



FRONTIERS NEWSLETTER

WINTER 2024

2023 Fall Conference at WMU

The annual Michigan Space Grant Consortium (MSGC) Fall Conference hit the road again this year to our affiliate in Kalamazoo, Western Michigan University (WMU). Attendees were welcomed from around Michigan to the Fetzer Center on a cheerful Saturday.

After a warm welcome from Professor Mark Moldwin, Director of NASA's MSGC; Dr. Remzi Seker, Vice President for Research and Innovation from WMU kicked off the conference. Troy A. Thrash, President & CEO of Air Zoo Aerospace and Science Center was the keynote speaker who captivated the audience with his talk on "The Extraordinary Power of Experience in Inspiring the Next Generation of Explorers." Thrash and the Air Zoo team seek every day to provide new ways for young people across Michigan to fall in love with STEAM disciplines with their hands, their minds, and their hearts.

The day was filled with three sessions of oral presentations, as well as two opportunities for the large batch of forty-three poster presentations that lined the perimeter of the center.

The next Fall Conference will be held back in Ann Arbor to celebrate our 35th anniversary on Saturday, October 19, 2024. Everyone is welcome to attend.

From top to bottom: MSGC Campus Representative Professor Massood Z. Atashbar and attendees from WMU; MSGC Campus Representative Professor Brian Yurk and attendees from Hope College; MSGC Campus Representative Professor Bopaiah Biddanda and attendees from Grand Valley State University.



Professor Mark Moldwin and student looking at the sun through a sunspotter telescope

MESSAGE FROM THE DIRECTOR

We welcome Central Michigan University and their new Board Affiliate Prof. Tao Zheng to the Michigan Space Grant Consortium this year, expanding our reach to twelve university and college affiliates.

At our Fall 2023 Conference held at Western Michigan University in Kalamazoo, we learned about the success of last year's programming from over 100 presenters and attendees. Our Keynote was from the President and CEO of AirZoo, Troy Thrash, describing his experiences that led him to help develop one of the world's unique aerospace and STEM engagement centers.

We look forward to the total solar eclipse on April 8, 2024 with the path of totality just touching SE Michigan and the partial eclipse visible throughout Michigan

Please join us on October 19, 2024, at our Fall Conference at the University of Michigan in Ann Arbor where we will celebrate the 35th Anniversary of NASA Space Grant. We look forward to expanding our partnerships, collaborations, and programming across Michigan in 2024.

Mark Moldwin

Mark Moldwin, PhD - Arthur F. Thurnau Professor, Department of Climate & Space Sciences & Engineering, Director of NASA's Michigan Space Grant Consortium.

Michigan Space Grant Consortium
www.minspacegrant.org

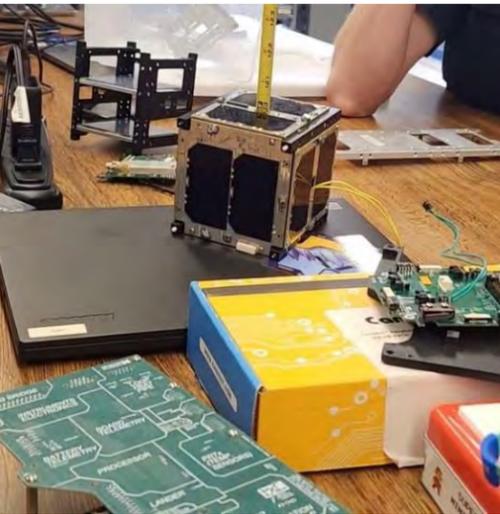
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Pushing Boundaries: A Collaborative CubeSat Mission

Led by student researcher Sara M. Tavárez García, a joint effort between the Inter-American University of Puerto Rico (IAUPR) and the University of Michigan (UM) is advancing space exploration. This Summer Research Opportunity Program (SROP) project focused on a CubeSat mission testing a 4-magnetometer board (Quad-Mag) in Low Earth orbit.



The Quad-Mag excels when in noisy environments and is a game-changer in magnetometer technology. Its resilience promises breakthroughs in space-related research. Unlike traditional CubeSat missions requiring a complex BOOM structure, Tavárez García's team aimed to eliminate this need, streamlining the CubeSat design. The significance of this mission was that testing Quad-Mag's efficacy in space is crucial for understanding celestial bodies' magnetic fields and monitoring Earth's magnetic field. The mission's success has broad implications for navigation, space weather prediction, and studying geomagnetic storms. The collaboration spanned a year, involving mechanical engineering students from IAUPR and UM, emphasizing interdisciplinary cooperation.



Tavárez García, the project manager, oversaw critical aspects like the Attitude Control and Determination subsystem, ensuring precise CubeSat orientation. Her work optimized the Ground Data Handling subsystem for efficient data transmission. Reflecting on her SROP experience, Tavárez García highlighted the transformative impact, solidifying her commitment to space exploration technology. She is currently leading the team as they finalize details for a key Preliminary Design Review (PDR) involving UM evaluators, as feedback from this review is vital for project success. The team is gearing up to submit a proposal to NASA's Launch Initiative Program, a potential milestone for the project. Sara's CubeSat mission exemplifies collaborative spirit and innovation in space exploration. As the team progresses towards the Preliminary Design Review, the impact of their work promises to resonate beyond the project itself.



From top to bottom: Posing in front of the Climate and Research building with two members of the CubeSat and institutional advisor Dr. Amilcar Rincon-Charris; CubeSat from a manufacturing lab tour and mentor meeting; Members of the CubeSat team giving a presentation to Dr. Mark Moldwin; Final presentation in the annual SROP Symposium 2023

MSGC Calendar

- May 1, 2024:** Funding starts for 2024 Awards
- August 16, 2024:** Registration opens for Fall Conference
- September 3, 2024:** Applications open for 2025 Awards
- October 19, 2024:** Fall Conference in Ann Arbor
- November 13, 2024:** Applications due for 2025 Awards



Allison Pease collecting data at Argonne National Laboratory

Exploring Earth's Depths: Insights from High-Pressure Mineral Research

In a laboratory study to investigate the formation of different minerals at lower mantle conditions, researchers have unlocked insights into the Earth's evolution. Michigan State University graduate student Allison Pease conducted the research using the Advanced Photon Source at Argonne National Lab in Illinois. The study used in situ X-ray diffraction to analyze different minerals at extreme pressures and temperatures that exist deep in the Earth's mantle.

By constraining the composition of these minerals, the research aimed to generate a piezometer so that observation of these minerals in xenoliths and meteorite inclusions could be correlated to the depth at which they formed, providing key insights into Earth's geological history.

In addition, the project fostered collaborations across disciplines and at different institutions, enhancing Pease's skills and professional network. As an integral part of her PhD thesis, the project help shape Pease's career in mineral physics. The impact of the

research extended globally with presentations at conferences and in publications. The research was also supported by a Mineralogical Society of America Grant for Research in Crystallography.

Pease's research contributed to unraveling some of Earth's mantle's mysteries by providing insights of high-pressure minerals and their implications for planetary evolution. Beyond contributing to scientific knowledge, the study aligned with NASA's goals and holds promise for future planetary exploration endeavors. The project's impact on the researcher's career and potential for extramural funding further emphasizes the significance of this study.



From left to right: Evan Thomas, Skylar Dewitt, Dr. Erika Calvo-Ochoa, and Nate Vorhees

Decoding Hypoxia: Zebrafish Research Unveils Olfactory Secrets

In a research project, Hope College undergraduate student, Evan Thomas and a team of researchers explored the effects of hypoxia on the olfactory morphology and function using the zebrafish model. Beyond biology health, which is important for space exploration. The study aimed to uncover broader implications of oxygen deprivation on human health.

The experiment immersed zebrafish in hypoxic conditions, mimicking challenges faced in space and various other extreme conditions. Different techniques, such as measuring dissolved oxygen and staining for mitochondrial activity, revealed intriguing outcomes. For instance, decreased TTC staining in olfactory bulbs indicated potential neural damage due to hypoxia. In addition, Immunohistochemistry assays revealed an increase in astrocyte activation and cells undergoing apoptosis. The researchers were able to successfully navigate multiple challenges, showcasing their resilience and problem-solving skills of the scientific community. Team member Skylar Dewitt presented the findings at several, including the 2022 Society for Neuroscience convention and other academic forums helping to foster collaboration and recognition.

This research not only enhanced our understanding of hypoxia's impact on olfactory structures but also held implications for broader health issues. Working towards disseminating their results broadly, the team is constructing a dedicated website.



Bi-Propellant Rocket Engine: Static fire

Michigan Launch Alliance Teams up

The Michigan Launch Alliance (MLA) has one primary objective: "to make aerospace related project-based learning real for any student in Michigan." They acknowledged early on that they could not accomplish this alone. This led to a collaboration with students from two prominent Michigan universities, Western Michigan University (WMU) and Grand Valley State University (GVSU); on a special project to produce a fully capable static firing demonstrator. This served as a trial run, as well as a first step to realizing their vision.

The project involved building and testing a "Bi-Propellant Rocket Engine." With the help of very talented and dedicated students from both WMU and GVSU; it was a great success. In a relatively short time the team managed to build an engine capable of generating significant force, proving that students are willing and able to build, test, and design complex structures.

with Western Michigan and Grand Valley State to Build Rocket Engine

However, they did encounter some challenges along the way, including combustion instabilities, ignition timings and oxidizer mass flow rates, that took over a month of testing to overcome. The most picturesque challenge was a "flamethrower" created as a result of ignition timing problems (shown below). With a divide and conquer strategy that involved WMU constructing the static test stand and GVSU handling the engine, every problem that they faced was eventually resolved.

The Michigan Launch Alliance team is going through the process of becoming a

non-profit organization. This will allow them to be able to create much needed connections between education and industry through designs and projects similar to the rocket engine. Simultaneously, MLA is currently building their official website where all the findings for this project as well future experiments and publications will be posted.

The team has posted a more in depth update on their YouTube channel. You can view the eleven minute video here: <https://myumi.ch/n75XV>

Flame thrower due to ignition detonations





Graduate student Gabrielle Lochrie attending IFAC WC 2023 in Yokohama, Japan

Fueling Advancements: Pioneering Lithium-Ion Battery Diagnostics in Michigan

In the pursuit of cutting-edge technology, researchers at Oakland University, led by Dr. Yongsoon Yoon and graduate student Gabrielle Lochrie, researched a project focused on developing a comprehensive system diagnostic for lithium-ion batteries.

This research transcended traditional fault detection, diving into the complexities of fault analysis and robust fault isolation. The methodology employed a faulty feature extractor based on anti-windup parameter estimation and a faulty feature evaluator using machine learning techniques. There was a main emphasis on capturing changes in physical parameters and battery state resulting from internal and external faults. Presentations at conferences such as the MSGC 2022 Fall Conference and the IFAC Triennial World Congress highlighted the project's progress, showcasing the team's capability to navigate challenges and contribute to the evolving field of lithium-ion battery diagnostics. The outcomes extend beyond academia, with Dr. Yoon leveraging theoretical insights for a new NSF research proposal, illustrating the project's potential applications across various systems.

Bits & Bytes Summer Camp: EMU's Approach to Tech Education

Eastern Michigan University's (EMU) Bits & Bytes summer camps achieved success in 2022, embodying the mission to "inspire and educate the next generation of tech leaders." The collaboration with students from diverse backgrounds showcased a transformative learning experience that exceeded expectations.

Supported by the Michigan Space Grant Consortium (MSGC). The virtual camp served as a unique trial run, successfully bridging the gap between education and industry. Meticulous planning, mentor recruitment, and intensive curricular preparations, set the stage for a fully subscribed in-person camp on June 20th. In July, mentors underwent comprehensive training, establishing crucial platforms for a seamless virtual learning environment. Daily reflections to go along with on-campus sessions added a hands-on dimension, while a closing

ceremony with a LEGO Education software engineer highlighted the camp's overall impact. Also, pre and post-surveys provided valuable insights into participants' journeys, revealing positive experiences from diverse programming to the joy of coding "ozobots". Post-camp, mentors reflected on lessons learned, which echoed the camp's transformative impact.

As the camp website undergoes development, the Bits & Bytes team aims to formalize their impact by becoming an official nonprofit organization. This step will strengthen connections between education and industry, ensuring the legacy of the camp continues to inspire and shape the tech leaders of tomorrow.

Participants in EMU's Bits & Bytes Summer Camp

Fall 2023 Plant the Moon Challenge

This past Fall, MSGC supported nine teams for the Plant the Moon (PLM) Challenge. There were 48 total students involved during the "growing" season." Feedback from students included, "It was exciting to see how my plants grew in lunar regolith. I felt like I was part of something truly big and exciting, NASA's mission to the moon."

The PLM Challenge aligns with the Artemis Mission in returning to the Moon and challenges middle and high school students to understand how to grow crops in lunar soil. MSGC is actively joining this effort by supporting diverse school teams from across Michigan in this program. Teams are given a bag of lunar soil simulant along with instructions on growing the crops. There are check-ins throughout the challenge, leading up to the closing ceremony where teams share their results.

On Right: Willard Library's grow set up from October 2023





Aerial view of the Central Michigan University Campus

Welcome Central Michigan University!

Central Michigan University (CMU) was unanimously approved to join the Michigan Space Grant Consortium (MSGC) and become the twelfth affiliate University at the MSGC Board Strategy Retreat in July held in Port Huron.

Professor Tao Zheng from the department of Geography and Environmental Studies has taken the lead as the CMU MSGC Campus Representative and a member of the MSGC Board.

MSGC is thrilled to welcome CMU to the consortium.

New Campus Rep for SVSU

Saginaw Valley State University (SVSU) MSGC Board Member and Campus Representative, Professor Khandakar Abir Rahman stepped down in 2023. Making the way for a new faculty affiliate to represent SVSU, Professor Mohammad Ashraf Khan. Professor Khan is from the Electrical and Computer Engineering Department. We thank Professor Rahman for his significant contributions and wish him the best of luck in his next adventures and welcome Professor Khan to MSGC.

FY2023 MSGC Funding Snapshot

- \$160,947** for Educational Programs
- \$55,000** in Research Seed Grants
- \$326,800** NASA Internships & Fellowships
- 248** College Students
- 6,446** K-12 Students
- 158** K-12 Teachers
- 41** Publications

98 Significant Awards

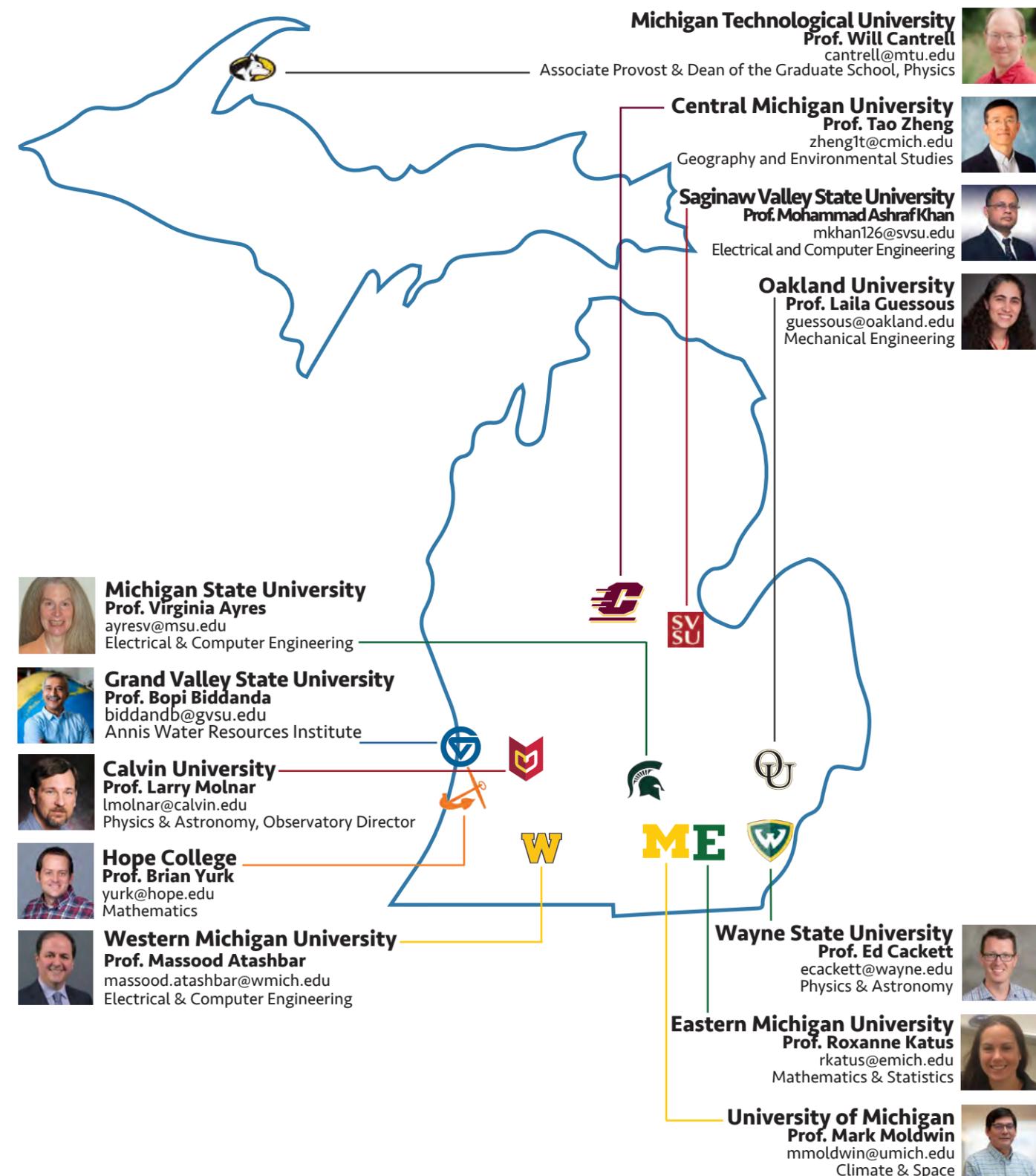
Underrepresented Learner

- 17%** Hispanic or Latino
- 7%** Black/African American or Native American
- 6%** Disability
- 48%** Women

"Significant Awards" are defined as college students with either \$3,000+ funding or 160+ hours effort.
 "Underrepresented Learner" is defined as unique learners that self-identify into at least one of the following underrepresented categories: American Indian or Alaska Native, Black or African American, or Native Hawaiian or Other Pacific Islander; Female; Hispanic or Latino; or Reported having a Disability
 *Reported in NASA STEM Gateway system for FY2023

MSGC Affiliates

There are 12 affiliated Universities/Colleges around the state of Michigan. The University of Michigan is MSGC's lead institution. If you are interested in learning more about MSGC feel free to contact your MSGC Campus Representative or visit our web-page www.mispace-grant.org.





FYRES Students measuring dune vegetation characteristics on a Lake Michigan dune.

2023-2024 Award Recipients

Faculty Led Fellowships for Undergraduate Student Participants:

Akhmatdinov, Sergei - Western Michigan University
 Al-Allaf, Bassma - Oakland University
 Alexopoulos, Christopher - Oakland University
 Beaudoin, Siona - Saginaw Valley State University
 Bergstrom, Jacob - Hope College
 Cardoza, Ella - Michigan State University
 Denning, Nathan - Michigan State University
 DeWitt, Skylar - Hope College
 Dogdu, Hakan - Western Michigan University
 Dykstra, Naomi - Calvin University
 Figueroa, Nicholas - Hope College
 Goldsmith, Calvin - Oakland University
 Hallemann, Peyton - Hope College
 Hinman, Madison - Grand Valley State University
 Luchs, Jia - Calvin University
 Nelson, Justin - Wayne State University
 Sierra, Elijah - Michigan Technological University
 Smith, Madison - Hope College
 Sprys-Tellner, Olivia - Hope College
 Stolnicki, Nathan - Hope College
 Stone, Abraham - Michigan Technological University
 Stowe, Matthew - Hope College
 Wakeman, Rine - Calvin University

Graduate Fellowships:

Allwine, Nathaniel - Western Michigan University
 Anderson, Katelyn - Grand Valley State University
 Barnes, Jackson - Michigan State University
 Collins-Edward, Ellana - Oakland University
 Dunham, Keely - Grand Valley State University
 Elizondo, Emily - Michigan State University
 Hanson, Anthony - Western Michigan University

Jewell, Ben - Michigan Technological University
 LaFrance, Tyler - Wayne State University
 Lucas, Katherine - Grand Valley State University
 Muflahi, Zlyad - Wayne State University
 Nathan, Gabriel - Michigan State University
 Norwood, Ian - Michigan Technological University
 Novitch, Jacob - Michigan Technological University
 O'Dea, Marisa - Wayne State University
 Partika, Enid - Michigan Technological University
 Paulen, Eli - Michigan Technological University
 Pease, Allison - Michigan State University
 Pray, Emilie - Michigan Technological University
 Ramos, Rafael - Michigan State University
 Sell, Jakob - Western Michigan University
 Sutherland, Caitlyn - Michigan Technological University
 Thomas, Austen - Western Michigan University
 Wehmanen, Kyle - Michigan Technological University
 Wilson, Kathryn - Grand Valley State University
 Witherspoon, Erin - Oakland University
 Wu, Judy - University of Michigan

Summer Research Opportunity Program (SROP)

Allart, Teagan - University of Buffalo
 Chacon, Philip - Leland Standford Junior University
 Chambers, Auldynn - Baylor University
 Cruz, Natalie - California State Polytechnic University Pomona
 Echeverria, Jonathan - California State University, Long Beach
 Gupta, Amiya - University of Florida
 Hernandez, George - California State Polytechnic University Pomona
 Tatem, Isabela - Roosevelt University
 Tavarez Garcia, Sara - Interamerican University of Puerto Rico
 Zheng, Xiao Lin - Syracuse University

HONES Groups

Alesawy, Saif - University of Michigan
 Lemmer, Kristina - Western Michigan University
 Partika, Enid - Michigan Technological University
 Pawlows, Dave - Eastern Michigan University
 van Susante, Paul - Michigan Technological University

Research Seed

Anyiam, Uzonna Okenna - Hope College
 Chen, Jingshu - Oakland University
 Figueriedo, Vandre - Oakland University
 Kim, Jinseok - Western Michigan University
 Masihi, Simin - Western Michigan University
 Olagbemi, Omofolakanmi - Hope College
 Philben, Michael - Hope College
 Wiacek, Alycen - Oakland University
 Xi, Xin - Michigan Technological University
 Xu, Lanyu - Oakland University
 Yuan, Yinan - Michigan Technological University

PreCollege Program

Lindsay, Harriet - Eastern Michigan University
 Narayanan, Krishnakumari - Eastern Michigan University
 Thompkins, Gerald - Engineering Society of Detroit

Public Outreach

Gipson, Karen - Grand Valley State University
 Ross, Patrick - Flint Institute of Science and History

Multiple Programs

Hagen, Megan - Gogebic-Ontonagon ISD
 Heraud, Cynthia - Forsythe Middle School
 Ipri Brown, Susan - Hope College
 Kobus, Krzysztof - Oakland University
 Lynn, Jennifer - Copper Country ISD
 Miller, Diane - Grand Valley State University

NASA Interns

Coulding, Isaac - Michigan Technological University
 Palumbi, Christabella - University of Michigan

Industry Interns

D'Urso, Eric - University of Michigan
 Terhaar, John - Michigan Technological University

K12 Incentive

Brillhart, Christine - Midland Public Schools
 Chai, Joe - Jefferson Middle School Robotics

Plant the Moon

Bentley, Chelsea - SEEDS EcoSchool, Betsie Valley
 Cieplechowicz, Leslie - Landmark Academy
 De Jong, Jenny - Willard Library
 Judson, Jen - STEM and Branch Academy
 Kobel, Dave - Wayne Memorial High School
 Lightle, Merralee - Bridge Academy West
 Megge, Kristine - Murphy Elementary
 Raddatz, Jason - Marshall Opportunity High School
 Richards, Bob - Stockbridge Jr/Sr High School



Eric D'Urso with radarography.com Client and Database

Wolverine Radar Company's Summer of Earth Observation Advancements

In pursuit of scalable Synthetic Aperture Radar (SAR) technology, Wolverine Radar Company saw Eric D'Urso, a student intern from the University of Michigan as an ambitious intern contributing to the development of a versatile SAR processor for commercial and government applications.

The first milestone was radarography.com, a user-friendly data portal revolutionizing SAR data access and orders. D'Urso not only crafted an intuitive front end but also expanded the Wolverine Radar framework for large-scale SAR data orders, ensuring scalability. The focus then shifted to the second iteration of the data portal, supporting raw SAR imagery and introducing the Flow utility. His dedication to scalability was evident in the design, with a processing backend capable of running on multiple machines to address increased throughput demands. After enhancing the radar processing infrastructure, Crosshatch, D'Urso addressed limitations by revising the memory allocation component. An installer for the Razor processor as well as dependencies was developed for easy deployment, simplifying the end-user experience. With his forward-thinking approach, D'Urso showcased Wolverine Radar's commitment to real-world problem-solving and added a valuable dimension to Earth observation capabilities.