Poster Session Assignments with Abstracts

Poster Session A

2. Learning Surface Terrain Classifications from Ground Penetrating Radar
Anja Sheppard, PhD Candidate, Robotics, University of Michigan. Jason Brown, Undergraduate, Aerospace/Robotics, University of Michigan. Nilton Renno, Professor, Climate and Space Sciences, University of Michigan. Katherine A. Skinner, Assistant Professor, Robotics, University of Michigan

Terrain classification is an important problem for robots operating in extreme environments as it can aid downstream tasks such as autonomous navigation and planning, which are tedious for human operators to accomplish. While cameras are widely used for terrain identification, vision-based methods can suffer due to poor lighting conditions and occlusions. In this paper, we propose the novel use of Ground Penetrating Radar (GPR) for terrain characterization for mobile robot platforms. Our approach leverages machine learning for surface terrain classification from GPR data. We collect a new dataset consisting of four different terrain types, and present qualitative and quantitative results. Our results demonstrate that classification networks can learn surface terrain categories from GPR signals. GPR sensors are already being deployed on planetary rovers such as the Perseverance and ExoMars rovers, and this work opens up the possibility for novel uses of GPR for autonomous navigation on these mobile robot platforms.

4. Influence of Surface Roughness on Mechanochemical Competition of Wear vs Growth for Metal Oxide Nanoparticle Antiwear Films
Benjamin Jackson, B.S. in Chemical Engineering with a minor in Math and B.A. in Chemistry, Undergraduate Researcher, Department of Chemistry, Hope College. Meagan Elinski, Ph. D. , Assistant Professor, Department of Chemistry, Hope College

Reliable and safe moving components depend on controlling chemical and physical interfacial properties. Within moving components, sliding forces drive chemical reactions (mechanochemistry) through a stress-assisted Arrhenius model, leading to accelerated wear or growth of protective (antiwear) films. The net effects of material removal or addition depend on a competition of these mechanochemical processes. To understand this competition, we used metal oxide nanoparticles as a platform that readily forms

surface bound antiwear films under sliding. Mechanical testing using a rheometer with a tribology adaptor was implemented to drive film formation under different surface conditions. Post-sliding analysis with confocal Raman microscopy and SEM/EDS helped understand film composition, with the central finding that film formation is limited to smoother surface topographies. The results provide essential insight into fundamental processes of film growth and the reliability in scaling to broader applications.

6. Recent Carbon Accumulation Rates of Michigan Peat Bogs
Ben Pikaart, Undergraduate Student, Department of Geological and Environmental Sciences. Michael Philben, PhD, Assistant Professor, Departments of Chemistry and Geological and Environmental Sciences

In this study, we studied Michigan peat bogs in order to understand how bogs respond to the increasing temperatures resulting from climate change. We extracted peat cores from seven different sites along a latitudinal transect in Michigan. Surface cores sampled the top 20 cm, and a Russian instrument extracted deeper profiles of 50 cm range. In the lab, we dried and ground samples, used elemental analysis to measure the carbon content in each sample, and gamma spectrometry was used to measure Pb-210 activity to calculate the age of the cores. Combining these measurements determined the carbon accumulation rates, the first of which is 60.16 g*yr-1*m-2, which is within the range of previously published carbon accumulation rates in peat bogs. Comparing carbon accumulation values along the latitudinal transect will allow us to evaluate the net effects of warming on the carbon balance of photosynthesis and decomposition in peat bogs.

8. In-Orbit Space Structure Inspection Trajectory Generation
Brandon Apodaca, M.S., PhD Candidate, University of Michigan, Robotics. Leia Stirling, PhD, Associate Professor, University of Michigan, Industrial and Operations Engineering, Robotics. Ella Atkins, PhD, Fred D. Durham Chair in Engineering and Department Head, Virginia Polytechnic Institute and State University, Kevin T Crofton Aerospace and Ocean Engineering

Current practices for International Space Station maintenance require astronaut extravehicular activity for visual inspection, a safety risk for astronauts. Hardware exists for robotic systems to perform visual inspections, but current trajectory-generation algorithms implementing complete coverage trajectory generation for terrestrial inspection do not consider orbital dynamics. The trajectory generation algorithm we present integrates orbital dynamics with complete coverage path planning algorithms to maximize surface coverage and minimize fuel consumption while avoiding obstacles. Our algorithm leverages (1) geometric viewpoint generation to define robot viewpoints that enable coverage, (2) a novel method to connect these viewpoints using a point-to-point path planner designed for zero gravity, and (3) an optimal control methodology including orbital dynamics that generates the final trajectory from these ordered viewpoints. Solutions support the reduction of risk posed to astronaut safety during

space station operation and maintenance by providing trajectory generation algorithms for external semi-autonomous in-orbit inspection of complex space structures.

10. Investigating the Impact of Atg10's Activity Level on Autophagosomes.
Cameron Brewer, High School Student at Bishop Foley Catholic High School, Department of Chemistry, Eastern Michigan University; Olivia Clarino, Graduate Assistant, Department of Chemistry, Eastern Michigan University; Steven Backues, PhD, Professor, Department of Chemistry, Eastern Michigan University.

Nonselective autophagy is a cellular process where various cytoplasmic materials are recycled to support cell survival during nutrient deprivation. This involves autophagosomes - double membrane vesicles that transport cellular components to the vacuole or lysosome for degradation. Atg10, the protein that we are focusing on, is part of a specific protein cascade that produces Atg8-PE, which is vital to autophagy. Previous research has shown that Atg7, upstream of Atg8, influences both autophagosome size and number, while Atg8 only affects size. Our research aims to determine how the activity levels of Atg10, an intermediate protein, impact the size and number of autophagosomes. We used western blotting to verify the levels and activity of Atg10 in four genetically modified yeast strains and prepared samples for Transmission Electron Microscopy to measure autophagosome size and number. While protein levels were as expected, the microscopy images suggested the need for further optimization of the sample preparation.

12. In-Situ Resource Utilization for Lunar Tools and Exploration
Divya Sovani, High school intern, NASA SEES; Jatin Aggrawal, High school intern, NASA SEES; Pia Agrawal, High school intern, NASA SEES; Molly Gerding, High school intern, NASA SEES; Thomas Gershanik, High school intern, NASA SEES; Serena Huang, High school intern, NASA SEES;

To address the fact that transporting supplies from Earth to future colonies on the Moon will likely be both time-consuming and costly, we present leveraging in-situ resource utilization (ISRU) techniques to harness existing lunar material to build necessary items for future missions. Specifically, we propose using regolith and ice, “to abundant lunar materials” to create a clay-like mixture for construction. This mixture can be used to build the bulk of a toboggan hauled by a pulley system, along with other useful instrumentations for future missions to the Moon. In contrast with a wheeled rover, the canoe-like shape of this toboggan will make it more practical for navigating the fine-grained regolith and steep slopes of the lunar surface. Lunar resources collected by instruments attached to the toboggan may also be used to build additional in-situ equipment, continuing the cycle of sustainable and responsible resource utilization. The results of this study will offer insights into using ISRU techniques as an efficient, cost-effective method for developing sophisticated colonies on the Moon.

14. What Happpens to the Debris of Giant Impacts
Emily Elizondo; BS, Physics, Wayne State University; Graduate Student; Department of Physics and Astronomy, Michigan State University. Dr. Seth A. Jacobson; BS, Applied

and Engineering Physics, Cornell University/MS, Astrophysical and Planetary Sciences, University of Colorado at Boulder/PhD, Astrophysical and Planetary Sciences, University of Colorado at Boulder; Assistant Professor, Department of Earth and Environmental Sciences, Michigan State University

It has been theorized that the giant impact that formed the Moon may not have been the only impact to occur. The number of giant impacts that took place during the late stages of terrestrial planet formation is currently unknown. These impacts produced debris, and the amount of debris is dependent on the number and the violence of the collisions. Therefore, simulations can be run in which the number of collisions varies and the amount of debris can be tracked. Since it is thought that a certain population of asteroids could be debris from terrestrial planet formation, an upper mass limit of possible debris in the asteroid belt can be calculated and can be compared to the amount of debris that resides in the asteroid belt at the end of the simulations. A higher simulated debris mass in the asteroid belt would suggest that less frequent or violent giant impacts occurred.

16. Characterization of individual sea spray aerosol particles produced from sea ice cracks in the rapidly changing Arctic

*Hailey Kempf, Department of Chemistry, Department of Earth and Environmental Science, University of Michigan, Ann Arbor, Michigan. Jessica A. Mirrielees, Department of Chemistry, University of Michigan, Ann Arbor, Michigan. Tiantian Zhu, Department of Earth and Environmental Science, University of Michigan, Ann Arbor, Michigan. Jessie M. Creamean, Department of Atmospheric Science, Colorado State University, Fort Collins, Colorado. Rachel M. Kirpes, Department of Chemistry, University of Michigan, Ann Arbor, Michigan. Nora Bergner, Ecole Polytechnique F√©d√©rale de Lausanne, Lausanne, Switzerland *Now at Department of Chemistry and Fermentation Sciences, Appalachian State University. Benjamin Heutte, 4Ecole Polytechnique F√©d√©rale de Lausanne, Lausanne, Switzerland *Now at Department of Chemistry and Fermentation Sciences, Appalachian State University. Julia Schmale, 4Ecole Polytechnique F√©d√©rale de Lausanne, Lausanne, Switzerland *Now at Department of Chemistry and Fermentation Sciences, Appalachian State University. Andrew P. Ault, 1Department of Chemistry, University of Michigan, Ann Arbor, Michigan. Kerri A. Pratt, Department of Chemistry, Department of Earth and Environmental Science, University of Michigan, Ann Arbor, Michigan*

The Arctic is warming faster than the global average, causing sea ice to thin and develop cracks where sea spray aerosols (SSA) are produced. SSA particles are generated at the ocean surface via bubble-bursting processes and can affect Arctic climate by forming clouds and scattering solar radiation. SSA particles are generally composed of an inorganic salt core coated in organic matter; these organic coatings reflect sea microbiology and can reduce a particle’s potential to activate as a cloud droplet. In this work, we analyzed SSA particles collected during the September 2019 - October 2020 Multidisciplinary drifting Observatory for the Study of Arctic Climate (MOSAiC) icebreaker expedition. We use Raman microspectroscopy to characterize the molecular composition of organics within ~1,500 individual Arctic atmospheric particles

collected across ~17 days. This work is improving our understanding of the connections between microbiology, sea ice, and aerosols in the rapidly changing Arctic.

18. Sheep Carbon: Composition Dynamics of Soil Carbon in Response to Grazing
Tara Kneeshaw, Ph.D. in Geology, Professor, Department of Geology, Grand Valley State University. Katelyn Smith, undergraduate student, Department of Geology, Grand Valley State University. Julia Shreve, undergraduate student, Department of Geology, Grand Valley State University. Lauren Burns, Owner, Tending Tilth LLC

Soil organic carbon (SOC) is one of the largest and most reactive carbon reservoirs on the planet. Increasing SOC is a form of CO2 removal. Can sheep help increase SOC and balance the carbon budget to help mitigate climate change threats from increasing atmospheric CO2 and minimize the impacts of environmental change? Prescribed sheep grazing is becoming an increasingly affordable ‚Äúmowing‚Äù option supporting climate action and net zero carbon initiatives, but little data exists that quantitatively evaluates the effectiveness of sheep grazing for improving soil carbon sequestration, due to challenges in directly measuring increases in SOC in response to new management practices. Yet, this information is necessary for achieving climate goals and restoring soil functions. This study in SW Michigan at a prescribed grazing site aims to quantify changes in functionally relevant soil fractions to evaluate the change in soil carbon dynamics in response to sheep grazing.

20. Anomalous Vertical Velocities and the Testing of the NEBP Ventilation System
Jacob Morgan, Mechanical Engineering, Mr., Eastern Michigan University. David Pawlowski, Ph. D. Space Physics, Dr., Physics and Astronomy Department, Eastern Michigan University. Thomas Kovacs, Ph.D. Meteorology, Dr., Environmental Science and Society, Eastern Michigan University.

During the annular solar eclipse on October 14, 2023, a team of students from Eastern Michigan University participating in the Nationwide Eclipse Ballooning Project (NEBP) launched a high-altitude weather balloon near Albuquerque, New Mexico. An anomalous vertical velocity was observed during the flight while attempting to release helium using the ventilation system used by most NEBP participants. Topography and atmospheric conditions could have played a role in this anomaly. However, due to uncertainty about the operational status of the ventilation system during this anomaly, we decided to test whether the stratospheric environment disrupted the proper release of helium out of the balloon. This presentation will summarize the anomalous vertical velocities observed during the annular eclipse. Furthermore, the presentation will detail the addition of the environmental suite to the ventilation system. Findings from testing the new environmental suite in both lower and upper atmospheric conditions could also be in the presentation.

22. Quantifying Greenhouse Gas Emissions along a Latitudinal Gradient of Lake Michigan Drowned River Mouths Using DIY Samplers and Remote Sensing
Jillian Greene, Graduate Student, Annis Water Resources Institute - Grand Valley State University. Ashtyn Gluck, Undergraduate Student, Annis Water Resources Institute -

Grand Valley State University. Dr. Michael Philben, Department of Geology - Hope College. Dr. Bopaiah Biddanda, Annis Water Resources Institute - Grand Valley State University. Dr. Sean A. Woznicki, Annis Water Resources Institute - Grand Valley State University

Aquatic ecosystems are known hot spots of the carbon cycle, including production and emission of methane, a potent greenhouse gas (GHG). Few studies have examined the production of lake methane emissions in temperate climates and how anthropogenic impacts could alter fluxes. Methane concentrations were measured from three drowned river mouth (DRM) estuaries along the eastern shore of Lake Michigan. The DRMs occur along a latitudinal gradient spanning from mesotrophic to hypereutrophic and have varying watershed land cover. The sampling design used autonomous GHG samplers and monthly discrete sampling from May - September 2024. Preliminary results suggest high variability between lakes with seasonal means and standard errors ranging from 293.8 +/- 144, 105.1 +/- 75.5, and 77.9 +/- 30.6 mg/L, for Lake Macatawa, Muskegon, and White respectively. Results of this study will further be coupled with satellite imagery to create a machine learning model capable of quantifying GHG emissions from Michigan's DRMs.

24. Investigation of Tc change due to 600 keV proton irradiation in TBCCO superconductors

Mr. Joseph Fogt, undergraduate student, Hope College Physics Department. Mr. Trevor Harrison, undergraduate student, Hope College Physics Department. Ms. Hope Weeda, undergraduate student, Hope College Physics Department. Mr. Nolan Weeda, undergraduate student, Hope College Physics Department. Dr. Kyuil Cho, PhD Clark University, Hope College Physics Department

We studied the effect of 600 keV proton irradiation on thin film Cuprate superconductors. A 650 nm thick TBCCO-2212 sample was subjected to a series of proton irradiations totaling a fluence of 5.2 x 10^16 p/cm^2. Superconducting critical temperature (T_c) was decreased from 100 K towards zero Kelvin, and the normal state resistivity increased accordingly. The rate of T_c reduction to resistivity increase will be used to discuss the fundamental property of the superconductor.

26. Evaluating convolutional neural networks for reconstructing Compton scatter tomography images

Jeffery Martin, PhD, Assistant Professor of Mathematics Instruction, Department of Mathematics and Statistics, Hope College. Dominic Cugliari, Student, Research Assistant, Department of Mathematics, Hope College. Sydney Olander, Student, Research Assistant, Department of Engineering, Hope College. Karsten Wiegerink, Student, Research Assistant, Department of Engineering, Hope College

Compton scatter tomography (CST) is a technique for non-invasively generating tomographic images of electron density in materials using Compton scattered gamma rays. We have reconstructed computed tomography (CT) images with using convolutional neural networks (CNN). Nonlinear integration paths inherent in CST

makes reconstructing images more challenging than CT. A convolutional neural network (CNN) approach has been evaluated for Compton scatter tomography image reconstruction.

28. Longitudinal evolution of Escherichia coli in microgravity

Kristen Henein, Researcher, Department of Bioengineering and Biological Sciences, Oakland University. Kayla Whitney, Researcher, Department of Bioengineering and Biological Sciences, Oakland University. Dalton Raymond, Researcher, Department of Bioengineering and Biological Sciences, Oakland University. Caleb Kienbaum, Researcher, Department of Bioengineering and Biological Sciences, Oakland University. Fabia Battistuzzi, Associate Professor, Department of Biological Sciences, Oakland University. Shailesh Lal, Professor and Chair of Bioengineering, Department of Bioengineering, Oakland University. Madhan Tirumalai, Research Assistant Professor, Department of Biology and Biochemistry, University of Houston. Madhan Tirumalai, Research Assistant Professor, Department of Biology and Biochemistry, University of Houston. George E. Fox. Emeritus Professor and Research Professor Department of Biology and Biochemistry, University of Houston. Quyen Tran, Research Assistant Professor, Department of Biology and Biochemistry, University of Houston

Variant calling software are used to find variations within a sequenced genome through a comparison against a reference genome. This is an important step to understand phenotypic variability and adaptation strategies. The accuracy of these software depends on many factors, including the quality of the sequencing, the type of genome being analyzed (e.g., prokaryote vs. eukaryote), and the performance of the software itself. Thus, to evaluate the accuracy of identified mutations for a given genome, it is important to compare the results of multiple software. Using an Escherichia coli genome exposed to microgravity for 1000 generations and sequenced with PacBio, we compared the results from 8 commonly used software: Freebayes, Snippy, GATK, DeepVariant, Varscan, Delly, cuteSV, and Sniffles. These software identify different types of mutations (polymorphisms, structural variants, or both). From these 8 software we found that Freebayes, GATK, and DeepVariant identify 70% of the same mutations while Delly, which is a structural variant specific software, only found 25% of the structural variants. We propose that using a consensus approach among multiple software can decrease the rate of false negative and false positives during the variant calling process, thus improving the accuracy of our post-sequencing analysis process.

30. Stability Considerations in Contact Binary Star Evolution

Dr. Lawrence Molnar, Professor, Department of Physics & Astronomy, Calvin University; Levi Carr, Department of Physics & Astronomy, Calvin University

A contact binary star system consists of two stars that orbit each other so closely that they share an atmosphere. Despite decades of research on them, there has been no clear way to treat their evolution over their lifetime, from birth to death. In this work we construct a roadmap to how to compute evolution by careful consideration of the stability of mass transfer between the two stars. This stability will depend on the relative masses of the stars as well as the relative sizes. We use Modules for Experiments in

Stellar Astrophysics (MESA), a star simulation code, to compute both dynamic and thermal stability shortly after first contact. Combining these results with models for angular momentum loss (driven by magnetic fields), we derive the range of total mass possible for contact binaries along with the ratio of masses expected in newly formed systems. Additionally, are progressing on an effort to extend MESA to compute the structure of both stars after contact is well established. We expect this to lead to the first predictions of the size of the common atmosphere (known as the fillout factor) as a function of system mass and age.

32. Substitution and Evaluation of Serine-26 Substituted with Alanine in a Regulatory Fragment of Amyloid-Œ≤

Maahik Trivedi, High School Student, Department of Chemistry, Eastern Michigan University; Issah Seidu, MD, Graduate Assistant, Department of Chemistry, Eastern Michigan University; Deborah Heyl-Clegg, PhD, Professor, Department of Chemistry, Eastern Michigan University.

Recent studies have found an inverse relationship between Alzheimer's Disease (AD) and cancer, where AD patients have a lower risk of developing cancer, and conversely, cancer patients have a reduced risk of developing AD. This study investigates the effects of amyloid-Œ≤ peptide variants, known to have a role in both diseases, on cancer cell viability. Specifically, it looks at the substitution of serine, a target for phosphorylation, with non-phosphorylatable alanine at position 26 in the 12-28 fragment of the amyloid-Œ≤ peptide to assess its impact on the A549 lung cancer cells. Two peptide variants were created through Solid Phase Peptide Synthesis and tested through MTT assays. While initial results indicated that the Ala-mutant required higher concentrations to achieve 50% cancer cell death (IC50), the difference was minimal and not statistically significant. Further trials should be conducted to help gain a better understanding of the relationship between the AD and cancer.

34. Micromagnetism of Œ≥-FeSi2 Nanoislands

Matthew D. Sisson, PhD Candidate, Graduate Student, Materials Science & Engineering, Michigan Technological University. Liwei D. Geng, PhD, Graduate of Materials Science & Engineering, Michigan Technological University. Yongmei M. Jin, PhD, Professor, Materials Science & Engineering, Michigan Technological University

Iron disilicide (FeSi2) is nonmagnetic in bulk, but nanoscale symmetry breaking features can produce novel ferromagnetic behavior. Based upon previous work showing that nanoisland edges are the dominant contributing factor to ferromagnetism, as opposed to other possible sources like epitaxial strain, this poster shows simulated local magnetic domain evolution of a 40x40x4 nm nanoisland under a cyclic magnetic field. Hysteresis curves are presented, showing ferromagnetic behavior at 0 K, superparamagnetic behavior at 4 K, and paramagnetic behavior at 100 K. Furthermore, visualization of domain evolution shows that the ferromagnetic contribution originates from the edges of the island, and that increased lateral aspect ratio increases the calculated hysteresis. This work demonstrates the important role of shape anisotropy of

the edge region in magnetic domain configuration and hysteresis, providing an explanation for experimental magnetic phenomena of Œ≥-FeSi2 nanostructures.

36. “Bitter Water”: Identifying Residues of Cacao Ritual Beverages in Mesoamerican Ceramics

Ruth Ann Armitage, Ph.D., Professor of Analytical Chemistry, Department of Chemistry at Eastern Michigan University. Tara Fairchild, Graduate researcher, Department of Chemistry at Eastern Michigan University. Hailey McCloskey, Undergrad Researcher, Department of Chemistry at Eastern Michigan University

Rituals in ancient Mesoamerica included many activities, including feasts that incorporated consuming foods and beverages that may have had special meanings. Ancient people in Mesoamerica consumed “bitter water” that contained seeds from the Theobroma cacao plant mixed with water. This beverage was called xocolatl by the Aztecs and kakaw by the Maya. At the Carlos Museum, there are unique ceramic vessels that may have been used to prepare or serve these chocolate beverages. We were asked to determine if the residues in the ceramic vessels showed evidence of the cacao by looking for its biomarkers: theobromine and caffeine. We also wanted to know what methods would be more accurate in identifying the biomarkers. We examined the residues using two analytical methods: DART-MS and GC-MS. Our results revealed that through DART-MS, biomarkers of the chocolate-based beverage were identified. However, GC-MS was not sensitive enough to verify our data from DART-MS.

38. Luminescence Characterization During Operation of a Porous Emitter Ionic Liquid Electrospray

Nathaniel Allwine, BS Aerospace Engineering, Ph.D. Student, Mechanical and Aerospace Engineering Department, Western Michigan University. Thomas Kerber, MS Aerospace Engineering, Ph.D. Candidate, Mechanical and Aerospace Engineering Department, Western Michigan University. Nicholas Taylor, Ph.D., Senior Research Associate, Mechanical and Aerospace Engineering Department, Western Michigan University. Kristina Lemmer, Ph.D., Professor, Mechanical and Aerospace Engineering Department, Western Michigan University

Luminescence often appears near the emitter tips of porous emitter ionic liquid electrospray thrusters. The study presented investigated this phenomenon by capturing high-resolution images while operating under conditions conducive to specific luminescence generation mechanisms, including secondary species emission (SSE) induced and orifice-accumulated propellant impacts. Emitter-extractor geometry was varied and SSE rates were controlled by biasing a downstream beam collector and suppression mesh. The findings of this study suggest that SSE has minimal impact on observed luminescence during negative emission. Instead, there is a direct correlation between intercepted extractor current and luminescence, indicating that primary beam impacts with accumulated propellant on the orifice is the primary driving mechanism of the luminescence.

40. Public outreach and interdisciplinary collaboration through art workshops

Orion Wakeman, BfA, Preserve Fellow, Calvin Ecosystem Preserve and Native Gardens, Calvin University

Intersections between art and science are far more extensive than the academic separation of disciplines would lead you to believe. Bridging the gap opens up opportunities for students like me, who straddle the line between artist and scientist. After my graduation with a Bachelor of Fine Arts and interdisciplinary science major, I worked through the summer of 2024 at Calvin University's Ecosystem Preserve and Native Gardens offering observational drawing workshops to faculty and staff of the university, especially those in science disciplines who I had learned so much from. You'll hear how professors, student researchers, and other university employees responded to learning gesture drawings and sketching techniques, as well as the workshop's roots in the plant taxonomy class that I was the TA for.

42. Batch manufacturing of polyelectrolyte biomaterial capsules with tailored internal micro-environments through use of electrospray technologies.
Rafael Ramos, MS, MD-PhD Candidate, Wayne State University Department of Biomedical Engineering, Wayne State University / Wayne State University School of Medicine. Howard Matthew, PhD, Professor, Department of Chemical Engineering and Materials Science, Wayne State University

Studying the physiological effects of space travel creates a need for high fidelity, in vitro models of complex tissues. Tissue constructs engineered using a bottom-up modular approach offer a solution to this problem. Here, we expand on a previously reported method of cell encapsulation using glycosaminoglycan-stabilized chitosan membranes generated by polyanion-polycation interactions. The resulting hollow capsules allow for cellular growth and organization within a defined spherical volume, and the internal environment can be tailored through inclusion of extracellular matrix based biomaterials. We have enhanced this technology through an electrospray method that extends the feasible range of capsule sizes down to 200-50 um. This size regime allows encapsulation of cells at densities of >107 cells/ml while minimizing diffusion limitations and the likelihood of central necrosis in cellular spheroids. These electrospray capsules may serve as ideal modular units in the development of tissue constructs for physiological modeling using lab-on-a-chip and bioreactor approaches.

44. Exploring Habitability and Life Detection: Insights from Microbial Biofilms in Serpentinizing Mars Analog Environments
Sarah Gonzalez-Henao, B.Sc Biology(ICESI University)/MsC Biotechnology (ICESI University),/current PhD Student (Michigan State University), Department of Earth and Environmental Sciences,Department of Microbiology and Molecular Immunology Michigan State University. Matthew O. Schrenk, B.Sc. Geology & Geophysics (University of Wisconsin)/Ph.D in Oceanography (University of Washington)/Associate Professor at Michigan State University, Department of Earth and Environmental Sciences,Department of Microbiology and Molecular Immunology Michigan State University.

Serpentinization is a geochemical process that occurs in ultramafic rocks that produces molecular hydrogen (H,ÇÇ) and methane (CH,ÇÑ), providing energy for microbial life. The Santa Elena Ophiolite (SEO) in Costa Rica, is terrestrial serpentinizing site that harbors hyperalkaline springs characterized by a pH up to 11.25 and CH,ÇÑ vents (24.3% v/v). Due to its unique conditions, SEO serves as a Mars analog, making it significant for astrobiological research. This project focuses on analyzing microbial biofilms from SEO which thrive in these extreme environments and consist of an organized aggregate of microorganisms living within a self-produced matrix of Extracellular Polymeric Substances (EPS) attached to a surface. Therefore, through the combination of advanced microscopic and genomic approaches, we aim to develop a holistic understanding of the microbial biofilm samples collected from the SEO. Preliminary results show community composition shifting along a pH gradient, highlighting potential implications for understanding habitability in extreme environments.

45. Development of a High-Fidelity Pressure Mapping Glove for Enhanced Grip Analysis and Injury Assessment in EVA Spacesuits.

Simin Masihi, Doctor of Philosophy, Assistant Professor, Electrical and Computer Engineering, Western Michigan University. Hakan Dogdu, Master Student, Electrical and Computer Engineering, Western Michigan University. Alimohammad Haji Adineh, PhD Student, Electrical and Computer Engineering, Western Michigan University

Although astronaut suits and gloves are crucial in space mission safety, they may induce challenges like discomfort and injury during spacewalks. To address this, a glove with capacitive pressure sensors is developed, providing astronauts with real-time data on grip dynamics and injury assessment. These sensors, made from flexible, biocompatible silicone materials with microstructures, enhance sensitivity. The glove also features a load distribution system that replicates the hand's bone structure, improving hand health and performance. This project aligns with NASA's deep space exploration goals and supports infrastructure maintenance. My role involves designing, fabricating, and testing this glove prototype, significantly advancing sensory technology. This innovation is not just beneficial for astronauts but also has potential applications in prosthetic limbs and other fields where precise force measurement is crucial

46. Precipitation Imaging Package (PIP): A Potential Instrument for Measuring Raindrops

Sloane Poppei, Department of Climate and Space Sciences and Engineering, University of Michigan, Ann Arbor, MI, USA. Ali Tokay, Mesoscale Atmospheric Processes Laboratory, NASA, Goddard Space Flight Center, Greenbelt, MD, US, Goddard Earth Sciences Technology and Research II, University of Maryland Baltimore County, Baltimore, MD, USA. Charles Helms, Mesoscale Atmospheric Processes Laboratory, NASA, Goddard Space Flight Center, Greenbelt, MD, USA, Earth System Science Interdisciplinary Center, University of Maryland, College Park, College Park, MD, USA.

The Precipitation Imaging Package (PIP), developed by NASA, is a camera-based disdrometer initially designed for snowflake measurement. Recently, its potential for

capturing the entire size spectrum of raindrops has been explored. Our project evaluated PIP's performance during NASA's 2023 and 2024 GPM winter field campaigns, comparing six image-processing methods against traditional rain-measuring devices like the PARSIVEL disdrometer and tipping bucket gauges. Preliminary results indicate that certain PIP methods produce higher rain totals than traditional instruments, suggesting room for refinement. PIP's ability to measure complete particle size distributions makes it a promising tool for weather research, potentially enhancing the accuracy of climate models and forecasting. This instrument could be integral to the National Weather Service's automated surface observing system, offering a cost-effective, low-maintenance solution for comprehensive precipitation measurement.

48. Viewpoint Planning for Semi-Autonomous Human-Supervised External Visual Inspection of Space Stations

Thor Helgeson, Undergraduate Student, University of Michigan, Robotics. Leia Stirling, PhD, Associate Professor, University of Michigan, Industrial and Operations Engineering, Robotics. Brandon Apodaca, M.S., PhD Candidate, University of Michigan, Robotics

Long term installations in space, such as the International Space Station, require external visual inspection to identify damage that could pose a risk to missions and the safety of astronauts. Meteoroid and orbital debris (MMOD) impacts, stresses caused while other spacecraft dock with the station, or rapid temperature fluctuations could be sources of damage. An autonomous, human-supervised spacecraft can provide inspection capability, but requires a path planner which selects viewpoints that ensure complete surface coverage. Viewpoint selection consists of generating viewpoints directly from a 3D station model, pre-filtering viewpoint coverage with a viewpoint to surface normal incidence angle threshold, and greedily selecting viewpoints. Viewpoint generation leverages non-uniform rational b-spline (NURBS) and triangular mesh station representations. The resulting viewpoint sets maximized coverage for a range of quality thresholds. Our future work will explore the utility of incidence angle as a measure of quality, in particular for different types of damage.

50. Calibration of Fluence of High-Energy Particles using a RBS Method

Mr. Trevor Harrison, Undergraduate Student, Physics Department, Hope College; Mr. Nolan Miles, Undergraduate Student, Physics Department, Hope College; Mr. Joseph Fogt, Undergraduate Student, Physics Department, Hope College; Ms. Hope Weeda, Undergraduate Student, Physics Department, Hope College; Dr. Kyuil Cho, PhD Clark University, Physics Department, Hope College.

Electrostatic particle accelerators are devices of large importance to many research fields, capable of accelerating ions to the high velocities necessary for scientific work. The Faraday cup is a useful detector that can measure the amount of charged particles (current) in an ion beam. However, the measured value via the Faraday cup is inaccurate due to backscattered particles and secondary electron emissions. Obtaining an accurate reading of the current of an ion beam is needed to calculate the fluence imparted on a sample, and is essential to understanding the effects of irradiation on

devices. We developed a new calibration method that can be performed efficiently using Rutherford Backscattering Spectroscopy (RBS) with a 3.4 MeV proton beam and a copper target. We will present the calibration procedure and results.

52. Ground-To-Satellite Quantum Clock Synchronization
Ethan Grant, Bachelors, Student, Electrical and Computer Engineering at Michigan State University. Virginia Ayres, PhD, Professor, Electrical and Computer Engineering at Michigan State University. Harry Shaw, PhD, Director, Quantum Communications at NASA Goddard Space Flight Center. Haleh Safavi, PhD, Director, LCOT at NASA Goddard Space Flight Center. Alejandro Rodriguez-Perez, Principal Researcher, QCS IRAD at NASA Goddard Space Flight Center

The Michigan Space Grant Consortium award for Ground-To-Satellite Quantum Clock Synchronization (QCS) allowed the Awardee to visit NASA's Goddard Space Flight Center during summer 2024. During my time there, I was able to work with the groups in charge of both QCS and Low-Cost Optical Terminal (LCOT) projects in order to create an accurate analysis of how the QCS project could be implemented on LCOT's Port Optical Bench. This effort was successful and I produced a series of CAD models that show possible implementations. I am continuing this work as an Independent Capstone at Michigan State University, with possible further continuation at NASA in 2025. This experience was very impactful in many ways. The MSGC award allowed me to not only visit a NASA facility, but to work with and interact with the people there. Working at a NASA facility was something I only dreamed about as a kid. This experience and the connections I made will be invaluable in helping me pursue a potential career in the space industry.

Poster Session B

1. ARC-LIGHT: Algorithm for Robust Characterization of Lunar surface Imaging for Ground Hazards and Trajectory
Alexander T. Cushen, Graduate Student, Department of Climate and Space Science and Engineering, University of Michigan. Samuel Carrico, Undergraduate, Department of Aerospace Engineering, University of Michigan. Ariana Bueno, Graduate Student, Department of Climate and Space Science and Engineering, University of Michigan. Mirko Gamba, Associate Professor, Department of Aerospace Engineering, University of Michigan. Chris Ruf, Frederick Bartman Collegiate Professor of Climate and Space Science, Department of Climate and Space Science and Engineering, University of Michigan. Corrydon Wettstein, Undergraduate, Computer Science and Engineering Division, University of Michigan. Jaykumar Ishvarbhai Adalja, Graduate Student, Department of Climate and Space Science and Engineering, University of Michigan. Mengxiang Shi, Undergraduate, Computer Science and Engineering Division, University of Michigan. Naila Garcia, Undergraduate, Department of Mechanical Engineering, University of Michigan. Yuliana Garcia, Undergraduate, Department of Mechanical Engineering, University of Michigan

Reliable lunar landings are crucial for future exploration of the Moon. The regolith ejected by a lander's rocket exhaust presents a significant obstacle in achieving this goal as dust interferes with the navigation sensors used to monitor trajectory and spot emerging surface hazards during landing. As our entry to NASA's 2024 Human Lander Challenge, we explored the development of a system that integrates data from the cameras and lidars that landers already carry but disable during the final landing phase to provide usable altitude data to the spacecraft. To demonstrate feasibility in an analog environment, we implemented a machine learning-based system to determine the optical depth of an atomized Di-Ethyl-Hexl-Sebacate mist (acting as dust simulant), which is used to rescale a lidar scan of a target through the mist. This works to 'see-through' the interference and reproduce a distance determination from the lidar, even when the system is optically thick.

3. Optimizing portability of bioluminescent cortisol sensors stress hormone monitoring

Anthony Rentzel, Undergraduate research assistant, Central Michigan University
Eric Petersen, PhD, Assistant Professor of Neuroscience, College of Medicine Neuroscience Graduate Program, College of Science and Engineering Biochemistry, Cellular and Molecular Biology Graduate Program, College of Science and Engineering Central Michigan University

High cortisol levels are a direct predictor of the body's response to increased stress levels. Increasing stress levels are proven to have shown many negative effects inside the body including an increased risk for cardiovascular disease, depression, diabetes, and others. Currently there is no ultralight weight, portable and efficient way to measure cortisol levels outside of a specialized clinical test. This serves as a problem for continued monitoring of NASA employees who may not have access to these tests. The goal of this project is to develop a portable, low-cost cortisol reporter by making a bioluminescent cortisol sensor that emits light when combined with saliva with high cortisol levels. We will develop a cortisol detection assay consisting of a protein-based biosensor that can be lyophilized for storage, and reconstituted when in contact with saliva, allowing the bioluminescent sensor to activate when a high level of cortisol is in the saliva.

5. Extracting Aluminum Through Chemical Processing of Lunar Anorthosite

Benjamin Thiel, undergraduate student. Megan Harvey, undergraduate student. Dr. Sarah Dean, assistant professor. All authors: Geological and Environmental Sciences Department, Hope College

Future exploration and habitation of the moon will benefit from local production of infrastructure and equipment, including the extraction of aluminum. Rock samples brought back from Apollo 16 contained 65-99% plagioclase, which has been proposed as a source of aluminum (Neron et al., 2022 and Wanvik, 2000). Anorthite is the calcium rich end member of the plagioclase series predominantly found in the lunar highlands. Aluminum is extracted through leaching of anorthite with a hydrochloric acid, followed

by sparging the leachate with HCl gas, and calcinating the precipitate into aluminum oxyhydrate. Hydrochloric acid and water will need to be transported to the lunar surface, but can be recycled thereafter. Lunar daytime temperatures could stimulate the leaching & sparging steps without additional heating, but operating time would be limited without additional heating. The aluminum oxyhydrate can be used as feedstock in lunar 3-D printing or further processed.

7. Life in Space: The 2024 ”Roger That!” Symposium
Bradley Ambrose, GVSU Professor of Physics. Amy Coon, GRPM Public Programs Coordinator. Jack Daleske, GRPM Planetarium Manager. Karen Gipson, GVSU Professor of Physics. Samhita Rhodes, GVSU Professor of Engineering. Rob Schuitema, GRPM Director of Public Programs. Glen Swanson, Chaffee Scholarship Fund. Deana Weibel, GVSU Professor of Anthropology

“Roger That!” is a celebration of space exploration in honor of Roger B. Chaffee. The 2024 theme of this annual collaboration between Grand Valley State University (GVSU) and Grand Rapids Public Museum (GRPM) was “Life in Space.” Activities on Friday Feb. 16 included expert presentations delivered online, school field trips at GRPM, and a multitude of events at GVSU, including a record number of “Design That!” entries by local schoolchildren and an inspirational presentation by astronaut Dr. Robert Satcher. On Saturday Feb. 17 GRPM hosted a second presentation by Dr. Satcher and over 20 community partners offering family-friendly interactive activities. MSGC supplemental funding enabled almost 200 STEM kits to be delivered to students at under-resourced schools. Online aspects enhanced accessibility, while in-person aspects supported community-building and hands-on learning. The 2024 MSGC grant supports the hybrid symposium on February 14-15, 2025, which is themed “Communication in Space.”

9. The Hunt for New Number Sequences in the Union of Path and Cycle Graphs
Bridget Rozema, currently finishing my BS in Mathematics, N/A, Mathematics Grand Valley State University

This study focuses on the sequence of numbers formed by counting the edge covers of specific graph families. An edge cover is a subset of a graph where each vertex is adjacent to at least one edge. Using the known sequences derived from the path and cycle graphs (Fibonacci and Lucas, respectively), we examine how combining these two graph families together at certain vertices lead to new number sequences. We will employ various methods to find the sequences that arise from these combinations of path and cycle graphs, such as rocket and bolo tie graphs, and determine their properties.

11. Analysis of soil carbohydrates across a longitudinal transect of Michigan peatlands
Christopher Klaver (Undergraduate Researcher, Departments of Geology and Environmental Science and Chemistry, Hope College), Parker Diaz (B.S. Biochemistry and Molecular Biology, Department of Chemistry, Hope College), Dr. Michael Philben

(PhD in Marine Science from University of South Carolina, Assistant Professor in Geology, Departments of Geology and Environmental Science and Chemistry, Hope College)

Peatlands sequester large amounts of carbon as organic matter, removing CO2 from the atmosphere. Global warming will increase both inputs and outputs of carbon in peatlands via photosynthesis and decomposition, but the net effect is uncertain. In this project, we assessed the effects of temperature on carbon outputs by measuring the carbohydrate content of the peat across a latitudinal transect of 7 different bogs. The carbohydrate levels were measured by hydrolyzing a ground up peat sample with sulfuric acid. Then samples were then derivatized with PMP (3-Methyl-1-phenyl-2-pyrazoline-5-one) and analyzed by HPLC-DAD. We hypothesized that the southern (warmer) bogs are more extensively degraded than the northern bogs. This would be reflected in the northern bogs having higher carbohydrate content than the southern bogs. This ongoing project will provide an integrative measure of the temperature sensitivity of decomposition and will help predict how temperature could impact on peatlands' ability to store carbon.

13. Protein Based Lanthanide Capture from Coal Fly Ash

Elliot Furr, B.S., Graduate Student (PhD), Department of Chemistry, Wayne State University. Valerie Akrawi, Undergraduate Student Researcher, Department of Chemistry, Wayne State University. Sayak Gupta, PhD, Former Graduate Student, Department of Chemistry, Wayne State University. Sai Praneeth, PhD, Post-Doctoral Researcher, Department of Civil and Environmental Engineering, Wayne State University. Matthew J. Allen, PhD, Department Chair, Department of Chemistry, Wayne State University. Timothy M. Dittrich, PhD, Associate Professor, Department of Civil and Environmental Engineering, Wayne State University. Jeremy J. Kodanko, PhD, Associate Department Chair, Department of Chemistry, Wayne State University

This project aims to develop a sustainable, protein-based approach for recovering lanthanides (Lns) from waste materials, aligning with NASA's goals in resource utilization. We created metal-capturing conjugates by covalently bonding diethylenetriamine pentaacetate (DTPA) to proteins such as serum albumin and myoglobin. These conjugates effectively capture and release Lns, like EuIII, using a simple buffer exchange process, which was applied to coal fly ash leachate. Characterization techniques, including mass spectrometry, electrophoresis, UV-Vis spectrometry, and circular dichroism spectroscopy, confirmed creation of the conjugates and revealed strong EuIII binding. Recyclability studies showed that the conjugates maintained over 80% efficiency after three cycles, highlighting the method's sustainability. This research exemplifies green chemistry principles and supports NASA's strategic interests in developing resource allocation technologies for aerospace applications and space exploration.

15. Solar Energy and Partial Harvesting Study by a Solar Cage

Gabe Gransden, Senior Undergraduate Student, Undergraduate Fellow of MSGC, Electrical and Computer Engineering, Saginaw Valley State University. Zachary

Franzel, Senior Undergraduate Student, Electrical and Computer Engineering, Saginaw Valley State University. Mohammad Khan, PhD, Associate Professor, Electrical and Computer Engineering, Saginaw Valley State University

Renewable energies are of significant focus considering the cost and the impact on climate. The study primarily focuses on the energy harvest and the energy remaining in a harvesting cage in terms of light intensity and developed voltage. A 3-panel based small solar cage was modeled and built for the study. Si-based solar cells are connected in series and placed on the cage. The preliminary results from the cage show wide light intensity variation inside the cage whereas the generated voltage has narrow variation. The results also indicate how a solar cage plays a role in potentially sustainable energy consumption.

17. Formalizing Motion Plan Legibility Using Empirical Manual Takeover Data in Autonomous Spacecraft Docking

Hannah Larson, M.S. (University of Michigan Department of Mechanical Engineering), Leia Stirling Ph.D. (University of Michigan Department of Industrial & Operations Engineering, Department of Robotics)

As space missions look towards Mars, workload of astronauts will increase as larger communication delays inhibit the real-time support mission control can provide. Tasks can be reallocated to automation to limit the added workload placed on the astronaut, but automation will require careful design to support appropriate use and safety. Spacecraft docking maneuvers are one task that has become increasingly automated, but still requires astronaut monitoring to take over control in a failure scenario. This research experimentally examines how the motion trajectory of a spacecraft during docking influences decisions to manually take over control. Thirty-three participants monitored multiple simulated autonomous docking maneuvers and asserted manual control when they believed failure to be imminent. Results showed that motion plan characteristics of initial condition and path curvature significantly influenced if and when takeover was performed. Knowledge gained from these results can inform spacecraft motion planners to support the astronaut in decision-making tasks.

19. Measuring the Charge Half-Life of Desert Dust Using an Open-Source CERN Ion Trap: Implications for Climate Modeling

Ian Norwood, BS Physics, Graduate Student, Department of Physics at Michigan Technological University

Understanding the electrostatic properties of atmospheric dust is vital for refining climate models, as these particles influence radiative forcing, cloud formation, and biogeochemical cycles. I measured the charge half-life of dust particles from the Sahara and Arizona deserts using an AC-driven ring Paul trap. This precise setup allowed us to observe charge decay in a controlled environment. The results revealed distinct charge decay characteristics between the two dust types, linked to differences in mineral composition and particle size. These findings highlight the need to incorporate electrostatic properties into climate models, as they can significantly reduce

uncertainties in predicting dust behavior and improve climate projections. Future work will extend this methodology to more dust types, frictional charging mechanisms, and validating laboratory results with field data, enhancing climate modeling accuracy.

21. Control of Hot Carriers Cooling in Perovskite Solar Cell

Jihan Abou Halloun, PhD candidate, Department of Chemical Engineering and Materials Science, Wayne State University, Helen Durand, Associate Professor, Department of Chemical Engineering and Materials Science, Wayne State University.

Perovskite solar cells (PSC) that have been of interest for space photovoltaic systems can be used in supplying power to NASA's missions. Despite of the PSC's advantages, various challenges remain before becoming a competitive solar cell in space. One main challenge is that in the presence of a powerful electric field hot carriers (HC) (i.e., electrons or holes with high kinetic energy) might be injected into undesirable area in the semi-conductor device which might lead to its degradation. Our goal is to incorporate a process control tool which is model predictive control (MPC) integrated with a recurrent neural network (RNN) into the control of matter in terms of controlling HC cooling mechanism in PSC with reduced computational time. In this presentation, we introduce the complex mechanism of the HC cooling which is needed to elaborate an optimization problem that will be incorporated into an MPC to control the HC cooling.

23. The impacts of iron oxide nanoparticles on the antipredator behaviors of house sparrows

John Wenderski, undergraduate researcher, Hope College. Liam Hanlon, undergraduate researcher, Hope College. Shae Johnston, undergraduate researcher, Hope College. Chisom Okogbue, undergraduate researcher, Hope College. Dr. Natalia Gonzalez-Pech, PhD, Princepal investigator, Chemistry, Hope College. Dr. Kelly L. Ronald, PhD, Principal Investigator, Biology, Hope College

The past 50 years have led to a significant increase in urbanization leading to multiple detrimental effects on the environment including increased industry and pollution, and a decrease in North American bird populations by 29% with cats causing the most bird deaths per year. The solid portion of air pollution, called particulate matter (PM), can have a diameter of 2.5 ŒºÊm or even smaller (i.e., PM2.5). PM2.5 are small enough to enter the bloodstream by the blood-gas barrier and once in the bloodstream can enter the brain and alter species-appropriate behavior. We predicted that house sparrows (Passer domesticus) exposed to aerosolized iron oxide nanoparticles would show less antipredator responses (e.g. scanning and fleeing) and less exploration (i.e. movement) compared to controls. These results will shed light on the effects of pollution on bird populations as well as determine other downstream consequences of urbanization.

25. Binary Stars and Big Data

Mr. Joshua, undergraduate at Calvin University department of Physics and Astronomy. Mr. Levi Carr, undergraduate at Calvin University department of Physics and Astronomy. Dr. Larry Molnar, PhD Harvard University, Astronomy, Calvin University department of Physics and Astronomy.

Time-domain survey astronomy is a rapidly growing observational approach. Already, brightnesses of millions of stars are being monitored over time, with plans in the very near future to scale this up by orders of magnitude. In this work we study observations from two time-domain surveys, combining them with the Gaia astrometric survey, to study the properties of contact binary stars as a class. We also search for rare systems near the end of their evolutionary cycle. We develop an automated approach to editing data, classifying the stellar types, and deriving relevant physical parameters. We present here some of the challenges we encountered to ensure reliable results in a catalog too large to inspect each case individually. Once complete, the resulting catalog can be used as a powerful test of a comprehensive theory of contact binary evolution our group has developed in recent years. The methods we develop can be scaled up for use with the much larger surveys coming online soon.

27. Long-Term Metabolic Measurements Reveal Seasonal Carbon Cycling Trends in a Great Lakes Estuary

Kaylynne Dennis, Zoology B.S., Graduate Research Assistant, Department of Biology, Grand Valley State University, Annis Water Resources Institute. Anthony Weinke, Masters of Biology, Lab Manager, Annis Water Resources Institute. Dr. Bopi Biddanda Ph.D in Ecology, Research Scientist, Biology, Grand Valley State University.

Carbon metabolism represents the sum of photosynthesis and respiration and determines if an environment is a sink or source of carbon. Inland water bodies are recognized as hotspots of carbon cycling. In Muskegon Lake, a Great Lake‚Äôs estuary, two decades of seasonal metabolism measurements reveal that on average, summer has the lowest ratio of Production: Respiration (3.4) compared to Spring and Fall (6.2 and 7.8, respectively) indicating net annual autotrophy. High-frequency measurements of metabolism conducted during 2023-2024 reveal a trend of peak production during late May and early June, suggesting past measurements may have missed moments of peak production. There were no statistically significant changes across sites and seasons over the span of this dataset. Currently, we are synthesizing a decade of continuous dissolved oxygen measurements into complimentary metabolism data (www.gvsu.edu/buoy/). Through this, we hope to assess the role of temperate lakes and estuaries in the changing global carbon cycle.

29. Human Powered Locomotion on Variable Terrain: Implications for How to Move on Mars

Kyle Wehmanen, MS, Department of Kinesiology & Integrative Physiology, Michigan Technological University. Steven Elmer, PhD, Department of Kinesiology & Integrative Physiology, Michigan Technological University

BACKGROUND: Human locomotion on variable terrain (i.e., sand, snow) provides unique physiological challenges. The evolution of passive tools has enabled travel across some terrain (e.g., skis on snow), with improved economy (i.e., energy required to move a given distance). The benefit on other terrain remains unknown.

PURPOSE: To determine which mode of human locomotion, walking/running or bicycling, has the best economy for travel on sand.
METHODS: Five adults traversed a sand course on foot and on bicycle at multiple speeds while oxygen consumption (VO2) was measured and used to calculate economy (J/kg/m).
RESULTS: Economy was lower for bicycling versus foot at all tested speeds (2.97+/-0.37 vs. 4.58+/-0.79 J/kg/m; p<0.001).
CONCLUSION: Bicycling had better economy than foot when traveling on sand, indicating it is the superior mode of travel if minimizing energy cost is a consideration. This has implications for human powered movement in desert environments including the surface of Mars.

31. Temperature sensitivity of nitrogen mineralization in peat from bogs across a Michigan transect

London Yoder, undergrad research, Geological and Environmental Sciences, Hope College. Madison Smith, undergrad research, Geological and Environmental Sciences, Hope College. Dr. Michael Philben, Ph.D., marine science, University of South Carolina, 2014, B.A., earth and planetary science, Northwestern University, 2010, mentor, Geological and Environmental Sciences, Hope College.

Seven peat bogs across a latitudinal transect of Michigan were used to analyze inorganic nitrogen release to predict the impact that climate warming has on peatland nitrogen cycle. Samples were kept at 22¬∞, 18¬∞, and 13¬∞C to simulate warming. The highest rate of nitrogen release was expected in samples at 22¬∞ and from samples from southern latitudes. 50cm peat core samples were taken at each site. 20g of sanitized sand was added to upper chambers of microlysimeters. 50g of peat was added onto the sand and was left to equilibrate for 5 days. Microlysimeters were leached with 80mL of 0.01M CaCl,ÇÇ solution and inorganic nitrogen was quantified using ion chromatography. Microlysimeters were incubated for two weeks, and leaching was repeated. A field-based cation-anion analysis was performed by plant root simulators. Results indicate that nitrogen mineralization is higher in southern sites and in microlysimeters at higher temperatures, supporting our hypothesis.

33. FuzzRT: Enhancing Assurance for Robotics Applications

Mallory Jacobs, Working towards a B.S. in Computer Science, College of Computing, Grand Valley State University

Safety-critical robot platforms must ensure that they continuously satisfy their key mission objectives while subjected to changing environmental or system conditions. For example, an autonomous two-wheeled robot must fully explore a space while avoiding collisions with human participants and environmental hazards that may damage the robot. Such expressions of uncertainty may change over time to conditions for which the robot was not explicitly designed, potentially leading to catastrophic system failure. Exploratory assurance techniques such as fuzz testing and run-time testing can be used to detect flaws in code and expressed behavior. However, such techniques may directly impact the system under test in terms of performance and/or satisfaction of key

objectives. This project will establish preliminary results in designing and implementing a testing framework for robotics platforms that can be used both for design-time and run-time testing for enhancing assurance against uncertainty.

35. Freshwater fish as a bioindicator for Escherichia coli (E. coli) in contaminated river systems in Michigan

Mitchell Olszewski, Graduate Student, Biology, GVSU. Dr. Carl R. Ruetz, GVSU Annis Water Resource Institute. Dr. Kevin B. Strychar, GVSU, Annis Water Resource Institute

The presence of Escherichia coli (E. coli) in streams and rivers is a significant health threat, particularly in the Great Lakes, where many water bodies fail to meet safety standards. E. coli contamination arises from various sources, such as wildlife feces, agricultural runoff, and poor wastewater management. Outbreaks can cause severe health conditions, including hemorrhagic colitis and hemolytic uremic syndrome, especially from the dangerous E. coli O157 strain. While E. coli transmission is typically linked to water and food, fish may also serve as a vector. This study explores fish as potential bioindicators for identifying E. coli sources. Fish mucus could retain E. coli, providing insights into contamination events that may otherwise go undetected. Preliminary data show fish in contaminated waters can have E. coli levels from 400 to 1000 cfu/100mL, suggesting the need for closer monitoring of public waterways, similar to beach closures, to protect human health.

37. Urbanization Effects on Stress and Auditory-Visual Processing in House Sparrows (Passer domesticus)

Natalie Leake, Undergraduate Researcher, Biology, Hope College. Emma Yonker, Undergraduate Researcher, Biology, Hope College. Kelly Ronald, PhD, Primary Investigator, Biology, Hope College

Urban expansion presents numerous challenges for wildlife, including habitat fragmentation, novel predators, and pollution. These factors can disrupt animal communication and increase stress levels. This study investigates the physiological impacts of urban stressors on house sparrows (Passer domesticus). We focus on how urbanization influences the anti-stress hormone corticosterone (CORT) and its effects on auditory and visual processing. Sparrows were collected from rural, suburban, and urban areas around Holland, MI. Blood samples were analyzed to determine baseline and elevated CORT levels. Auditory processing was assessed using auditory brainstem responses, measuring sound detection across various frequencies and intensities. Visual processing was evaluated through electroretinogram tests, which gauge motion detection ability by determining flicker fusion frequency. We hypothesize that urban sparrows will exhibit higher chronic CORT levels and differences in sensory processing compared to rural birds. This research aims to enhance understanding of animal communication amidst urban growth and inform conservation strategies to mitigate human impact on wildlife.

39. Comparing the Effects 1.7 MeV and 0.6 MeV Proton Irradiation on YBCO Thin-film Superconductors

Nolan Miles, Undergraduate Student, Undergraduate Research Student, Department of Physics at Hope College Trevor Harrison, Undergraduate Student, Undergraduate Research Student, Department of Physics at Hope College Joey Fogt, Undergraduate Student, Undergraduate Research Student, Department of Physics at Hope College Hope Weeda, Undergraduate Student, Undergraduate Research Student, Department of Physics at Hope College. Kuil Cho, PhD, Research Advisor, Department of Physics at Hope College.

We studied the effect of 1.7 MeV and 0.6 MeV proton irradiation on thin film Cuprate superconductors. Apart from a change in beam energy, sample characteristics were kept near-constant between the two experiments. Similarly to the previous 0.6 MeV experiment, the critical temperature (Tc) of the YBCO sample was suppressed upon irradiation with a 1.7 MeV proton beam. We found that the 1.7 MeV higher-energy beam is more effective in suppressing the Tc of YBCO than the 0.6 MeV beam. Consequently, the 1.7 MeV data was slightly closer to the generalized d-wave AG theory curve than our previous experiment with 0.6 MeV proton irradiation. We will discuss the details of this experiment and the results.

41. Grain Shape Analysis of Fine Sand in a Post-glacial Inland Dune and a Phoenix Mars Lander Site Analog

Michael Velbel, Doctorate, Professor Emeritus, Department of Earth & Environmental Sciences, Michigan State University, Brian Wade, Masters, Laboratory Technologist, MSU-DOE Plant Research Laboratory, Michigan State University, Pablo Rizzo Mora, Undergraduate, Research Assistant, Honors College, Michigan State University, Guilherme Eckert Roda, Undergraduate, Research Assistant, Honors College, Michigan State University, and the Sands of Mars of Mars X Seminar students.

The Phoenix Mars Lander (PHX) collected sand from periglacial polygonal patterned ground (PPPG). The rounding of the sampled grains is attributed to abrasion, either during saltation, eolian transport, or local cryoturbation. The Saginaw Lowlands (SL) PPPG in Michigan serves as a terrestrial analog for the PHX landing site. The Pinetum is a sand dune at MSU, formed within 2,000 years after the SLPPPG. This work characterizes grain shapes in these landforms to discern aeolian inputs to troughs and ice-wedge casts as an analog for Mars‚Äôs PPPG.

Eighty fine-sand-sized grains from the SLPPPG polygon interior, SLPPPG trough-fill ice wedge cast, and the Pinetum dune were studied using a SEM. Their length and width were measured to quantify equantcy. Equantcy values do not differ significantly, implying that the sand inventories of the SLPPPG cast may include some aeolian sand. Aeolian transport may have been too short to reshape the grains.

43. Strengthening under-resourced Michigan student engagement in science through astrophysics research

Rhianna Taub, Undergraduate physics and astronomy student, Student Research Assistant, WSU physics & astronomy department; Kristen Dage, PhD in astrophysics, Student research Mentor, lecturer at Curtin Institute for Radio Astronomy and co-chair

of Rubin Observatory's Stars, Milky Way and Local Volume Collaboration; Edward Cackett, WSU representative, Associate Dean of the College of Liberal Arts & Sciences and Distinguished Service Professor, Dept. of Physics & Astronomy at WSU.

The metro-Detroit area is home to a large number of colleges and universities. In this talk I will introduce the Dead Stars Society, a student oriented research group based at Henry Ford College, and how we provide research opportunities to students from a wide range of backgrounds. I will discuss my involvement in the program as an undergraduate student researcher and how we are creating student focused research manuals probing astronomy at a variety of wavelengths from optical to gamma ray.

47. Optimizing Antioxidant and Nitrate Balance in Space-Grown Vegetables: The Impact of LED Light Treatments

Margaret E. Hitt, Undergraduate Engineering Freshmen & Egleston Scholar, Columbia University, Founder of Dow High Space Farmers, NASA Space Biology Intern; Sophie Cai, Vice President of Dow High Space Farmers, NASA Space Biology AI/ML Trainee, Herbert Henry Dow High School; Sanvi Patel, Chief Science Officer, member of Dow High Space Farmers, Herbert Henry Dow High School; Lisa S. Tsay, NASA GBE and HUNCH Mentor, Saginaw Valley State University

Leafy green vegetables, containing vitamin C and other antioxidants, can help counteract health issues caused by spaceflight, such as weakened immune systems and radiation damage. However, these vegetables are high in nitrates. When nitrates interact with processed meat or cheese in prepackaged space diets in an acidic stomach, they can form carcinogenic nitrosamines. To determine the best balance of antioxidants and nitrate in vegetables grown in space, we conducted experiments using two different LED light treatments (Control: 230PAR (R25B25G0W175); Experimental: 305PAR (R25B25G0W250)) in 12 28-day, 12-photoperiod trials, growing irradiated Red Romaine Lettuce and Pak Choi (pretreated with Neutron Radiation, Californium-252) in simulated ISS growth chambers with controlled CO2 levels. The ANOVA Analysis revealed that different light treatments yielded no significant difference in growing parameters (dimensions, growth rates, biomass). The nitrate concentrations positively correlated with light intensities and negatively with the CO2 levels, resulting in a preference for the control treatment.

49. CUDA Parallelization Of DCUHRE

Tobias Shaw, High School Diploma, Undergraduate Student, Computer Science, Hope College. Peter Worden, High School Diploma, Undergraduate Student, Computer Science, Hope College. Omofolakunmi Olagbemi, PhD, Assistant Professor, Computer Science, Hope College

Mathematical integration is a common process in a wide array of fields such as medical imaging, statistical analysis, orbital mechanics, and simulation modeling. Since analytical solutions to many integration problems are impossible to obtain, they are instead numerically approximated. There exists a variety of numerical integration software used to estimate such integrals; one such software is DCUHRE which employs

the global adaptive algorithm over a hyperrectangular region to estimate a given function. However, as the integral dimension increases, the number of region evaluation points increases exponentially. While DCUHRE was written to accommodate parallel execution on multiple processors, the level of parallelization is significantly less than what can be achieved using GPUs, thus resulting in significantly longer execution times in higher dimensions. Our parallel solution ParDCUHRE achieved a speedup of up to 80 with selected integrals (with dimensionality as high as 25) while yielding results comparable to the original DCUHRE.

51. Investigation of Mechanical Integrity of GeTe for Radioisotope Thermoelectric Generators

Weeam Guetari - Undergraduate Student, Department of Chemical Engineering and Materials Science, Michigan State University. A K M Ashiquzzaman Shawon - PhD candidate, Department of Chemical Engineering and Materials Science, Michigan State University. Alexandra Zevalkink - PhD, Professor, Department of Chemical Engineering and Materials Science, Michigan State University

Radioactive thermoelectric generators (RTGs) are the primary power sources in deep space probes. P-type GeTe, a promising candidate for next generation RTGs, undergoes a crystallographic phase transition at ~400 ¬∞C. In this work, we will investigate if this phase change causes any mechanical instability and decrease in long-term reliability. Dense samples are synthesized by melt-cooling followed by spark plasma sintering. After the phase is checked with x-ray diffraction, temperature-dependent elastic constants and microhardness testing will then be done to systematically explore the mechanical performance of these samples. We aim to determine the changes in elastic properties as a function of crystal structure in GeTe and quantify the Vicker’s microhardness of samples in two different crystal structures before and after heating cycles to probe reliability.

53. The Direct Formation of Contact Binary Planetesimals from Gravitational Collapse

Jackson Barnes; M.S. Northwestern University; Ph.D. Candidate; Michigan State University. Seth Jacobson; Ph.D. University of Colorado, Boulder; Assistant Professor; Michigan State University

The gravitational collapse of self-gravitating clouds of pebbles (~mm-cm) creates planetesimals (~10-100 km) and reproduces many of the observed properties of relict binary systems in the Kuiper Belt. Contact binary planetesimals compose a sizable fraction of the cold classical Kuiper Belt (~10-25%) and Plutino populations (~40-50%), of which the cold classical Kuiper Belt object Arrokoth is the premier example. The surfaces of its lobes contain similar amounts of highly-volatile chemical species, which indicate formation in a homogeneous and gentle environment. Thus, it has been proposed to have formed via direct gravitational collapse, or alternatively via subsequent dynamical evolution following binary formation. We show that contact binary planetesimals can form directly from gravitational collapse using the PKDGRAV N-body integrator and its soft-sphere discrete element method. We report the evolution of binary

systems prior to contact, contact binary lobe masses and sizes, spins, and morphologies prior to and after contact, and we compare our results to relict contact binaries in the asteroid and Kuiper belts.