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Book of Abstracts

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The Solar Shed: Off the Grid, from off the Shelf
Kevin Hernandez and Andrew Aucanzhala
Prof. Kevin Conzelmann

Today's off-grid structures are in a sense a return to pre-industrial practices i.e. living off the land, locally. Yet contemporary off-grid methods are fully informed by techniques, inventions and breakthroughs brought about by the 9000+ years of human curiosity, creativity and discovery, and their insatiable search for knowledge, advancement and improved standards of living. This research project will trace the technological timeline featuring pivotal human technological breakthroughs from the times of prehistoric cave dwellings to the beginning of agricultural settlements, to ancient civilizations, to the renaissance, the industrial revolutions and the space age. Using the Solar Shed as a real-world case study, we will explore and learn from the multitudes of natural resources (e.g. wind and sun etc) and man-made innovations (e.g. turbines and photovoltaic panels etc) to propose a solution and opportunity to consider what it can mean to be truly off-grid, living off the land, locally.

Advanced Assistive Technology Facilitates Hands-on Service Learning
Suchi Chowdhury
Prof. Farrukh Zia

The Twitch Switch is an assistive technology device designed to enable people with limited mobility to use digital devices or turn on adaptive switches with minimal or no movement. Because it meets a critical demand for accessible technology among individuals with disabilities, this device is important because it enables people with conditions including muscular dystrophy, spinal cord injuries, and cerebral palsy to interact with digital environments and improve their quality of life. The Twitch Switch incorporates wireless sensors to record intentional, small movements, designing on previous assistive technology. While similar projects have made use of adaptive or single-switch input devices, the Twitch Switch improves usefulness by allowing for greater customization and multi-device control. The project leverages a service-learning approach where students apply knowledge from STEM courses. Hardware components include three wireless sensors and a controller, while software supports Bluetooth and USB connectivity. Each subsystem integrates to create a customizable, user-friendly device. During development, testing and troubleshooting ensure that sensor sensitivity and response rates meet user needs. The project also involves 3D design and 3D printing of the assistive device which requires background knowledge and application of Math, Physics and Engineering. Expected outcomes include a functional prototype that accurately interprets user input for digital or switch control. Final deliverables encompass a working prototype, thorough documentation, and a presentation demonstrating the Twitch Switch’s design and functionality, ready to showcase as an innovative solution for assistive technology users.

How can the integration of Cisco switches and Next-Generation Firewalls (ASA) into an educational environment enhance abilities in network security?

Yinson Tso and Jamel Williams
Prof. Xiangdong Li

Network security is very important in today's business and our life. To do the technology research requires the most recent technology from the industry. In this research program, the students will learn how to configure and implement the state-of-the-art security equipment from the industry into the educational environment, integrated with other computer technology. The advanced equipment includes the Cisco switches and Next-Generation Firewalls Adaptive Security Appliance (ASA), etc. The research includes theoretical study and lab work. The students will learn how to find the problems and then try to solve them. This project will develop the strong hands-on skills and independent learning ability for the students which are essential in the research of technology. The research will also strengthen the students background in the field of network.

Exploring the Idiosyncratic Volatility Puzzle

Zihan Cao and Benny Wu
Prof. Ossama Elhadary

Idiosyncratic Volatility (IVOL) is the unique risk of an individual stock ignoring market movements, which is crucial for risk management within a portfolio. The Idiosyncratic Puzzle is a phenomenon where stocks with high IVOL on average earn low future average returns. We analyze this problem with the Fama-French three factor model to estimate IVOL, testing to see if we can find and explain this phenomenon. Stock data was merged with Fama-French factor data which we used to calculate daily returns, which we then used to calculate residuals. We applied rolling thirty-day windows to compute variance which finally is used to find IVOL. The Idiosyncratic Puzzle was then confirmed to exist.

Predicting IVF Success Using Machine Learning

Joel Mejia
Prof. Marcos Pinto

Complications and fertilization factors are numerous in the In-vitro fertilization (IVF) process, it is a cumbersome task for fertility doctors to give an accurate prediction of a successful birth. Machine Learning will be employed in this study to predict the live-birth occurrence. This work mainly focuses on making predictions of live-birth occurrence when an embryo forms from a couple and not a donor.

AI in Mathematics Teaching and Learning
Rachel Dawidowicz
Prof. Nadia Kennedy

Since the release of ChatGPT 1.0 in 2021, educators have been exploring the potential of AI to support academic learning. Artificial intelligence (AI) holds the promise of revolutionizing education by personalizing learning experiences for students and providing teachers with advanced teaching tools. This presentation examines the potential of ChatGPT 4.0 for enhancing mathematics teaching and learning. We explore multiple sources and summarize three keyways researchers believe AI can be most beneficial in math education: 1) developing differentiated lesson plans, 2) creating individualized assessments, and 3) using AI as a personalized tutor tailored to individual student needs. In each of these areas, we delve into prompt engineering and provide examples to illustrate its applications. AI has the potential to be a powerful tool for developing differentiated lesson plans and customized assessments, ensuring that mathematics education is accessible to all students, including emerging bilingual learners and those with diverse learning styles. By integrating ChatGPT into the classroom, educators can foster a more inclusive, engaging, and supportive mathematics environment that meets the needs of a wide range of learners.

Enhancing High School Computational Thinking through Unplugged Activities and Mathematical Manipulatives
Yadira Vazquez
Profs. Nadia Kennedy and Ariane Masuda

The Computer Science and Digital Literacy Standards for K–12, recently released by the NYS Education Department (NYSED), are expected to be incorporated into the K–12 curriculum. The NYSED advocates for teachers to enrich students' learning experience by incorporating computational thinking, among other competencies, within their lessons. Computational thinking is important because it empowers the learner with problem solving skills, and enriches one's logical thinking, and reasoning. This project aims to create, adapt, and remix unplugged computational activities for high school classrooms, with the goal of enhancing students' analytical reasoning, computational thinking, algorithmic thinking, and other cognitive skills. Additionally, the activities are designed to align with the NYSED's computational thinking learning standards. The activities are designed to be integrated into math classrooms, providing students with engaging, hands-on opportunities to develop essential computational thinking skills while deepening their understanding of mathematical concepts.

Ion Dynamics of Ionic Liquids

Elizabeth Brandwein
Prof. Steven Greenbaum

Fast Field Cycling Nuclear Magnetic Resonance (FFC NMR) is a technique used to measure the relaxation of nuclei when influenced by a varied external magnetic field. The relaxation, in this case, the spin-lattice relaxation rate (T1) is defined as the time required for the sum of the magnetic moments of the nucleus in question to return to their ground states (B0). This parameter can be utilized to observe the local dynamics of different materials, including, but not limited to, liquids, porous media, solids, contrast agents, or gels. Specifically, for energy storage materials, such as batteries, FFC NMR is important in determining the ion dynamics, which is related to electrolyte efficiency. Among the possible innovative electrolyte solvents, ionic liquids (ILs) are considered a safer alternative to organic carbonates due to their low flammability and vapor pressure. By definition, ILs are salts having a melting point below 100℃, with some being liquid at room temperature. The purpose of this experiment was to measure the R1 values of two ionic liquids; EMIM-FSI and EMIM-BF4 (Fig. 1) under varying magnetic fields, from 30kHz to 32MHz, in order to evaluate the cation and anion local dynamics, measured on 1H and 19F frequency domains, respectively. From the results, it is possible to distinguish the different mechanisms contributing to the ion relaxation rate and expand this knowledge to energy storage materials applications.

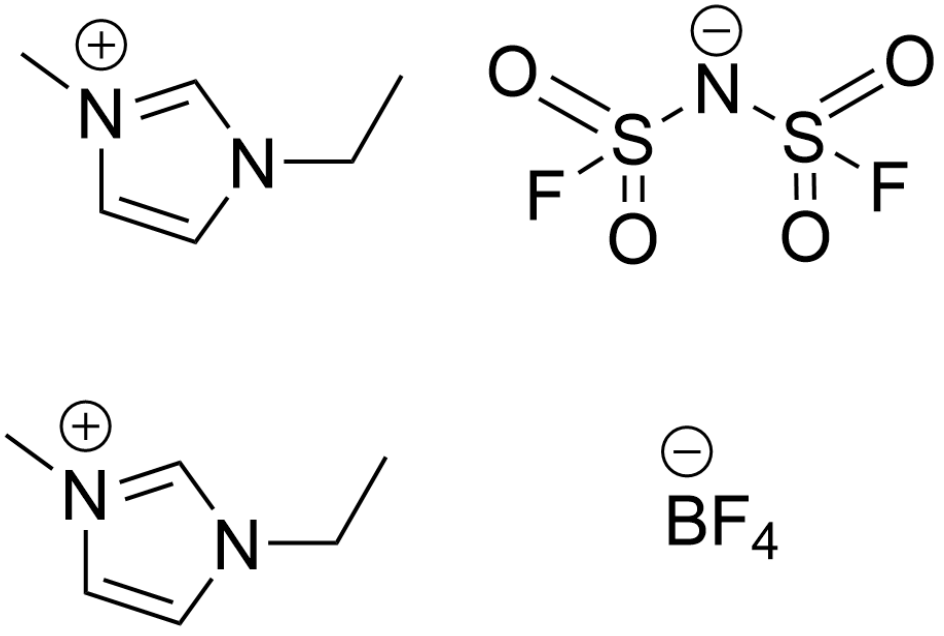

Fig. 1 - EMIM-FSI and EMIM-BF4. Self made.

Secondary X-ray Generation by Composite Filters

Somdat Kissoon, Jasper Cheung, Daler Djuraev, Achlyn Genao
Profs. Subhendra Sarkar, Evans Lespinasse, Eric Lobel

Scatter radiation is generated when incoming photons interact with loosely bound electrons in a sample. Many of the interactions with matter produce a large number of these secondary electrons with no known utility. Scatter is generally thought to be detrimental to the generated image by creating unnecessary noise and generating unwanted additional radiation in the patient. Our experiments explore ways to benefit from these harmful Compton scattering. We generate weak photon streams from higher energy incident photons by thin cellulose or organic filters and a second composite layer of crystalline salts or salt solutions embedded in porous matrix that provide surface charges at grain boundaries and pore surfaces mainly from surface seeking electron-rich halide ions. Alkali halides in porous matrix offer many nanomaterial advantages including generation of secondary or Auger electrons and phonon assisted various photon harmonic generation within the salt lattice structures depending on composite crystallinity. These new photon streams with their weak harmonic x-rays exit the composite filters with variable flux density in select directions similar to the laser beam amplification as standing waves in laser cavities and may be useful for low-dose photon therapy of superficial tumors.