractors facilitated synthesis of non-agglomerated nanoparticles of controlled size and their direct transfer from the synthesis medium to the device processing medium. The analysis of electrochemical testing results provided an insight into the influence of the chemical structure of the capping agents and their redox properties on nanoparticle synthesis, nanocomposite microstructure and device performance. A conceptually new approach was based on the use of organic capping agents-alkalizers. It was found that phase content and particle size of the materials can be varied and controlled using the multifunctional capping agents-alkalizers instead of inorganic alkalis. The use of advanced capping agents eliminated the need for the time-consuming activation procedures for electrodes with high active mass loading. Composite electrodes with high active mass loading of 40-50 mg cm^{-2} were developed for operation in a mild Na_2SO_4 electrolyte. Nanoparticles of MnO_2, Mn_3O_4, $BiMn_2O_5$ and V_2O_3 were prepared for applications in cathodes and nanoparticles of Fe_3O_4, $CuFe_2O_4$, γ-Fe_2O_3, $NiFe_2O_4$ and $CoFe_2O_4$ were synthesized for anodes. It was found that steroid dispersants, such as commercial bile acid salts, outperformed other dispersants in dispersion of carbon nanotubes, which were used as conductive additives. Further progress was

achieved using composites of inorganic nanoparticles and polypyrrole, which was synthesized using new polyaromatic dopants. The composites showed enhanced capacitance, especially at fast charge-discharge rates due to the synergy of contributions of the individual components. The new synthesis methods facilitated the fabrication of individual electrodes with capacitances of 6-7 F cm^{-2}. The asymmetric devices for operation in a voltage window of 1.6 V showed high capacitances and advanced power-energy characteristics. The electrochemical testing was performed using cyclic voltammetry, galvanostatic charge-discharge, impedance spectroscopy and modeling of the impedance spectroscopy data. Quartz crystal microbalance was used for the analysis of charge storage reactions and charge storage mechanisms were developed. The new nanotechnologies developed in this investigation pave the way for the fabrication of advanced functional materials for other applications, including batteries, fuel cells, catalysis, photovoltaic devices, and biosensors.

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