UNDERGRADUATE RESEARCH INSTITUTE

DISCOVERY 2024

RESEARCH ABSTRACTS

EMBRY-RIDDLE
Aeronautical University

URI DISCOVERY SCHEDULE OF EVENTS

FRIDAY APRIL 5, 2024

Parents and Family Reception and Poster Session
Eagle Gym | 6:30 - 9:00 p.m.

SATURDAY APRIL 6, 2024

URI Oral Presentations

Preview Day Welcome
Activity Center | 9:00 - 9:30 a.m.

ACADEMIC PROGRAM MEETINGS

College of Engineering
Eagle Gym | 9:45 - 11:00 a.m.

College of Business, Security and Intelligence
The Hangar | 9:45 - 11:00 a.m.

ANETTE M. KARLSSON, PH.D.
Chancellor
Embry-Riddle Aeronautical University Prescott Campus

WELCOME
TO UNDERGRADUATE RESEARCH INSTITUTE (URI) DISCOVERY 2024

At Embry-Riddle Aeronautical University, we engage our students far beyond just teaching from a textbook: all our students participate in a range of hands-on projects, both inside and outside the classroom. Through our URI Discovery Events, we showcase some of the students' best work and celebrate their success, their creativity and their talent.

I encourage you to explore the research and project results presented by the students. Ask the teams to explain their work; ask them what they did and why their research matters. You will be amazed by the depth and breadth of the students' knowledge and ingenuity.

The mentorship of the faculty and staff is the foundation for the success of our students. A sincere thank you to all of you who have assisted the students in these projects.

I am looking forward to talking to all the students about their discoveries and I hope you will enjoy URI Discovery events as much as I do!

Anette Karlsson

ANETTE M. KARLSSON, PH.D.
Chancellor

ANNE BOETTCHER
Assistant Dean of Research
Undergraduate Research Institute

It has been an exciting year for our Embry-Riddle Prescott undergraduates, as is reflected in the breadth and depth of the presentations and demonstrations included in our URI Discovery 2024 events. During the 2023-2024 academic year, the Undergraduate Research Institute was able to award over 50 projects funded through our Ignite and our Philanthropy Councils, Eagle Prize grants and the Arizona Space Grant program. These projects include students from all four of our colleges. Ignite and Arizona Space Grant projects ange from ones focused on cold cases and the eclipses to ones examining the capture and utilization of asteroids. Eagle Prize teams will compete or have already competed in regional and national competitions including the AIAA Design-Build-Fly, Human Lander Challenge and VEX Robotics. Our students have also been conducting independent and team research projects through course-based and student organization opportunities. Linked to their research and scholarship, these students have been active in numerous outreach efforts with regional middle and high schools, as well as the Prescott community as a whole.

I am repeatedly impressed with the insight, dedication and determination of our students, faculty and staff. Through their combined efforts, our students are gaining the skills needed to be successful in their chosen career paths.

Thank you for helping us celebrate the accomplishments of our students.

ANNE BOETTCHER
Assistant Dean of Research

UNDERGRADUATE RESEARCH INSTITUTE

ADVISORY BOARD

Catalina Aranzazu-Suescun, Cyber Intelligence and Security

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John Matthew Pavlina, Electrical Engineering

Jessica Quarles, Hazy Library and Learning Center

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Darrel Smith, Physics

Katherine Wood, Aerospace Engineering

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Bryce Chanes, Raytheon Technologies

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Jolly Kapoor, American Airlines

Calley Tinsman, Johns Hopkins Applied Physics Lab

Hunter Watson, JSX

COMMUNITY MEMBER

Yvonne Gibbs, Retired NASA

URI OFFICE

Kelly Brown

Karol Planadeball Fernandez

Caleb Spiessbach

A SPECIAL NOTE OF THANKS TO ALL OF OUR MENTORS!

INVITED ORAL PRESENTATIONS

SATURDAY, 6 APRIL 2024

PREVIEW DAY WELCOME

Hunter Nudson
Aerospace Engineering, College of Engineering; Air Force ROTC
Activity Center | 9:00 - 9:30 a.m.

ACADEMIC PROGRAM MEETINGS

COLLEGE OF ENGINEERING

Jakobe Denby and Aidan Kihm
Aerospace Engineering and Mechanical Engineering
College of Engineering
Eagle Gym | 9:45 - 11:00 a.m.

Zachary Traynor and Aspen Smith
Electrical Engineering and Software Engineering
College of Engineering
Eagle Gym | 9:45 - 11:00 a.m.

COLLEGE OF BUSINESS, SECURITY AND INTELLIGENCE

Lauren Estrada and Hailey Thatcher
Global Security and Intelligence Studies, College of Business, Security and Intelligence
The Hangar | 9:45 - 11:00 a.m.

EAGLELIFTER - AIR-LAUNCH TESTBED UAV

Kyle Abbas, Aerospace Engineering
Cody VandenBosch, Aerospace Engineering
William Ryan, Aerospace Engineering
Lynn Parker, Aerospace Engineering
Luke Rondeau, Aerospace Engineering

MENTOR

Johann Dorfling, Aerospace Engineering

Increased interest in small air-launched drones has created a demand for flexible, small-scale air-launch test capabilities. Inspired by larger "mothership" airplanes like Stratolaunch and Virgin Galactic's White Knight II, EagleLifter is developing an air-launch testbed which can carry drones up to six feet in wingspan between its twin fuselages. EagleLifter will enable in-house testing of air-launched airplanes and other exotic payloads. A half-scale demonstrator has made multiple air launches to prove EagleLifter's unique concept. The full-size airplane is being built with university-first composite manufacturing techniques, including 3-D printed fuselage molds and drill fixtures, and a custom I-beam main wing spar. This carbon fiber spar was optimized with iterative ply stacking and destructive testing on a purpose-built high-capacity test fixture. The final article withstands over 535 lb-ft of bending moment across an 8-ft length. EagleLifter's large, lightweight structure houses a full-featured electronics suite. An advanced flight controller and NVIDIA mission computer will give EagleLifter the ability to fly autonomously and perform collaborative missions with other drones. Its DroneCAN avionics bus reduces the wiring required by 40%, while providing fast, expandable onboard communications. Redundant flight controls, power supplies, and air-to-ground communications will provide additional safety during flights. EagleLifter will demonstrate a number of features that support regular, fast-paced flight operations. The aircraft can be packed in a typical pickup truck bed for transport, and assembled in approximately 20 minutes. A trailing-link suspension and electromagnetic brakes will allow operations from poor-quality runways. The final aircraft is under construction, and first flight is expected in April 2024.

IGNITE AWARD

SPACEPORT AMERICA® CUP

SPACEPORT AMERICA CUP ROCKET

David Anderson, Aerospace Engineering
Michael Di Nisco, Mechanical Engineering
Noah Pattin, Aerospace Engineering
Emilina Salazar, Aerospace Engineering
Shea Schmidt, Aerospace Engineering
Kevin Wise, Aerospace Engineering

MENTOR

Mark Benton Sr., Aerospace Engineering

The world of rocketry has exploded over the course of the last decade. Many different companies bring their own ideas and approaches to launching rockets into orbit. Despite this, suborbital or "sounding" rockets are still an integral part of the scientific landscape due to their unique ability to carry small experiments and payloads to high atmosphere environments on a significantly reduced budget. This category of rocket is well tailored to the budget and experience of many collegiate teams, driving consistent competition and cooperation within the demographic. This spirit is no better exemplified than in the Spaceport America Cup (SAC). The competition runs over the length of the academic year as students design, build, and test their rockets for the final week, where they are launched at Spaceport America in New Mexico for scoring. The team's score will be based on a multitude of factors including report writing, design choices, sportsmanship, and their ability to design a rocket to reach a maximum altitude as close to the target as possible. The team is competing in the category with altitude target of 10,000 feet. The rocket has been designed utilizing a rocket trajectory analysis software such as OpenRocket and RasAero II. These tools help the team optimize design choices such as weight distribution and aerodynamics for optimal fine tuning of maximum altitude. In addition, each rocket needs to carry either a functional or inert 8.8 pound payload. The rocket hopes to demonstrate the ability for rockets on campus to livestream video through the payload being designed for it. This will allow future student rocketry projects to better broadcast their work to the world and show off their progress.

EAGLE PRIZE AWARD

EAGLEWORKS - ADVANCED VEHICLE LAB

Brandon Barkey, Aerospace Engineering, **Liam Bunta,** Aerospace Engineering, **Ciara McGarry,** Mechanical Engineering, **Gabriel Payan,** Mechanical Engineering, **Joseph Peavy,** Aerospace Engineering, **William Punches,** Astronomy, **Robert Rice,** Mechanical Engineering, **Luke Schniederjan,** Mechanical Engineering, **Hunter Smith,** Mechanical Engineering, **Noah Temprendola,** Mechanical Engineering, **Jag Wray,** Mechanical Engineering, **Sam Yorio,** Electrical Engineering

MENTOR

Karl Heine, Mechanical Engineering

The world of motorsports has always been closely related to pushing technological boundaries and showcasing the capabilities of state-of-the-art engineering. One such frontier in recent years has been electric drag racing, where the acceleration and top speeds of electric vehicles have been making significant strides. In light of this progress, there exists a compelling rationale for clubs and organizations to undertake projects aimed at breaking electric speed records.

Breaking land speed records has always been about pushing the limits of technology and human achievement. In the context of electric vehicles, this tradition of advancement continues. The pursuit of the electric land speed record offers an opportunity to demonstrate the capabilities of electric powertrains. To demonstrate our advanced project, it will be brought to Speed Week at the Bonneville Salt Flats. The annual competition hosts a collection of different car class types, and among them is the 2/E class. The speed record for 2/E is 238 mph, and EagleWorks aims to exceed that.

Building an electric dragster to break the speed record aligns with the broader mission of promoting sustainable transportation. By demonstrating the impressive speed and performance of electric dragsters, this project can inspire a wider audience to consider EVs as viable alternatives to traditional combustion engine vehicles.

The team is hard at work to make this visionary a reality, and is solely designed and built by our undergraduate students.

The AVL project is scheduled to compete in summer 2025.

COE PHILANTHROPY COUNCIL

LUNA EV - RAPID LIUNAR TRANSPORT VEHICLE

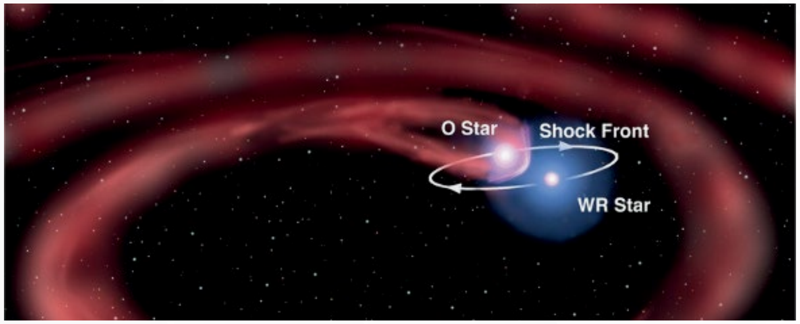
Kyle Bartholomew, Aerospace Engineering
Gavin Botts, Mechanical Engineering
Kevin Fedoruk, Mechanical Engineering
Alvaro Flores, Aerospace Engineering
Mitchell Mussler, Mechanical Engineering
Francisco Zuniga, Aerospace Engineering

MENTORS

Mark Benton, Aerospace Engineering
Richard Mangum, Humanities and Communication

With a renewed focus on the Moon and lunar habitats slated for implementation in 2025, NASA is developing large, pressurized, habitable mobility platforms from which astronauts can conduct research and explore the lunar surface. These larger, pressurized vehicles are designed for traveling long distances and for long duration missions, which can lead to lunar surface disturbances and increased lunar dust that can contaminate and/or destroy areas of interest. With increased interest in lunar exploration, the LUNA EV aims to provide a Rapid Lunar Transport Vehicle (RLTV)—a solution to the current lack of lightweight, rapidly deployable, single person transporters in proposed lunar missions. LUNA EV aims to develop a rechargeable electric RLTV with a compact footprint that will not only minimize lunar surface disturbance but also provide an on-demand transportation option for use with research around base camp and compatible with the habitable mobility platform.

IGNITE AWARD



PROBING THE MULTIPLICITY OF DUSTY WOLF-RAYET STARS WITH MULTI-WAVELENGTH TECHNIQUES; SURVEY OF INFRARED SPECTROMETRY

Hailey Beier, Astronomy

MENTOR

Noel Richardson, Physics and Astronomy

Wolf-Rayet (WR) stars, representing massive celestial bodies in advanced evolutionary stages, play a crucial role in shaping the cosmic environment. Among these, carbon-rich WR stars stand out for their broad infrared emissions, fostering unique conditions conducive to dust formation. Investigating galactic dust-generating systems entails a comprehensive analysis across multiple wavelengths to discern potential influences, such as the presence of companion stars. Current efforts focus on refining data through telluric line corrections, laying groundwork for subsequent investigations. Future endeavors aim to juxtapose observational data with theoretical models, particularly concerning O stars, to gain deeper insights into dust production mechanisms within these stellar systems. Ongoing research aimed at unraveling dynamics underlying dust production in WR stars, thus contributing to a broader understanding of stellar evolution and interstellar environments.

IGNITE AWARD

CHARIOT - A ROVER MOBILITY SYSTEM

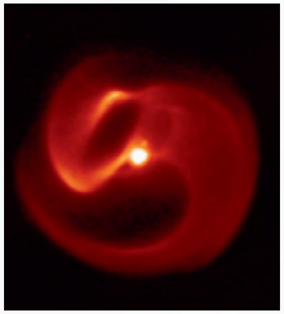
Michael Ashford Bevens, Aerospace Engineering, **Jacob Bohman,** Aerospace Engineering, **Natalie Dow,** Aerospace Engineering, **Samuel Hatz,** Aerospace Engineering, **Nathan Matthews,** Aerospace Engineering, **Thea Owens,** Aerospace Engineering, **James Lynn Parker,** Aerospace Engineering, **Nayeli Perez,** Aerospace Engineering, **Kate Shriki,** Aerospace Engineering, **Logan Silverman,** Aerospace Engineering

MENTORS

Davide Conte, Aerospace Engineering
Richard Mangum, Humanities and Communications

In the past decade, there has been a significant increase in interest in the lunar south pole due to the discovery of significant quantities of water ice and volatiles such as ammonia in lunar craters throughout the region. These resources are of great scientific interest as they could facilitate future, long-term missions, including manned habitation of the Moon for further research. One of the challenges of this year's NASA Revolutionary Aerospace Systems Concepts Academic Linkage (RASC-AL) competition is the development of a concept rover that can analyze these resources in the extreme cold and dark environment of the lunar south pole. Chariot is designing a maneuverability system for the rover to explore the depths of craters in a primarily shadowed environment.
The hope of our capstone team is to enable not only the concept of the systems required to maneuver a rover into a dark crater, but to allow our members to have a hands-on approach to the fabrication of such systems, as well. We believe this design approach will allow a more thorough understanding of challenges that we may face in industry and provide experience utilizing the engineering design process.

EAGLE PRIZE AWARD



A GALATIC SURVEY OF DUSTY WOLF-RAYET STARS IN THE X-RAY

Hailey Beier, Astronomy
Kaitlyn Casciotti, Astronomy
Jasmine Downing, Astronomy
Damar Lemelle, Space Physics

MENTORS

Pragati Pradhan, Physics and Astronomy
Noel Richardson, Physics and Astronomy

Wolf-Rayet (WR) stars are massive stars in late-stage evolution that have lost their outer hydrogen envelopes and have high mass-loss rates. WR stars could be one of the first dust-producers in the universe. We will examine observations of Galactic dust-producing systems, determining the conditions which dust can form, i.e. does the dust production require a companion? It is unknown if WRs could produce dust independently; some dusty WR stars have appeared single in studies thus far.

The majority of known WR stars are found near the Galactic center, which contains an abundance of dust and particles that scatter light. X-ray wavelengths do not get obstructed as much as Infrared from the dust, allowing for more stars to be surveyed without major interference. At present, it is still a matter of great debate how X-ray radiation is produced in WR stars, albeit there are some promising research avenues, such as the presence of Co-rotating Interaction regions in the winds of single WR stars. For binary stars on the other hand, the formation of shocks when the winds of two stars collide can generate higher temperatures. To fully understand WR stars, we need to unravel mechanisms of X-ray production in their wind.

We have created a source list of WR stars to examine, debugged and updated an automated stellar reduction software, and will continue to progress to our goal by executing the code on the archival NASA data to explore the light curve variability in relation to time. Mapping the X-ray luminosity over time can tell us if these sources have strong collisions from less-evolved O or B star companions, which still have a strong wind. Then, we will model X-ray spectra with models to measure the absorption, flux, and other spectral parameters. To the best of our knowledge, this is the first systematic survey of WR stars in the X-ray.

IGNITE AWARD

2024 LOCKHEED MARTIN ETHICS IN ENGINEERING CASE COMPETITION

Kylee Bennett, Aerospace Engineering
Christian Glemaud, Aerospace Engineering
Marcus Romero, Aerospace Engineering
Hannah Willer, Aerospace Engineering and Computer Engineering

MENTORS

Karoline Koons, Humanities and Communication
Chetan Date, Aerospace Engineering

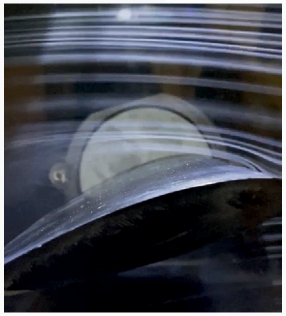
Special thank you to Dr. Siewi Fan, Mr. Mark Benton, Dr. Bradley Wall, Undergraduate Research Institute, and supportive staff.

The 7th Annual Ethics in Engineering Case Competition was held February 26 to February 28, 2024, at Lockheed Martin's Center for Leadership Excellence in Bethesda, Maryland. Embry-Riddle Aeronautical University joined other colleges and universities presenting solutions to a fictional case involving ethical, business, and engineering issues.

Each college or university was represented by a two-student undergraduate team accompanied by a faculty advisor. ERAU was represented by two teams: K. Bennett and C. Glemaud accompanied by Dr. Date, and M. Romero and H. Willer accompanied by Dr. Koons.

The competition required two stakeholder groups to come to a solution for a presented dilemma. Each ERAU team competed head-to-head with another school, representing one of the stakeholder groups. The goal of the competition was to take the lead in coming up with a win-win solution.

The competition addressed issues of the detection of potentially hazardous asteroids and the challenges of finding a collaborative solution in the workplace. The case study involved two subcontractors working on detection capabilities to better identify the asteroid. One subcontractor was responsible for infrared data processing and the other was responsible for artificial intelligence (AI) image processing. Each team represented one subcontractor facing ethical dilemmas and had to come to a mutual solution with the opposing team. Both ERAU teams presented their unique solutions to the ethical dilemma.



CHARACTERIZATION OF THE EFFECTS OF SWEEP AT LOW REYNOLDS NUMBER

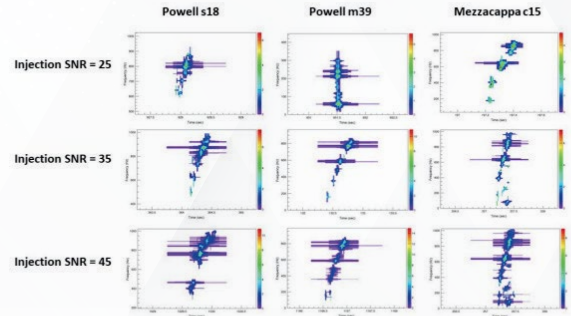
Kylee Bennett, Aerospace Engineering
Hunter Nudson, Aerospace Engineering
Davy Stanfield Brown, Aerospace Engineering

MENTOR
Lance Traub, Aerospace Engineering

This project is an investigation of wing sweep at low Reynolds numbers. Sweep is the offset of the wing from the direction of flow and the Reynolds number determines the type of fluid flow at specific speeds. The research idea is founded on the growing popularity of small-scale drones. Both unmanned aerial vehicles (UAVs) and micro air vehicles (MAVs) have seen a steady increase in use and application. Efficient design of UAVs and MAVs requires a better understanding of their associated aerodynamics. This need has contributed to an increase in research regarding various wing designs at low Reynolds number and has promoted an understanding of their aerodynamic behavior. For the project, the effects of wing sweep were examined on a series of wings. The wings, comprised of two different airfoil profiles, were manufactured with leading edge sweep angles ranging from 0 to 45 degree. Testing encompassed experimental load measurement at Reynolds numbers ranging from 40,000 to 80,000.

The expected outcome is the characterization of the performance of these wing geometries. The investigation will determine the effect of sweep at low Reynolds number. Sweep is expected to increase wing efficiency and performance by improving various performance parameters.

SPACE GRANT AWARD



ANALYZING STANDING ACCRETION SHOCK INSTABILITY USING GRAVITATIONAL WAVES

Miriam Biehle, Space Physics

MENTOR
Michele Zanolin, Physics

The detection of gravitational waves (GW) from Core Collapse Supernovae (CCSNe) would build a new understanding of the internal physics of a Core collapse Supernova (CCSN). One of the features of these GW is called standing accretion shock instability (SASI). In order to detect and reconstruct the SASI component of a CCSN GW, our team will be upgrading the current software. More explicitly by implementing MuLaSECc (Multi-Layer Signal Enhancement with Coherent Wave Burst and CNN [Convolutional Neural Network]) we can artificially decrease the role of the noise recorded by LIGO. By advancing this program further we can increase the potential of multi-messenger astrophysics since CCSNe can be studied with GW, electromagnetic waves, and neutrinos at the same time.

SPACE GRANT AWARD

LUNA CONNECT LUNAR CONCRET MIXER A RASC-AL 2024 & CAPSTONE PROJECT

Elijah Buckout, Aerospace Engineering, **Kyler Castro,** Aerospace Engineering, **Hunter DiFabio,** Aerospace Engineering, **Luke Jepsen,** Aerospace Engineering, **Jomar Lee,** Aerospace Engineering, **Kyle Newlin,** Aerospace Engineering, **Maguire O'Brien,** Aerospace Engineering, **Elizabeth Spellman,** Aerospace Engineering, **Lillian Sudkamp,** Aerospace Engineering, **Luke Whitman,** Aerospace Engineering

MENTORS

Davide Conte, Aerospace Engineering
Richard Mangum, Humanities and Communication

With a renewed interest in lunar exploration and the launch of NASA's Artemis 1 in November 2022, as well as planned future work on the Moon's surface in subsequent Artemis missions, the need for lunar habitats is becoming more pertinent. Proposals involving modules sent up by rockets to lunar orbit have been mentioned, however, a more sustainable solution might involve utilizing lunar regolith to create a concrete-like building material. Luna Connect aims to create a mixer for producing a lunar concrete, mostly using other materials that can be found on the Moon or produced by astronauts, such as potato starch and water. This design has the possibility to be scaled up, made space-ready, and deployed onto the lunar surface, creating a material that requires less cost and waste than other solutions. This alternative is especially attractive compared to solutions relying heavily on materials produced Earth-side and transported to the lunar surface, reducing both emissions and cost-per-mix. Luna Connect has envisioned and is building a prototype, as well as testing various ingredient ratios to determine the best workability. The team hopes this knowledge will help inform any further iterations and has developed a mission architecture for deployment on the moon.

EAGLE PRIZE AWARD

PRESCOTT OBSERVATORY TEAM FOR ANALYZING TELESCOPICALLY OBSERVED SPECTRA

Kaitlyn Casciotti, Astronomy, **Hailey Beier,** Astronomy, **Emily Beigler,** Space Physics, **Taylor Brown,** Space Physics, **Jasmine Downing,** Astronomy, **Derrick Drango,** Mechanical Engineering, **Anthony Fabrega,** Astronomy, **Sami Garcia Flores,** Space Physics, **Rishi Kishore,** Aerospace Engineering, **Alex Mellot,** Aerospace Engineering, **Shannon Moore,** Space Physics, **Daniel Newallis,** Aerospace Engineering, **William Punches,** Space Physics, **Blake Scheutz,** Space Physics, **Aaron Sperry,** Aerospace Engineering, **Kaeya Siriam,** Space Physics, **Dario Walter-Cardona,** Space Physics, **Hailey Widger,** Astronomy, **Adler Williams,** Astronomy

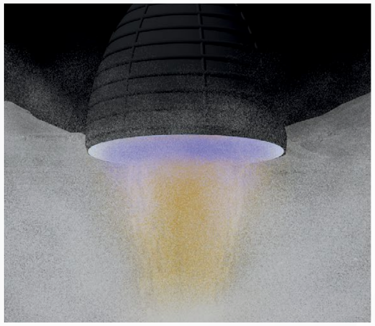
MENTOR

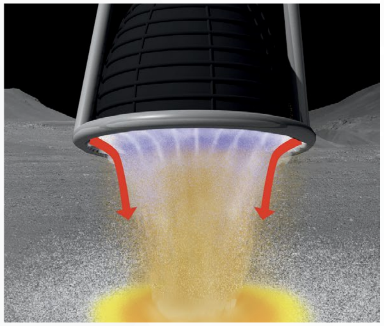
Noel Richardson, Physics and Astronomy

The Prescott Observatory Team for Analyzing Telescopically Observed Spectra (POTATOS) has created a team of observers to utilize the campus observatory to collect data and train new observers. By teaching these skills earlier in their college careers, students are better prepared for creating and working on their own research projects in upcoming years. This year, POTATOS has collected both spectroscopic and photometric data on four Be stars; Gamma Cas, HD6226, zeta Tau, and Alcyone. The team will look at the ways in which disks grow and dissipate spectroscopically and with brightness changes during times when the stars are also being observed with NASA's TESS (Transiting Exoplanet Survey Satellite) mission. By regularly examining these stars, we will be able to correlate how stellar oscillations and pulsations compare to the disk growth and loss.

POTATOS is Embry-Riddle Aeronautical University Prescott campus's first observation team. Moving forward, the team plans to continue expanding and encouraging retention in the astronomy degree program by training younger students in telescope operation and data analysis. Once fully trained, students will have the ability to create and pursue projects of their own.

IGNITE AWARD





PROJECT PARSEC - HUMAN LANDER CHALLENGE

David Clay, Aerospace Engineering
Bruce Noble, Aerospace Engineering
Aidan Kihm, Mechanical Engineering
Jakobe Denby, Aerospace Engineering
Grant Bowers, Software Engineering
Sanaya Nichani, Aerospace Engineering

MENTOR

Siwei Fan, Aerospace Engineering

During powered descent on the Moon, engine exhaust interacts with lunar soil through heat and momentum exchange blowing dust out from the landing site and producing high speed ejecta particles. These particles - ranging from a few micrometers to a few centimeters in diameter - can reduce visibility of sensors and optics, sandblast nearby landed assets, and erode the surface around the vehicle. Additionally, exhaust plumes can produce deep craters beneath landers and direct ejecta particles up towards the lander. This causes damage to on-board assets and compromises the stability of the landing site. Collectively, these interactions between the plume and surface are termed plume-surface interactions (PSI). Understanding and mitigating the effects of PSI is critical for safe landings and sustainable exploration on the Moon.

PARSEC (Plume Additive for Reducing Surface Ejecta and Cratering) is a project that aims to develop an on-board mechanism to mitigate the adverse effects of PSI. Utilizing concepts of thermal spray technology, the mechanism would deploy a temporary landing pad to increase the strength and stability of the landing surface. Through a fluidization process, granular additives can be injected into the exhaust plume Upon injection, additive particles would melt and accelerate towards the lunar surface, conglomerating with lunar regolith and resolidifying to form a high-strength coating, or landing pad. The objective is to apply this coating to the surface below the lander before PSI begins to take effect, reducing the amount of cratering and ejecta that would otherwise occur.

EAGLE PRIZE AWARD

PSYCHOPHYSIOLOGICAL INDICATORS OF STRESS AND FATIGUE IN AIR TRAFFIC CONTROLLERS: A PILOT STUDY

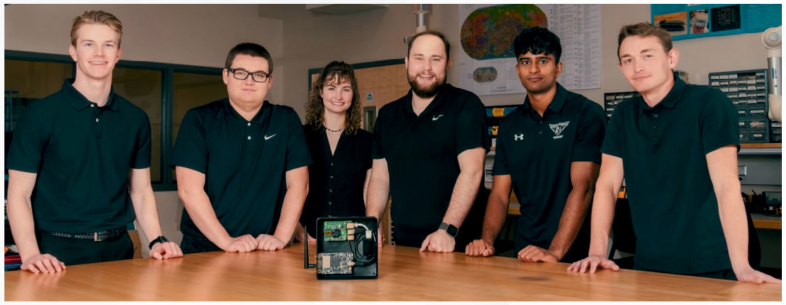
Margaret Colwell, Human Factors Psychology

MENTORS

Rose Danek, Behavioral and Social Sciences
Andrea Irish, Behavioral and Social Sciences
Kyle Wilkerson, Applied Aviation Science

This research is aimed at identifying the psychophysiological markers of stress and fatigue within the context of Air Traffic Control (ATC). In response to the recent increase in near misses at airports nationwide, as acknowledged by the Federal Aviation Administration (FAA), there is a recognized reason to investigate the causes behind these accidents. Currently 3 of the 313 ATC facilities around the country are fully staffed, understaffing is leading to increased fatigue and stress being experienced by ATC personnel. Various other studies point to the excess stress and issues fatigue can lead to when making decisions. Due to recent events, there is reason to believe the safety aspects of ATC and pilot communication should be investigated further. The study seeks to pinpoint specific physiological markers that may explain the reason behind the increasing frequency and severity of near misses. Drawing from existing research on fatigue which highlights the efficacy of indicators like heart rate, electrodermal activity, and brain waivers, our research approach involves further research into these indicators using BIOPAC technologies. Our research will be helping to identify the physiological markers while participants engage in a simulated scenario reflective of typical air traffic control duties. This will encompass standard procedures about controlled and uncontrolled airfield clearances, issuance of traffic advisories, managing wake turbulence separation minima, interfacility and intra facility coordination, course deviation and alterations, and making altitude adjustments. Anticipated outcomes include the statically significant data illustrating an increased heart rate, increased respiration rate, changes in electrodermal activity, and notable changes in beta wave activity during periods of stress and fatigue as encountered during ATC tasks.

COA PHILIANTHROPY COUNCIL AWARD



CELLULAR INTRUSION DETECTION SYSTEM

Ian Curtin, Electrical Engineering
Zachary Hart, Software Engineering
Calvin Henggeler, Computer Engineering
Aspen Smith, Software Engineering
Heeirthan Shanthan, Computer Engineering
Zachary Traynor, Electrical Engineering

MENTORS

John Sevic, Computer, Electrical, and Software Engineering
Ahmed Sulyman, Computer, Electrical, and Software Engineering

The Cellular Intrusion Detection (CID) system is a specialized surveillance framework designed to enhance security within sensitive compartmented information facilities (SCIFs). This system employs sophisticated cellular carrier signal detection technologies to identify and locate unauthorized 4G cellular devices in secured areas.

The CID system is comprised of a robust hardware framework consisting of omni-directional antennas, software-defined radios (SDRs), and microcontroller units powered by Power over Ethernet. The software backbone is centered around a Linux-based central computing unit that processes radio frequency data streams in real-time, with minimal latency. It features an interface designed for ease of use by security personnel, capable of real-time visualization and alert generation. The complexity of the CID system lies in its signal processing capabilities. Raw I/Q signal data is converted into Power Spectral Density information before undergoing several calculations. To ascertain the approximate location of an intruding 4G device, the system leverages a Time Difference of Arrival (TDOA) algorithm, which utilizes the time delays observed in the signal arrival at various sensor modules.

Progress on the CID system is on-going. At present, the prototype can successfully identify a tone communicating through an SDR, as well as between SDRs, utilizing both wired and wireless connections. In addition, Matlab simulations have demonstrated the effectiveness of the TDOA algorithm in precisely locating signal origins, and the algorithm is currently being integrated into the prototype. Looking to the future, the intention is to scale the CID system beyond 4G to detect a variety of cellular signals across different frequency bands with the addition of an advanced machine learning algorithm.

IGNITE AWARD

VEX U ROBOTICS TEAM

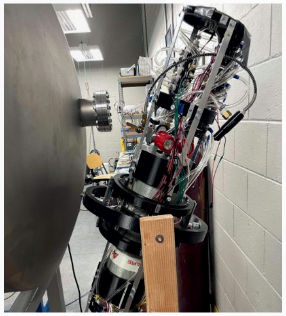
Elizabeth Curtis, Mechanical Engineering
Nikhil Dave, Computer Engineering
Eli Martin, Aerospace Engineering
George Roby, Aeronautical Science
Aiden Sorrells, Mechanical Engineering
Francisco Zuniga, Aerospace Engineering

MENTOR

Joel Schipper, Computer, Electrical and Software Engineering

The Robotics Education and Competition (REC) Foundation is a worldwide organization that hosts robot-based competitions and events at various educational levels. Students from diverse degree programs participate in VEX U through Embry-Riddle Aeronautical University's VEX Robotics Club, learning mechanical, electrical, and software engineering skills vital to the design and implementation of robots. VEX competitions challenge students to develop strategies and engineer systems to complete different tasks for points. Working as a team, students must diligently tackle a variety of engineering problems, which helps prepares them for a career in industry. This year's game, Over Under, challenged the team to attain points by scoring triballs into netted goals, and elevating robots to predetermined heights up 36 inches in competitive matches. The team designed, built, and tested robots to fulfill these objectives. Then, the robots were tested on mock competition scenarios to ascertain their effectiveness. After verifying the robot's functionality, the team brought the robots to the VEX sponsored Southwest Regional competition where the team earned a 2nd place finish. The team plans to attend another event with the goal of qualifying for the 2023-2024 VEX World Championship in Dallas, Texas. Participating in the VEX U robotics competition has also provided a platform for the Embry-Riddle's VEX Robotics team to research the use of high temperature, high strength, and flexible filaments when 3D printing components for their robots.

EAGLE PRIZE AWARD



PROJECT ANUBIS

Ambar Das, Aerospace Engineering
Parker Scibner, Aerospace Engineering
Hoijin Surh, Aerospace Engineering
Paul Brich, Aerospace Engineering
Bruce Noble, Aerospace Engineering
Brendan King, Aerospace Engineering
Ilan Larkins, Aerospace Engineering
Lawrence Tolentino, Aerospace Engineering

MENTOR

Stephen Bruder, Computer, Electrical, and Software Engineering

Project Anubis' main objective is to design, fabricate, and test a cold gas thruster attitude control system with at least 2 degrees of freedom. This project will serve as a test-bed to develop an active attitude control system for the Mountain Spirit Program, which is a program to develop a space-shot rocket at Embry-Riddle.

The system will use an inertial measurement unit (IMU) to determine the attitude of the system in the yaw, pitch, and roll axes with respect to its vertical attitude. The IMU will send data to be processed in a Raspberry Pi, which will control specific solenoids to allow pressurized gas to go to the thrusters. This will allow the system rotate back to its initial attitude. The software on the Raspberry Pi will use dead band control, so that within a specific range away from the vertical axis, the thrusters won't fire. This ensures that the vehicle only needs to correct its attitude when its attitude is too far away from being vertical.

The hardware of the system is intended to be cost-effective such that it can be used for future flight vehicles such as rockets for the later stages of Mountain Spirit. The majority of the hardware was sourced from a similar, but previously dismantled system with solenoids, Composite Overwrap Pressure Vessel, and thrusters. This lowered the budget as those parts, once working, wouldn't need to be bought or fabricated.

Initial testing has shown that with 100 psi, the system has enough thrust to rotate, while subsequent testing has gotten the IMU data to correctly fire the correct solenoids. The next stage will be to connect the entire pressure system together, and then test the system on a dedicated test stand.

IGNITE AWARD

PROBING THE MULTIPLICITY OF DUSTY WOLF-RAYET STARS: THE ORBIT OF WR70

Jasmine Downing, Astronomy

MENTOR

Noel Richardson, Physics and Astronomy

Wolf-Rayet stars are a late stage of evolution for massive stars that have high mass-loss rates and have also lost their outer hydrogen shell. While some stars have dust surrounding them, which forms in cold and dense conditions, these same conditions do not apply to WRs. From this, I am working to understand how dusty WRs move in comparison to other systems, and if that has any impact on their dust production.

In an effort to create an orbit for a lesser-studied WR star, archival data that was taken between 1999 and 2012 was reduced using Python, and was then used to begin piecing together the orbit of WR70. Once this data has been completely reduced and compiled, data from CTIO will be gathered, and reduced in a similar manner to try and fill in some gaps in the orbit that are present from the archival data. Once both of these are completed, the radial velocity of the system will be analyzed to understand how the system moves at different points in the orbit. Upon completion of this analysis, the first-ever orbit for WR70 will have been created.

IGNITE AWARD

X-RAY ASTRONOMY

Derrick Drango, Mechanical Engineering

MENTOR

Pragati Pradhan, Physics and Astronomy

Measuring the radius of the neutron star is a challenging task owing to its small size and extreme density. While one can indirectly infer the radius by methods of pulsar timing, burst analysis is the most direct of method to make such measurements. There have been debates in literature about the actual radius of these stars as it has implications in understanding their composition. Additionally, while it is not possible to directly image space-time curvature near the neutron star, we will measure gravitational red-shift of the iron line to make estimates as well.
The objective of this project is to study the behavior of a Low mass X-ray binary system (LMXB) to determine the size of the neutron star. We will do this by preforming detailed Spectro-timing analysis of the LMXB. This involves downloading and processing spectra from the Chandra telescope into time-resolved data during thermonuclear bursts, eclipses, and regular bursts using the software CIAO, DS9 and XSPEC tools, and making a comparison of the plasma temperature and other characteristics. Once the data reduction process is complete we will be able to make conclusions about the source for a future research paper.

SPACE GRANT AWARD

EXPLORING INCENTIVES AND BARRIERS TO CYBERSECURITY EDUCATION

Lauren Estrada, Global Security and Intelligence Studies
Hailey Thatcher, Global Security and Intelligence Studies

MENTOR

Katy-Jan Bobseine, Global Security and Intelligence

Current research highlights a deficiency in inventive strategies aimed at addressing the cybersecurity workforce shortage. This underscores the need for initiatives underpinned by a thorough analysis of student attitudes toward cybersecurity education. The objective of this study is to identify potential barriers and driving forces behind cybersecurity learning to engage more students and help fill the workforce gap. A primary focus in this research involves the exploration of how students outside the realm of cybersecurity perceive the practical applications of cybersecurity skills across different disciplines. The study involved administering a survey open to all majors at the Embry-Riddle Aeronautical University (ERAU) Prescott Campus. Through the survey, the researchers invited students to share their insights on past cybersecurity learning experiences and perceptions of the discipline more broadly, thereby uncovering potential motivators for student engagement in cybersecurity education. Through the deployed survey, the researchers hope to understand participant barriers to better combat cyber awareness/educational uninterest to produce campus wide changes, such as the implementation of a new cybersecurity course or the restructure of a previous one.

CBSI PHILANTHROPY COUNCIL AWARD

UTILIZATION OF COMBINED VISION SYSTEMS ON HELICOPTERS DURING LOW ALTITUDE AND LOW VISIBILITY OPERATIONS

Colby Evens, Aeronautics

MENTORS

Romulo Gallegos, Aeronautical Science
Brian Roggow, Safety Sciences

The implementation of vision-enhancing systems and technologies can improve the safety and efficiency of civil and military missions during low-altitude and low-visibility operations. Combined vision systems (CVS) have been studied and tested since 2005 and integrated into many aircraft for low-level and low-visibility operations. We gain more precise insight and understanding as to why this technology should exist in helicopters by analyzing the current use of CVS in aircraft compared to its absence before integration. Also, comparing the benefits of current forward-looking infrared (FLIR) and night vision goggles (NVG) to the period before this technology was adopted will provide evidence that CVS is worth investing in for helicopters. Airplanes and helicopters differ significantly. Airplanes land and then stop, while helicopters must stop before landing. Helicopters are omnidirectional and pose a higher risk of accidents occurring. Pilots go through intensive and rigorous training to fly helicopters safely and efficiently. However, the human eye is not powerful enough to detect all possible disaster threats. Pilots can make the simplest errors, even in the easiest landings. These errors can happen due to extended periods at low altitudes, causing miscalculations and improper judgment.
Keywords: Vision enhancing systems, combined vision systems (CVS), helicopter, accidents

BE STARS AND THE PROPERTIES THAT LEAD TO BUILDING AND LOSING DISKS

Sami Garcia Flores, Space Physics, **Sola Nova,** Astronomy, **Tara Lucas,** Aerospace Engineering

MENTOR

Noel Richardson, Physics and Astronomy

Be stars are stars of spectral type B (out of O, B, A, F, G, K, M spectral classes) with emission lines present (the ‘e’ in Be). The history of Be stars is relatively young with the first observation made in 1866 by Father A. Secchi, but our understanding of Be stars has started to grow much more rapidly in the past three or four decades. As of 2013, the still widely used definition of Be stars was: “A non-supergiant B star whose spectrum has, or had at some time, one or more Balmer lines in emission.” (Rivinius, 2013). However, the most interesting aspect of Be stars isn’t included explicitly in the definition above. For some reason still being researched, Be stars tend to release gaseous material that forms into a disk orbiting the star.

So far, the team has been analyzing data from two Be stars known as QR Vul and Lambda Pavonis. Sola Nova was assigned Lambda Pavonis while Sami Garcia and Tara Lucas were assigned QR Vul. The goal of this research is to properly reduce and analyze data collected for each Be star by developing code for each with the help of Dr. Noel Richardson and alumni Clarissa Pavao. Some code has already been developed for Lambda Pavonis, and plots of the velocity curves have been generated. New code is being developed that should describe how the star is emitting material through time, known as Time Series Analysis, and can be used to determine a period for the star's rotation. As for QR Vul, code is still a work in progress and will be able to produce plots that show potential outbursts and pulsation periods once it is properly running. An excel sheet has been created for to keep track of emission lines Halpha and Hbeta and will be used to further analyze QR Vul.

SPACE GRANT AWARD

SALTWORX - CAPSTONE PROJECT

Somaralyz Grullon, Mechanical Engineering , **Logan Hiland,** Mechanical Engineering, **Joe Lampasona,** Mechanical Engineering, **Maximilliano Robles,** Mechanical Engineering

MENTORS

Jonathan Adams, Humanities and Communication
Mehran Andalibi, Mechanical Engineering

We have many ways to power our daily lives, such as the sun, batteries, and gas. One of the most efficient ways to power the world currently is with a nuclear power plant. Nuclear power plants are excellent at moving heat, which is a form of energy, and converting it to power. However, we can't have the power of a nuclear plant on campus. The facilities needed would simply be too large. We need a way to show students the amazing power of nuclear generation on a smaller scale. To address these challenges, the Saltworx Capstone Team is creating an innovative solution to demonstrate nuclear power principles at a university scale. Our goal is to simulate the heat from a reactor, transfer it to a salt-based storage, and then move it through steel piping and a specialized pump to show temperature and pressure differences across a scaled system. Saltworx's molten salt system is providing a means for ERAU to develop analysis and understanding for high temperature molten salt applications as they might be used in a nuclear power plant. We expect the project to be used by future students and teachers to test various molten salt compositions and components, advancing the technical readiness of associated nuclear technologies at ERAU.

IGNITE AWARD

AEROSPACE MEDICIENE: THE HUMAN BODY IN MICROGRAVITY

Kaita Joseph Hayashibara, Applied Biology
Katelyn Kelch, Applied Biology
Adelie Zechmann, Applied Biology

MENTOR

Steve Waples, Biology and Chemistry

Muscle atrophy and bone demineralization are the most urgent problems for long duration space travel, because atrophy and demineralization happens quickly and at a constant rate. Atrophy of the skeletal muscle fibers, which are the voluntary muscles controlled by the somatic nervous system, is directly affected by space travel. Therefore, introducing effective countermeasures to decrease atrophy and demineralization are of utmost importance. When this becomes critical is when the astronauts return to Earth. The sudden change in gravitational force will apply a dangerous amount of force to the weakened bones and muscles of the returning astronauts, incapacitating them.

Bone atrophy in space is very similar to osteoporosis on Earth where bone formation is outpaced by bone resorption. However, unlike on Earth, bone resorption in space happens much more rapidly than osteoporosis. To keep muscle and bone loss to a minimum, high intensity resistance workouts are the most effective, in conjunction with taking supplements and designing special diets. Exercise remains the only validated treatment for muscle wasting, and there are currently no pharmacological therapies.

Despite the efforts of NASA to provide astronauts with exercise regimens, there is a glaring lack of eccentric extension work. This type of workout would be incredibly beneficial to astronauts in maintaining muscle and bone density. This type of training is becoming the trend among high-level athletes on Earth.

As private companies venture further into space, solutions to the long-term medical challenges of space travel are being investigated. Future civilian space exploration cannot occur if people cannot safely and efficiently function in this microgravity environment.

The goal of this research is to further study the physiological effects of space on the human body and to develop a training program, and equipment, for astronauts specifically designed to minimize bone and muscle atrophy.

IGNITE AWARD

BED BUG MOVEMENT RESPONSE TO CO2 WITH IMPLICATIONS FOR UNMANNED ARIEL VEHICLE SYSTEMS

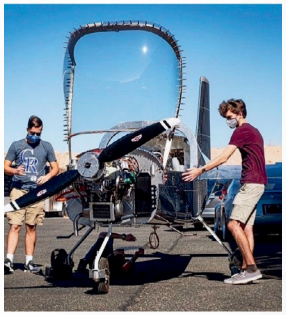
Lauren Hernandez, Applied Biology
Kaita Hayashibara, Applied Biology
Austen Pallen, Engineering Physics - Daytona Beach
Jonah Kohlmeyer, Aerospace Engineering - Daytona Beach

MENTORS

Corraine McNeill, Biology and Chemistry
Bryan Watson, Electrical Engineering and Computer Science, Daytona Beach
Karen Mittelstadt, Mathematics, Science, and Technology, Worldwide

In the last decade, there has been increasing research interest in the coordinated use of multi-unmanned aerial vehicles (UAVs), as modern aerospace systems recognize the advantage of networking many small and simple agents working together. Biologically inspired design has been used in the past to successfully create a variety of swarm algorithms. Previous biological research has focused on the behaviors of ants and bees. Bed bugs were proposed as a novel source of inspiration because their behaviors exhibit many of the desired characteristics of UAV swarm performance. The common bed bug, Cimex lectularius L., (Hemiptera: Cimicidae), is an ectoparasite that lives among vertebrate hosts, most commonly humans. Bed bugs aggregate based on several host attractants, with CO2 being the most attractive host cue that elicits the most movement. Bed bugs demonstrate sophisticated group decision-making while considering these criteria. Their responses to these factors can be quantified by recording their movement patterns based on a CO2 stimulus. Various CO2 concentrations were allowed into an enclosed testing arena through ports at the end of the apparatus. Responses to CO2 were recorded for individual and grouped bed bugs, based on gender and hunger status at every 305 mm within the testing arena. It was hypothesized that the collective decision-making movement process of bed bugs can be observed because their olfactory system will detect CO2 and aggregation pheromones. Preliminary results show that bed bugs that are 610 mm from the CO2 source will travel shorter distances, much faster, and with more angular movement, compared to bed bugs with no CO2 source. This research will not only help improve on bed bug behavior and pest management practices, but UAV swarm system designs will benefit from algorithms that are created from these bed bug movement patterns that will allow for better coordinated movements and decision-making.

IGNITE AWARD



EAGLE AERO SPORT VANS RV-12 - A STUDENT-BUILT TEST AIRCRAFT

Evan Hiland, Aerospace Engineering, **Julianne Mclendon,** Electrical Engineering, **Carson Karle,** Aerospace Engineering, **Daniel Mount,** Aerospace Engineering, **Benjamin Eben,** Aerospace Engineering, **Connor Algeri,** Aerospace Engineering, **David Close,** Software Engineering, **Jordan Richert,** Aerospace Engineering, **Angeline Masongsong,** Aerospace Engineering, **Jake Zuhlke,** Aerospace Engineering

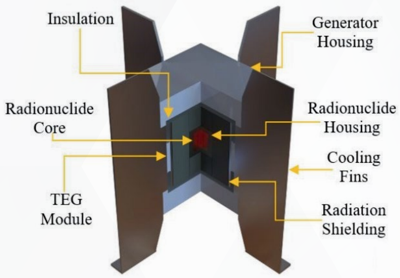
MENTOR

Seth McNeill, Computer, Electrical and Software Engineering

Eagle Aero Sport is the only build team working on a full-scale general aviation aircraft. The team is building an experimental Van's RV-12 aircraft and is modifying the plane to add real time flight test instrumentation for research. These instruments will gather data for aerodynamic, structural, and aircraft performance experiments. The team is divided into three sub-teams: engineering, build, and business. The Engineering team is responsible for designing, evaluating, and manufacturing modifications to the aircraft. Working closely with Engineering, the Build team focuses on the installation of these parts, as well as the manufacturing and assembly of the aircraft in accordance with the plans produced by Vans Aircraft. Finally, the business team organizes fundraisers and is working on a club newsletter.

The modifications to the Vans aircraft will allow future undergraduate students at Embry-Riddle to create airborne experiment packages, as well as visualize real-life applications of the concepts learned in class. At the same time, Eagle Aero Sport provides any undergraduate student the opportunity to gain valuable skills working on a real aircraft, regardless of major or previous experience.

COE PHILANTHROPY COUNCIL AWARD



LUNAR POWER: RADIOISOTOPE THERMOELECTRIC GENERATOR

Logan Hiland, Mechanical Engineering
Gabriel Payan, Mechanical Engineering
Joey Meboe, Mechanical Engineering

MENTOR

Karl Heine, Mechanical Engineering

The Lunar Power: Radionuclide Thermoelectric Generator (RTG) research project, also known as Prometheus, aims to convert waste heat from radionuclide heating units into electricity on the moon. This extra electricity will be suitable to power surface equipment during crewed missions. To accomplish this, Prometheus has developed an RTG design that integrates with current radionuclide heat source concepts. This design process entailed collaboration with industry experts to learn about the current state of radionuclide technology.

With some industry guidance, a design was developed that addresses the unique engineering challenges of lunar exploration, including extreme temperatures, power density, and radiation shielding. Prometheus addresses these challenges and can convert electricity from current radionuclide heater designs, that produce 30.5 thermal watts, into electricity at 3% efficiency for 160 days. Due to the systems' long lifetime, it becomes possible to achieve a greater energy density than the zinc-silver batteries that were used for the Apollo Lunar Module. Ultimately, this project aims to aid in the establishment of the Moon as a hub for human space exploration, while also decreasing the amount of resources required to get stored energy out of earth's orbit.

IGNITE AWARD

AI-Based Phishing Countermeasures

Jesse Hix, Cybersecurity and Intelligence Studies, Global Security and Intelligence Studies, **Teng Jiayao,** Software Engineering, **Maliah Juker,** Cybersecurity and Intelligence Studies, **Gregg Ryan,** Cybersecurity and Intelligence Studies

MENTORS

Sameer Abufardeh, Computer, Electrical, and Software Engineering
Catalina Aranzazu-Suescun, Cyber Intelligence
Terry Reinsch, Computer, Electrical, and Software Engineering

In the cybersecurity ecosystem, humans are often the weakest link. End users, through no fault of their own, can unwittingly become the targets of social engineering attacks designed to extract sensitive information. To establish an effective defense, we must understand both the mechanics and psychology of phishing, analyzing how attackers exploit and users respond to these deceptive tactics.

Our research focuses on the human factor, analyzing potential victim profiles to understand their vulnerabilities. Phishing attacks exploit innate human traits like trust, helpfulness, and fear of loss or legal trouble.

Trust: Attacks masquerade as legitimate entities, lulling victims into clicking malicious links or opening compromised attachments.

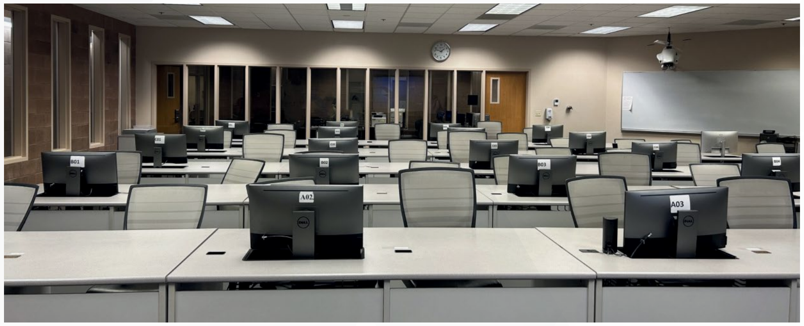
Urgency: By creating a sense of imminent danger, like account closure threats, attackers pressure victims into acting hastily, often bypassing critical thinking.

Fear: Threat of legal or financial repercussions can trigger panic, leading to rash decisions.

Lack of Security Training/Awareness: Particularly among older users, a lack of cybersecurity awareness leaves individuals ill-equipped to recognize or respond to phishing attempts.

Our project aims to combat phishing attacks through innovative training programs and robust technical controls. This comprehensive approach will result in the following deliverables: research paper detailing our findings and insights, cybersecurity presentations to educate audiences, a technical report outlining recommended control implications to guide organizations in strengthening their defenses, and a publicly available online training program. Following the research phase, we plan to develop AI-based software solutions while adhering to the Secure Software Development Life Cycle (SSDLC) framework. This ensures the resulting software is secure and reliable.

CBSI PHILANTHROPY COUNCIL



FOSTERING EQUITY IN ENGINEERING EDUCATION

Taylor Hobbs, Software Engineering, **Katrina Robertson,** Mechanical Engineering, **Trey Talko,** Aerospace Engineering, **Chanel Davis,** Aerospace Engineering

MENTORS

Ashley Rea, Humanities and Communication
Jonathan Adams, Humanities and Communication

Students in introductory engineering courses face challenges communicating and integrating their ideas in team projects. Often, these challenges with team communication fall along gendered lines, where women students experience marginalization in team settings. This project builds from prior research in the field of engineering education, which integrated frameworks from the domains of engineering education and technical and professional communication to implement this research into a classroom intervention aimed at reducing the gendered disparity in these communication challenges. To help resolve these issues, this project utilizes a new research method called "infrastructural rhetorical analysis" to develop an educational intervention case study involving the experiences of women in the first-year engineering classroom to determine a concrete classroom intervention that aims to make the most difference with the least amount of resources needed to implement it.

IGNITE AWARD

EAGLE SPACE FLIGHT TEAM - SYSTEMS ENGINEERING TEAM

Adrien Hobelman, Aerospace Engineering
Claire Picht, Mechanical Engineering
Aidan Maney, Aerospace Engineering
Andrew Reynolds, Aerospace Engineering
Levi Rushing, Aerospace Engineering

MENTOR

Kathryn Wesson, Applied Aviation Science

Eagle Space Flight Team (ESFT) is developing a solid rocket system to attempt a record flight past the Karman line. Model-Based Systems Engineering (MBSE) is becoming an industry standard for complex systems development from concept through operations. The systems team is developing a system model to support the integration and systems-level testing and requirements verification for the Space Shot-1 system design. Using the Systems Modeling Language (SysML) and Catia Magic, we can capture all system level interfaces, requirements, verification and test plans in a centralized model to facilitate a full-fit and eventual launch test of this design. Using this system model and the Cameo Safety & Reliability Plug-In, the systems team is able to provide failure, safety, and hazard analysis for the ESFT. This effort brings the team together as an Integrated Product Team (IPT) and shifts the focus from component development to systems-level integration. Model-based products will support the review, preparation, approval, and eventual launch of this system.

IGNITE AWARD

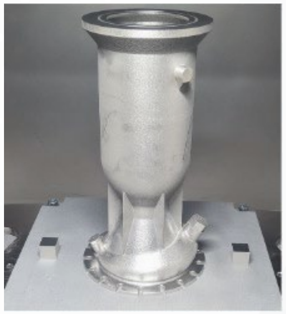
ESTABLISHING A CODING SYSTEM FOR USE OF FORCE ENCOUNTERS TO DEVELOP AN IMMERSIVE TRAINING MODEL

Alexandra Houston, Forensic Psychology
Alexus Marquez, Forensic Psychology

MENTOR
Diana Orem, Behavioral and Social Sciences

Modern day policing demands have expanded the scope of the types of individuals and situations law enforcements officers (LEOs) must be trained to handle. The current reality is that several issues hamper the potential for improvement: 1) inconsistent training; 2) inconsistent tracking; 3) not enough training, not mandatory, no follow-up 4) differences in populations that fall under this broad umbrella. Thus, it is imperative that new trainings methods are not only developed to accommodate these needs, but also be effective and feasible for LE agencies. We propose a novel method of determining why and how encounters between neurodivergent and LE go poorly, and in extreme cases, end in the death of the individual. In the Spring term, we will do this by cataloging known cases, locating the bodycam footage if it is available, and developing a coding system for analyzing the encounter. Due to restrictions of footage, we will pull data from any use of force encounters we have access to. Validity and interrater reliability will be assessed and training will continue until satisfactory criteria are met. Once this process is complete, data will be analyzed to determine which types of errors are most frequent and which are most likely to lead to undesirable outcomes. For the Summer term, we will translate the data into an interactive, simulation-based training protocol where trainees will interact with real footage and receive constructive feedback in real-time. Adapt Showcase, an online course building software, will be used to create a new training that analyzes critical points throughout an officer's interaction with an autistic individual. The goal is to pilot this training through an existing autism and LE curriculum. The outcomes hope to address the pressing need to provide training to members of LE on how to interact safely with autistic individuals in their communities.

IGNITE AWARD



CORRELATION OF A HEAT TRANSFER MODEL FOR A REGENERATIVELY COOLED ROCKET ENGINE

Austin Johnson, Mechanical Engineering
James Frost, Mechanical Engineering
Jared Erwin, Mechanical Engineering
Logan Walters, Mechanical Engineering
Joshua Kobluk, Mechanical Engineering
Hoa Ngyuen, Aerospace Engineering
Raj Sadafule, Aerospace Engineering

MENTOR
Neil Sullivan, Mechanical Engineering

Currently, Embry-Riddle Aeronautical University (ERAU) lacks the capabilities required to launch a vehicle into space. To build a space-capable vehicle, our team is collaborating with manufacturing at Honeywell Aerospace to additively metal print a regeneratively cooled rocket engine (depicted above) with the specifications required to escape the earth's atmosphere. The engine will have a burn time of 60 seconds and produce thrust of 3000 pound-force.

To aid our collaborators at Honeywell, our team seeks to validate a Microsoft Excel calculator to continually analyze regeneratively cooled rocket engines. These calculations will then be compared against physical test data gathered by the team. This process will provide ERAU with an iterative design to improve our collaborative work. Furthermore, the tool may continually improve the university's rocket engine designs.

IGNITE AWARD

ICE CLOUD PARAMETERIZATIONS FOR THE GLOBAL CLIMATE MODELS

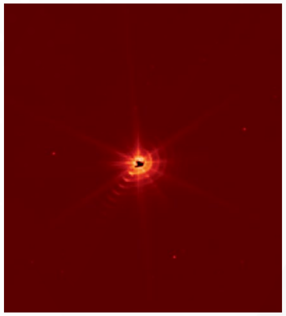
Victoria Lang, Applied Meteorology

MENTOR

Dorothea Ivanova, Applied Aviation Science

Cirrus clouds are one of the biggest uncertainties in radiative budget, crucial to the understanding of the short- and long-term trends in climate. Improved parameterizations of cirrus clouds in global climate models (GCMs) require good understanding of the cloud properties and especially the role of small ice crystals in cirrus. Cirrus clouds have an important impact on earth's climate by influencing the radiation balance and hydrological cycle. Ice clouds play an important role in the climate system, but they are often poorly represented in climate models. Improved parameterizations of cirrus clouds in GCMs require good understanding of the cloud properties and especially of the role of small ice crystals in cirrus. A goal of this proposed project is to help improve climate prediction through better representation of the microphysical cirrus properties in GCMs. We aim to create a GCM parameterization for bimodal size spectra in mid-latitude cirrus clouds and a trimodal size distribution parameterization for tropical cirrus. Both are expected to predict different behavior of the size distributions (SD) for the same ice water content (IWC) and temperatures. As temperature decreases beyond -35°C, the magnitude of the small mode is uncertain with the tropical scheme, but predictable with the mid-latitude scheme. This is a fundamental question and indicates that the radiative properties of tropical and mid-latitude cirrus are considerably different for the same IWC. This may also point to the different mechanisms by which convective and non-convective cirrus are generated.

COA PHILANTHROPY COUNCIL AND SPACE GRANT AWARD



PROBING THE MULTIPLICITY OF DUSTY WOLF-RAYET STARS WITH MULTI-WAVELENGTH TECHNIQUES:

Damar Lemelle, Space Physics
Micaela Sampsel, Astronomy

MENTOR

Noel Richardson, Physics and Astronomy

Wolf-Rayet (WR) stars, a late-stage of evolution for massive stars, have lost their outer hydrogen envelopes and have high mass-loss rates. These stars are characterized by strong carbon emission lines from their stellar winds and solid infrared excesses from the dust surrounding them. Dust should form in cold, dense conditions, but the opposite occurs for WRs. Though we are yet to find how dust is formed in such an extremely hostile environment, we take high-resolution mid-infrared imaging of a sample of the most prodigious WR stars. This allows one to map rapidly changing dust-forming regions and derive some basic properties of the freshly formed dust and the system it inhabits.

To resolve these produced dust shells, archival data will be collected from previous JWST/MIRI binary WR observations. Prototypes will consist of using this data to construct geometric models of the dust plumes these shocks produce and inferring the orbital geometry for these systems. We shall then follow this analysis with the JWST/MIRI imaging of additional WR systems to test our constructed program and reveal the fine structure of the dust shells and extend the known survivability to greater than 200,000 AU. Once these steps are completed, we will have a greater understanding of the dust survival, temperature, and propagation for these systems, as well as constraints for the orbits.

IGNITE AWARD

AIAA DESIGN, BUILD, FLY: PABLO - AN URBAN AIR MOBILITY / EMERGENCY MEDICAL DRONE

Matthew Marandola, Aerospace Engineering
André Leppert, Aerospace Engineering
Thomas Sly, Aerospace Engineering
Max Welliver, Aerospace Engineering
Cody Hall, Aerospace Engineering
Nic Barrick, Aerospace Engineering
Owen Dyer, Aerospace Engineering

MENTORS

Johann Dorfling, Aerospace Engineering
Joseph Smith, Aerospace Engineering

Design, Build, Fly (DBF) is an international, intercollegiate competition where teams develop an aircraft - from the ground up - to compete in flight missions and satisfy engineering constraints defined by the American Institute of Aeronautics and Astronautics (AIAA). This year, the competition revolves around urban air mobility. The aircraft must lift wooden passenger figurines in a commercial transportation configuration and as patients on model gurneys. Scoring is dependent on the amount of passengers transported, the weight of a medical supply cabinet payload, and the aircraft's cruise speed.

The DBF club on campus, team Coppertails, built PABLO (Public Airborne Biomedical Lifting Operator), an aircraft designed to complete three flight missions and one ground mission in accordance with the requirements stated by AIAA. To optimize all mission scores, Coppertails designed PABLO with a maximized medical payload weight of 4.5 lb, a 48-passenger count, and adequate accessibility to minimize aircraft assembly time. Team Coppertails adhered to an iterative design process to advance the aircraft when feasible improvements were identified.

PABLO is a single-motor, high wing UAV with a conventional tail and swivel wing. A single tractor motor configuration was chosen because it provides sufficient thrust for all flight missions, increases propulsive efficiency, and reduces weight. To enhance payload capacity, a flat-bottomed fuselage was adopted, and a boom tail was employed to give the stabilizers sufficient authority given the large inertia of the aircraft. A high wing was implemented to allow easy access to the payload and avionics. The wing swivel was incorporated to meet a minimum width requirement during parking as specified in the rules

EAGLE PRIZE AWARD AND COE PHILANTHROPY COUNCIL AWARD

INNOVATIVE SPACES PROJECT

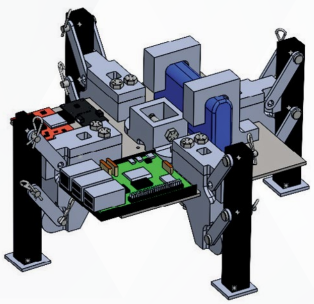
Angeline Masonsong, Aerospace Engineering
Alexia Richmond, Aerospace Engineering
Eli Martin, Aerospace Engineering
Trey Talko, Aerospace Engineering

MENTORS

Hadi Ali, Aerospace Engineering
Rose Danek, Behavioral and Social Sciences
Kathy Wood, Aerospace Engineering

Innovation is the driving force behind technological and economic advancements. However, challenges exist in creating spaces which encourage collaboration, communication and innovation. Our project, Innovative Spaces, questions traditional educational spaces in their suitability to encourage innovation. We explore this by developing a survey instrument to understand the reciprocal relationship between users and the space: how the environment affects a user's behavior and how the user affects the environment. The data collected will help in measuring the malleability of the innovation space. Furthermore, the data will assess the design efficacy of users (both students and faculty) and their expectancy of the value gained in manipulating the space (to achieve certain communicative or collaborative goals). Ultimately, our goal is to identify a list of properties that make a space inspiring for an innovative, communicative and collaborative culture, and ones which can be easily implemented into innovative spaces. These properties could be in the form of easily accessible creative materials, infrastructure that provides an avenue to easily prototype ideas, or seating arrangements that focus more on peer communication and ideation.

IGNITE AWARD




GRAVITATIONAL REPLICATING AUTONOMOUS SPACE HOPPER

Joshua McBeth, Aerospace Engineering, **Dulce Marquez,** Aerospace Engineering, **Aviad Golan,** Aerospace Engineering, **Zachary Johansen,** Aerospace Engineering, **Noelle Kartvedt,** Aerospace Engineering, **Jordan Lowry,** Aerospace Engineering, **Tara Lucas,** Aerospace Engineering, **Nicanor Newman,** Aerospace Engineering, **Julian O'Connor,** Aerospace Engineering, **Logan Setzkorn,** Aerospace Engineering, **Michael Stich,** Aerospace Engineering

MENTORS

Davide Conte, Aerospace Engineering
Richard Mangum, Humanities and Communication

Gravitational Replicating Autonomous Space Hopper (GRASHopper)'s purpose is to autonomously identify suitable landing areas, map terrain, and stabilize itself during the decent using Artificial Intelligence (AI). Completing these tasks will contribute to safe and consistent asteroid landings without human intervention. GRASHopper's purpose aligns with the RASC-AL prompt and aims to advance the possibilities of deep space exploration through the integration of AI. By implementing components like a depth camera, GRASHopper will be able to choose an appropriate landing site with material necessary in the greater self-replication process. The chosen landing site must also have minimal debris and low peaks and valley to ensure a stable landing position. Determining and controlling the attitude of the spacecraft with an IMU will allow for a soft landing and keep the spacecraft intact for subsequent landings. GRASHopper's incorporation of the Generalizable Episodic Memory (GEM) AI Model serves to improve the overall accuracy and speed of each landing using thousands of computer simulated tests and physical tests on rocky terrain on Earth. GRASHopper's physical testing method uses an overhead three-axis motorized structure which will communicate with the onboard computer to land in Prescott, AZ and mimic landing on an asteroid.

IGNITE AWARD

ZOO POO POWER

Xander McLendon, Mechanical Engineering
Clyde Miller, Mechanical Engineering

MENTOR

Karl Heine, Mechanical Engineering

Animalian feces in United States agricultural production constitutes 60 million dry tons of usable biofuels annually which accounts for 31% of mass available for bioenergy from all sources. Organizations throughout the country have large quantities of animals in their care, sometimes referred to as "living collections," which come accompanied by regular fecal production. Direct combustion of biofuels as a carbon neutral alternative to fossil fuels in power production occurs across the United States in Rankine cycle power plants, yet animal manures are an underutilized resource in this field. Animal waste could provide alternative methods of waste disposal for many organizations nationwide. Expansion of a market for fecal matter could be beneficial to both consumers and producers, however, little about the energetic and economic potential of animalian excretions is known.
The proposition henceforth discussed is whether feces from zoological organizations is a veritable source of power. Within feces there is a significant disparity in the combustive properties from sample to sample, so animals are divided first into smaller groupings based on diet and classification so as to group animals with similar digestive circumstances. Within these categories individual species will be evaluated separately to divide the samples further, and within individual species the samples will be homogenized to eliminate error from inconsistency on a smaller scale than the species. Homogenization will result in the development of fecal pellets ideal for both storage and transportation. Bomb calorimetry will be conducted to gather data on the heating value of the biofuel.

IGNITE AWARD

ANALYSIS OF ULTRACOMPACT X-RAY BINARY SOURCE 4U-1916

Clyde Miller, Mechanical Engineering
Xander McLendon, Mechanical Engineering

MENTOR

Pragati Pradhan, Physics and Astronomy

Ultracompact X-ray binary systems are a rare type of low mass X-ray binary system consisting of a low mass donor star and an accretor, which is typically a neutron star or black hole. The donor star transfers mass to the accretor, forming an accretion disk that contains the heated gases of the donor star. These heated gases are responsible for emitting the X-rays as they become accelerated through the accretion disk. Ultracompact X-ray binary systems are characterized as having relatively short orbital periods, usually less than an hour.

The goal of this project is to examine the mass transfer between donor and accretor for several UCXB systems. The overarching drive behind this project questions how mass transfer varies with orbital period and mass ratio between the compact objects, and how accurate are current models for UCXB mass transfer parameters.

Thus far 4U-1916, which is an ultracompact X-ray binary system that has been shown to experience noticeable periodic dips in X-ray emission, has been analyzed thoroughly. These dips are aligned with the orbital period of the system, which is about 50 minutes and are caused by the obstruction of the central source of the X-rays via an object that is located within the accretion disk of the neutron star. This system has been observed using both the Chandra and NuSTAR X-ray telescopes. Using data from the observations of the NuSTAR telescope, the lightcurve and spectral curve of the system have been extracted and analyzed.

Moving forward, additional sources will be examined with data collected by the NuStar telescope. Ultimately, this data from several sources will be compiled to evaluate the validity of current models for mass transfer within UCXBs.

SPACE GRANT

ANALYZING THE VARABILITY AND ORBIT OF MASSIVE BINARY SYAR SYSTEM ETA CARINAE

Shannon Moore, Space Physics
Taylor Brown, Space Physics

MENTOR

Noel Richardson, Physics and Astronomy

Eta Carinae is an usually massive, highly eccentric Luminous Blue Variable (LBV) star. While the system is highly studied, it is also highly misunderstood. Eta Carinae shows intense, periodic peaks in its brightness and astrophysicists have yet to find out why. To study this variable behavior, we are analyzing seven years of data from the BRITE (BRIght Target Explorer) Constellation mission. These pulsations have been theorized as potential Tidally Excited Oscillations (TEOs). There are reports of potential TEOs in massive binary systems, but Eta Carinae would be the most massive and periodical system known to exhibit tidally-induced pulsations. Further analysis of more spectroscopic data from the system is necessary to determine the impact tidal forces play in Eta Carinae' s variable behavior. Regardless of the origin of the pulsations, our analysis of the system at various points in the orbit could provide a better understanding of how this unique system operates.

Additionally, we are expanding on the study of Eta Carinae's orbit by analyzing new emission lines from the system. Past analysis of Eta Carinae's orbit focused on Hydrogen Alpha and Hydrogen Beta, and we are extending the research to Helium and Nitrogen based emissions. The profiles of other elemental emission lines are becoming increasingly significant as their results better match models made to fit Eta Carinae. Further analysis of other elemental emission lines could better constrain Eta Carinae's orbit and provide key information in the effort to explain the system's past, current, and future behaviors.

We aim to more clearly and accurately describe the kinematics of the system's orbit and model the forces influencing its luminosity, ultimately providing the astrophysical community with information regarding the highly eccentric Eta Carinae system. Eta Carinae is used to better understand Luminous Blue Variable stars and Supernova Imposters, and our expansion on past research could contribute to that effort.

SPACE GRANT AWARD

INFLUENCE OF APPROACH AND AVOIDANCE ON MEMORY

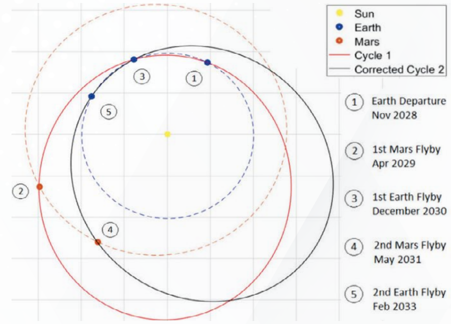
Chloe Nelson, Forensic Psychology

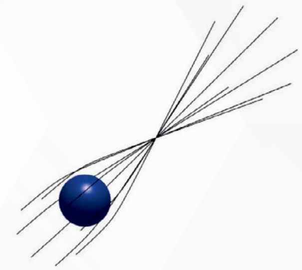
MENTOR

John Woodman, Behavioral and Social Sciences

Stereotype threat is a threat that is seen as something that affects an individual's group, which could potentially lead to a reduced ability in a cognitive task or other abilities within that area. Stereotype threat can impact working memory, in which an individual may spend time trying to reduce the impact of stereotype threat rather than use their cognitive resources to work on a problem. There is an opportunity for a persistent lack of ability within a person's cognition to evolve based on the issue of individuals perceiving a group they are affiliated with to be attached to stereotype threat. Due to stereotypes surrounding the older population, there are opportunities for the elder population to self-stereotype and cause a hinderance on their cognition among other health-related aspects. We propose that utilizing the an online visual simulation using the VAAST (Visual Approach/ Avoidance by the Self Task), will allow for the mitigation of stereotype threat among older adults. During the Spring term we will use an experimental design to observe the influence of stereotype threat on an older population, while applying the VAAST as an intervention. A primer will be used where the individual will be exposed to a simple prompt that has no information that related to manipulation. This will provide results as to whether or not the VAAST can be used as an intervention to mitigate stereotype threat on older adults' cognition. Research participants over the age of 60 will be recruited using an online platform. The use of the VAAST can provide information towards a potential intervention in mitigating stereotype threat, so that this information can be used to improve confidence in older adults' cognitive abilities. The outcomes of this project will ultimately will allow for an intervention that could support more successful living for older adults. The outcomes will also provide opportunities to further examine the attributes that affect stereotype threat in older adults, and examine any observations of lack of confidence.

IGNITE AWARD





Potential Earth Gravity Assists Visualization

TRAJECTORY OPTIMIZATION - SHUTTLE VIA EARTH-MARS CYCLER ORBIT

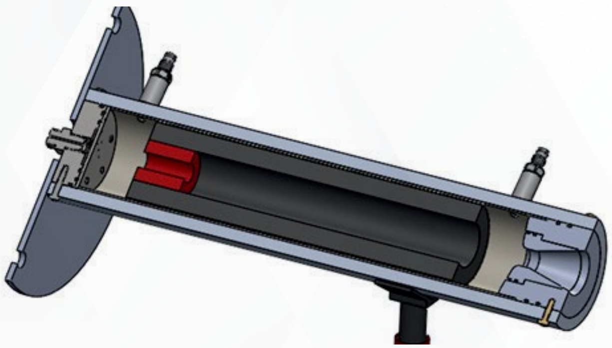
Kyle Newlin, Aerospace Engineering

MENTOR

Davide Conte, Aerospace Engineering

NASA and other space-faring organizations have long expressed hopes of sending crewed missions to Mars before the year 2035. Like-minded ambitions have also driven some to believe that a long-lasting human presence on the red planet could be soon to follow. As humanity prepares to strive toward these extraordinary feats, the ability to craft interplanetary pathways for consistent transportation between our planets holds profound significance.
The Aldrin cycler, a namesake of the legendary astronaut, proposes a trajectory capable of "cycling" between Earth and Mars without the need for costly impulsive maneuvers. However, the basic concept of this trajectory and those like it often make notable simplifications to the Solar System's geometry that limit their real-life practicality. Our research aims to leverage the primary concepts behind cycler orbits to develop and optimize possible spacecraft trajectories using state-of-the-art planetary data and optimization schemes.
In order to develop a robust computational structure, the implementation of multiple orbital mechanics functions and embedded optimization loops are necessary. To further push accuracy, planetary ephemerides computed by NASA's JPL Solar System Dynamics are used for each interplanetary segment of the trajectory. The computations produced by this project aim to supply practical, mission trajectories spanning across the next 10+ years, including necessary maneuvers needed to maintain and rendezvous with such orbits.

SPACE GRANT AWARD



CORVUS- A HYBRID ROCKET ENGINE CAPSTONE PROJECT

Brianna Ney, Mechanical Engineering, **Issa Meboe,** Mechanical Engineering, **Joey Meboe,** Mechanical Engineering, **Finley Myler,** Mechanical Engineering, **Noah Kane,** Mechanical Engineering, **Kevin Sweet,** Mechanical Engineering, **Winona Roulston**, Mechanical Engineering,.

MENTORS

Brian Roth, Aerospace Engineering
Richard Mangum, Humanities and Communication

Unmanned aerial vehicles (UAVs) have proven their value for reconnaissance missions, but integrating UAVs into manned aircraft to extend mission capabilities is an emerging field. Launch UAV's goal is to design an aircraft that fits inside a G-sized sonobuoy canister, deploys from a manned aircraft in flight, and flies for at least 50 miles and 45 minutes while providing live video and telemetry to a remote operator. Multiple UAVs can be deployed in the air to expand the search capabilities of manned aircraft.
An example scenario would be a search and reconnaissance mission over a large expanse of open land. The multiple UAVs would be deployed, loiter over an area, transmit their findings, and then fly back to base to be recovered and reused.
To develop the design, aircraft characteristics such as aerodynamics, weight, and stability were modeled in MATLAB and assessed to judge overall performance. A high-wing/twin-tail aircraft configuration was selected by considering the outcomes of multiple trade studies. Wing-folding mechanisms were prototyped to evaluate candidate design concepts and technologies. The folding mechanisms used in thisUAV allow it to achieve the benefits of a longer wingspan while remaining strong and compact. Three prototype airframes have been built and prove that the UAV is stable in flight. Launch UAV validated the structure of the aircraft through load testing and the drag through wind tunnel testing. Another flight model will be ready shortly that incorporates the results from testing.

IGNITE AWARD

BOLT AEROSPACE

2023-2024 DESIGN-BUILD-VERTICAL FLIGHT COMPETITION

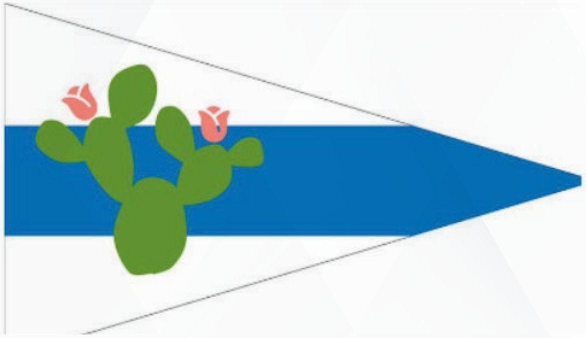
Hunter Nudson, Aerospace Engineering, **James Morris,** Aerospace Engineering, **Liz Behan,** Aerospace Engineering, **Luke Rondeau,** Aerospace Engineering, **Mandy Goodbody,** Aerospace Engineering, **Paul Farrah,** Aerospace Engineering, **Ryan Begley,** Aerospace Engineering, **Skyler Uhler,** Aerospace Engineering, **Yeshan Kalpage,** Aerospace Engineering, **Angel Appelzoller,** Unmanned Aerial Systems

MENTORS

Johann Dorfling, Aerospace Engineering
Richard Mangum, Humanities and Communication

BOLT (Battery Operated Light Transport) Aerospace is a student design team developing an electric Vertical Takeoff and Landing (VTOL) aircraft to compete in the Vertical Flight Society's Design-Build-Vertical Flight Competition. The competition consists of two phases, one piloted, and the other autonomous. In both phases, the aircraft must be fitted with a payload, take off vertically, complete a lap around the designated course, and land vertically. The participating teams will receive points for the number of laps completed in ten minutes, the weight of the payload, and the fastest lap time. The competition also includes a scored technical report and presentation. The aircraft designed by BOLT Aerospace has been designated CARLOS (Craft for Aerial Relocation of Light Objects and Supplies) and will be electrically powered, capable of VTOL, have a six-foot wingspan, and a gross takeoff weight of twenty pounds.

EAGLE PRIZE AWARD



AUTONOMOUS SAILBOAT

Ela Ozatay, Aerospace Engineering
Phil Gerard, Unmanned Aircraft Systems
Anika Ginger, Mechanical Engineering
Jack Seigworth, Mechanical Engineering

MENTORS

Stephen Bruder, Computer, Electrical, and Software Engineering
Matt Pavlina, Computer, Electrical, and Software Engineering

Autonomous vehicles have existed since the 1980s, and within the past decade, the number of autonomous vehicles used in consumer and commercial settings has skyrocketed. The Autonomous Sailboat team – also known as the Prescott Yacht Club, PYC - will utilize weather data, GPS, and LiDAR (Light Detection and Ranging) scans to detect the position and the surroundings of the boat to adjust its course in real time.

The project began as a LiDAR testing group, attempting to solve LiDAR's limited range underwater. LiDAR has been identified as a lower-cost option and is unrestricted by the government. While the initial project was successful in developing an underwater housing for the LiDAR sensor, we aim to take the previous results and optimize the operating system and the data analysis method in the autonomous system.

Currently, the team will design and fabricate a fiberglass catamaran hull and a rigging system. On the software aspect of the project, we will construct a circuit to integrate the sensors, and program the autonomous code using MATLAB.

The Autonomous Sailboat team aims to not only advance our experience in LiDAR technology and autonomous systems with hopes to design an optimal control system to aid future marine and deep space research.

EAGLE PRIZE AWARD

NOISE REDUCTION IN THE LOW FREQUENCY LIGO DETECTORS

Brandon Pillon, Space Physics
Charles Wszalek, Space Physics

MENTORS

Michele Zanolin, Physics
Darrel Smith, Physics
Joshua Freed, Physics

This study has two objectives. The primary objective is centered on looking into how to improve the detection capabilities of low-frequency gravitational waves. The current generation of gravitational wave detectors is not focused on the low-frequency end of the spectrum, and this project aims to map the low frequency noise so that a detector can be made more efficiently. Another aspect of this project will be to build a functional representation of the LIGO mirrors to learn about their natural frequencies and how to mitigate the noise due to these natural frequencies. Since the noise most common in the LIGO interferometer is in the low-frequency range, the same range as low-frequency gravitational waves, reducing the noise will allow LIGO to detect these gravitational waves.

SPACE GRANT AWARD

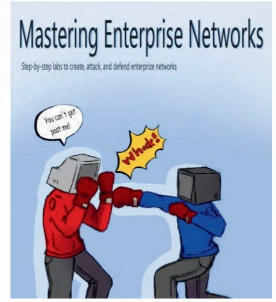
ERAU EAGLENAUTICS - SAE AERODESIGN

Ty Rice, Aerospace Engineering, **Andrew Onato,** Aerospace Engineering, **Nicco Wolter,** Aerospace Engineering

MENTOR
Shigeo Hayashibara, Aerospace Engineering

Learning the design and engineering process of creating an aircraft is one of the most valuable things that we can learn as engineering students, and through Eaglenautics we will be able to do this in this semester. This semester, our team will be utilizing a balsa wood model aircraft in order to gain inspiration and learn more about the actual construction of the aircraft itself. Through the creation of this aircraft, we will be able to determine what will be effective in the creation of our own aircraft and be able to apply it effectively. The Eaglenautics team will also be creating initial designs, models, and structures for our own unique aircraft, in preparation for next years competition. We will be utilizing this semester to learn and prepare for next year's competition; We are creating a model airplane to practice our construction skills, and to learn new design elements that can be incorporated into our design. Through the creation of a design for a plane this semester, we will learn what will be practical on our aircraft and what will help us achieve the goals of the competition in the most effective way. These two practices will give us valuable engineering experience, all the way from the design phase to the actual construction and physical flight testing of our model. By learning these methods this semester, we will be able to prepare ourselves for the SAE Aerodesign competition in the 2024-2025 year. The goal of the Eaglenautics team is to give us engineering experience, through real practice and application of design theory that we have learned during our time here at Embry-Riddle.

EAGLE PRIZE AWARD



Open Educational Resource

https://eaglepubs.erau.edu/mastering-enterprise-networks-labs/

MASTERTING ENTERPRISE NETWORKS - A FREE, HANDS-ON TEXTBOOK

Julian Romano, Cyber Intelligence and Security
Raechel Ferguson, Cyber Intelligence and Security
Dante Rocca, Cyber Intelligence and Security

MENTOR
Mathew Heath Van Horn, Cyber Security

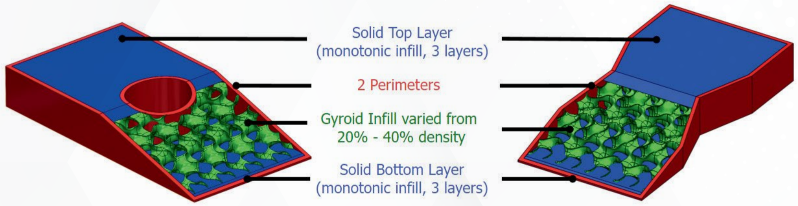
We've successfully created a free textbook of hands-on learning activities in preparation for future qualitative and quantitative studies concerning the effectiveness of hands-on learning in the emerging field of cybersecurity.

Open Educational Resources (OERs) have proven their value in making education accessible to everyone. Integrating hands-on labs using industry standards and Open-Source software enables Mastering Enterprise Networks to be much more than just a textbook. The goal of *Mastering Enterprise Networks, Step-by-Step Labs to Create, attack, and Defend Enterprise Networks*, is to prepare the next generation of Cyber Warriors responsible for keeping the world's cyber infrastructure secure. Mastering Enterprise Networks focuses on applying theory to build enterprise networks on a personal computer without requiring high-end equipment or other resources. This provides experience-based learning to the student at no cost.

In less than a year, we have built 9 semester hours of instruction into 45 chapters of hands-on labs composed of more than 60,000 words and over 600 distinct figures and illustrations. Despite not being officially published, Mastering Enterprise Networks has received thousands of unique visitors and is being evaluated by multiple higher education institutions nationwide. Our team's efforts are privileged to present at the National Security Agency's Conference for National Centers of Academic Excellence in Cyber Security and the College Cyber Defense Competition. Already winning the Prescott Campus Textbook Affordability Award, we are preparing for a 2nd edition. Designed for the masses, a middle-schooler or a graduate student now has a starting point and build upon what they already know. With the ever-evolving landscape of Cyber Security, our online textbook will be updated dynamically to stand up against the test of time, while being available to any willing to learn.

Content Contributors: Jacob Christensen, Zeek Correa, Isabella Whalen, Brandon Hammer, Trevor French, Taha Al Luhaibat

CBSI PHILANTHROPY COUNCIL



INVESTIGATION OF STRESS CONCENTRATIONS IN FUSED DEPOSITION MODELED PARTS

Winona Roulston, Mechanical Engineering
Nathan Bleakley, Mechanical Engineering

MENTOR

David Lanning, Aerospace Engineering

Rapid prototyping using additive manufacturing has an ever-increasing presence in industry. Fused Deposition Modeling (FDM) is a common type of additive manufacturing and has experienced significant growth in recent years. There are many process parameters that affect the quality and mechanical properties of FDM parts, which makes it a highly desirable manufacturing process but also creates a barrier due to the lack of knowledge of their effects. There exists a large gap in knowledge about how specimen geometry coupled with infill parameters affects mechanical properties, which this study aims to address.

To investigate these effects, infill pattern is constrained to a 'gyroid' pattern, and the infill density is varied at 20%, 40%, and 60%. Previously, work was conducted to demonstrate how stress concentrations, in the form of notches and holes, affect the strength of FDM-printed specimens. These studies resulted in non-intuitive results that contradict traditional solid mechanic theories to predict failure and crack propagation. Specimen geometry is now constrained to stress-inducing "v" notches and elliptical holes. The new geometry can be correlated to previously tested specimens with stress concentrations in the form of circular holes and semi-circle notches. While the theoretical stress concentration factor can be designed the same between a "v" and semi-circular notch, the stress field around the notch varies with a higher maximum stress at the "v" notch due to the sharp curve compared to the semi-circle. This leads to a higher probability of crack initiation and propagation than traditionally expected, which will be influential in creating failure theories for 3D-printed products. Initial results have lead to continued belief from prior work, in that the shell in 3D printed parts makes the edges solid. The added material reinforces the part at that location, which decreases the stress concentration factor.

IGNITE AWARD

ADDRESSING THE COLD CASE CRISIS AMONG NATIVE AMERICAN TRIBES IN ARIZONA

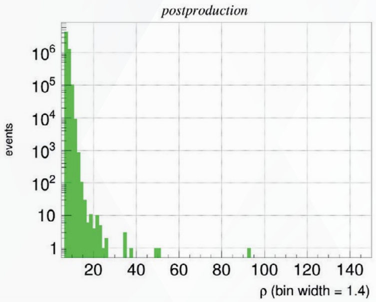
Narayt Salcido, Forensic Psychology

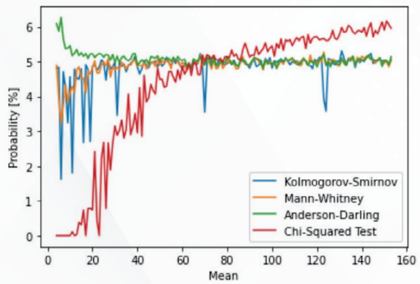
MENTORS

Diana Orem, Behavioral and Social Sciences
Kelly Crockett, Behaviroal and Social Sciences

According to reports published by multiple government agencies, there is a disproportionately high number of unsolved missing persons and unsolved murder cases among Native Americans. This appears to be due to several factors: 1) rates of murder, rape, and violent crime are all higher in this population compared to the national average; 2) there appear to be discrepancies in the number of missing persons reported among various agencies which has resulted in underreporting to critical databases, such as the National Missing and Unidentified Persons System (NamUs), which logged a small fraction of the cases reported to the United States Department of Justice; 3) many investigations remain unsolved due to a lack of investigative resources; and 4) there exists a history of mistrust of government agencies due to instances of discrimination and other transgressions against Native Americans. There are many challenges this population faces, many of which stem from a history of being under-served, underfunded, and overlooked. By examining the literature, we can determine where these discrepancies are, both by government agencies and by unofficial databases. We can also determine ways in which the government has attempted to address this crisis and why these have fallen short. By examining the history, we can determine how both generational and historical trauma have influenced certain aspects of this crisis. Approaching this through the lens of forensic psychology and in conjunction with tribal perspectives is one way to attempt to work through the trust and credibility problem.

IGNITE AWARD





DISTRIBUTION METHODS FOR DETECTING SUPERNOVA GRAVITATIONAL WAVES

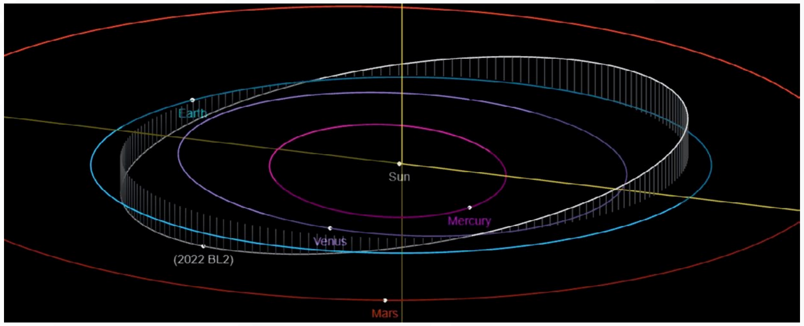
Kya Schluterman, Space Physics

MENTOR

Michele Zanolin, Physics

The goal of the project is to investigate the potential of different distributional methods in the detection of Core-Collapse supernova gravitational waves for quiet signals that would have been previously missed. To date, no supernova GW detections have been made; the leading software for supernova signal analysis, coherent waveburst, looks only at the loudest 'event' in a span of time data and forms its metrics for the one event. Our process instead looks at larger distributions of candidates. This statistical approach allows us to look for GWs at the strongest events as well as those at far lower signal-to-noise ratios (SNR). With the Cogherent Waveburst software,, the SNR is inversely proportional to the distance from the source. This means our method could extend the reach of the LIGO interferometers and with this increased range, the volume of SN we consider as candidates goes at a cubic rate. With this project, we may be able to create the method for a far more powerful SN detection pipeline. This method would be able to assist with not only new SN Candidates, but all candidates in the past LIGO observation runs.

SPACE GRANT AWARD



NEAR EARTH ASTEROID LOW-ENERGY REDIRECTION

Peter Schmitt, Aerospace Engineering
Kenya Ruiz, Aerospace Engineering

MENTOR

Davide Conte, Aerospace Engineering

There are over 30,000 discovered Near Earth Objects (NEO) orbiting the Sun. As humanity strives to learn more about our Solar System, asteroids are a key component to that research. Previously, we have sent probes to investigate various asteroids such as the OSIRIS-REx and DART missions, but if we want to learn more about their origins and potentially mine their resources, the next step is to make reaching asteroids more accessible by bringing them closer to us. Our research will focus on whether it is possible, feasible, and efficient to move one or more of these NEOs from a heliocentric orbit to a more accessible and useful cislunar orbit using a method known as weak stability boundary (WSB) trajectories. This method could vastly reduce the energy requirement for capturing asteroids by leveraging the perturbation of the Sun over long periods of time. This would, consequently, lower the propellant needed to move these asteroids using other more conventional trajectories and could simplify and reduce the cost of a future asteroid redirect mission and asteroid resource utilization.

We are narrowing down asteroid candidates by looking at the asteroids' physical characteristics, the orbital characteristics of the asteroids' heliocentric orbits, and the characteristics of their close encounters with Earth. We are using particle swarm optimization as well as a qualitative analysis of the WSB in the Circular Restricted Three Body Problem. analysis of the WSB in the Circular Restricted Three Body Problem.

IGNITE AWARD

NOVEL INSECT DETECTION USING LOW-COST, FIELD-DEPLOYABLE, STAND-ALONE MICROCONTROLLERS

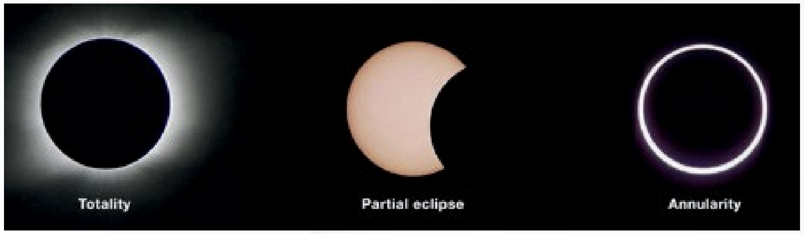
Heeirthan Shanthan, Computer Engineering
Aviad Golan Peretz, Aerospace Engineering

MENTOR

Seth McNeill, Computer, Electrical, and Software Engineering

The goal of the project is using machine learning algorithms on embedded system to detect harmful insect calls, specifically focusing on psyllid calls, in collaboration with USDA researchers. Additionally, the project will help working towards a redesign of the robots for Dr. McNeill's microcontrollers course, with the objective of providing each student with their own robot rather than solely relying on the robots in the lab. The ESP32 and RP2040 development platforms has shown the feasibility of employing more cost-effective and user-friendly processors, along with a VS Code development environment that integrates git usage into the class. Dr. McNeill has expressed a desire to incorporate git into the class, but the current development environment presents challenges in doing so. Moreover, this research aims to build a library of working materials that Dr. McNeill can utilize in teaching an Embedded Machine Learning course. Following the achievement of these fundamental goals, we plan to start researching ways of detecting illegal drones crossing the USA/Mexico border, using cheap microcontrollers for the acoustic side of detection, which aligns with our ongoing development efforts. We also aim to use connections from the industrial sector, where there is interest in using embedded machine learning to monitor machine health. In summary, this project seeks to address research, industrial, and educational objectives.

IGNITE AWARD



ECLIPSE BALLOON PROJECT- SINYELLA

Mackenzie Shughart, Mechanical Engineering

MENTORS

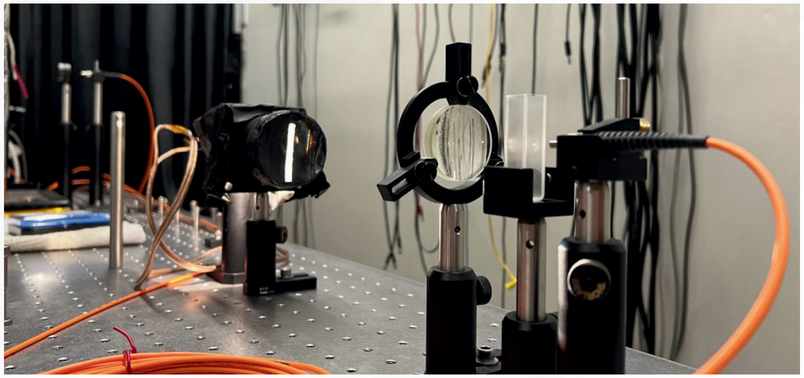
Kathryn Wesson, Applied Aviation Science
Yabin Liao, Aerospace Engineering
Seth McNeill, Computer, Electrical, and Software Engineering

The Nationwide Eclipse Ballooning Project (NEBP) is a scientific initiative that aims to capture valuable data and images during eclipses. Equipped with advanced sensors and cameras, the project's payload is capable of capturing atmospheric levels of ultraviolet and visible light intensity during eclipses, providing valuable insights into the impact of these events on the atmosphere. The payload includes an array of sensors, such as an acceleration, angular velocity, magnetic field, absolute orientation, positioning, temperature, pressure, altitude, ambient light, and UV light sensors. Additionally, cameras equipped with no filter and an infrared filter will capture visual data during eclipses. The captured images will offer valuable insights into the physics of eclipses and help researchers better understand their impact on the atmosphere.

To analyze the data collected during eclipse events, the NEBP project team plans to use the Model-Based Systems Engineering (MBSE) discipline, which will allow them to identify patterns and trends more efficiently and provide additional insights into the impact of eclipses on the planet's atmosphere. Finally, a micro SD card mount will be utilized for storing the collected data, enabling researchers to analyze the data at a later time. Overall, the NEBP project is an exciting scientific initiative that has the potential to provide a better understanding of the impact of eclipses on the planet's atmosphere.

To ensure the successful capture and analysis of data during the upcoming eclipse events, the NEBP project team will conduct ground and flight testing. These testings will help the team refine and optimize the equipment and procedures for capturing and analyzing valuable insights into the impact of eclipses on the atmosphere.

SPACE GRANT AWARD



BATHYMETRIC LIDAR: INVESTIGATION OF OPTIMAL VISIBLE LIGHT FOR NON-IDEAL AQUATIC ENVIRONMENTS

Zachary Traynor, Electrical Engineering
Breck Meagher, Space Physics

MENTORS

John Pavlina, Computer, Electrical & Software Engineering
Parker Landon, Physics, Boston University

The purity of water is a critical factor in various industrial applications, including Bathymetric LiDAR. Bathymetric LiDAR depends on the transmission and reception of laser beams through water to capture underwater topography. The water quality can affect the performance of LiDAR systems, as the impurities and suspended particles lead to light attenuation and scattering, impacting the accuracy and detail of the data.

This project's objective is to investigate the relationship between water purity and its effects on visible light spectrum lasers, focusing on light attenuation and scattering methods and quantitatively identify the optimal type of visible light laser for Bathymetric LiDAR applications for different types of suspended particles in impure water. Accurate and detailed underwater mapping relates to fields in defense, security, and space exploration. This includes, but is not limited to: submarine navigation, harbor security, and even moon subsurface water exploration and mapping. By analyzing impure water on laser performance, we can enhance the accuracy and reliability of LiDAR systems in complex settings and contribute to stronger security and new pathways of space exploration.

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ERP FENCE MONITORING PROJECT

George Waldron, Software Engineering - Cyber-Security
Kestrel Carlough, Cyber-Security

MENTORS

Luis Felipe Zapata-Rivera, Computer, Electrical, and Software Engineering
Catalina Aranzazu-Suescun, Cyber-Security

In Africa, the poaching of elephants and rhinos is an ongoing issue. ERP (Elephants, Rhinos, and People) organization is collaborating with Embry Riddle Aeronautical University to develop a fence monitoring prototype. Our ERP fence monitoring project purpose is to create a fence monitoring system to detect poacher intrusions to protect the animals. This iteration of the project has the goal of improving the detection system proposed by the ERP capstone group from 2023 by lowering the cost, improving performance and power consumption. The project's expected outcome is to detect a poacher near reserves in South Africa with at least 75% confidence, with nodes that can operate with battery for long periods of time.

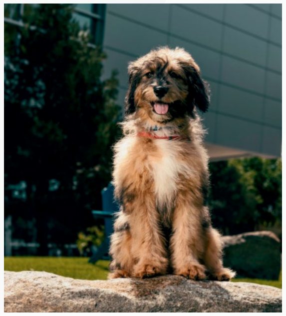
Our proposal is to place low-cost sensor nodes along the fence to detect humans near the fence. We will also detect disruptions to the fence using an accelerometer and a microphone. Based on the events detection the node will notify the central node to alert for the presence of poachers.
Two breadboard prototypes are in the process of development to test out node design. The ESP32C3 development boards, the accelerometer sensor LIS3DH, and a microphone MAX4466 are used as the main components of the nodes. In parallel we are developing software for collecting and analyzing data and for the message’s transmission. The nodes developed will be integrated in a sensor network with a hybrid network topology.

We are co-authoring a paper titled “Sensor fusion with multi-modal ground sensor network for endangered animal protection in large areas” in collaboration with California State University-Chico. The paper is being published at the SPIE Defense + Commercial Sensing Conference in April.

Upcoming steps include:

- Creation of printed circuit board PCBs with just the required components to develop the custom nodes
- Integration of the audio detection functionality using a microphone
- Implementation of sensor fusion based of threshold detection

IGNITE AWARD



ASSESSING THE VIABILITY OF A FACILITY DOG IN HIGHER EDUCATION TO REDUCE STRESS AND IMPROVE MENTAL HEALTH

Michael Zabriskie, Aeronautics
Skylar Ramos, Aeronuatcis

MENTOR

Stacey McIntire, Aeronautical Science

This research study investigates the impact of a facility dog on the mental health and stress levels of college students in a higher education setting. College is a pivotal yet challenging time for many students, marked by significant transitions and increased susceptibility to mental health issues. With mental health disorders predominantly surfacing between the ages of 18-24, a demographic that coincides with the typical college age, higher education institutions are facing a mental health crisis. In response, some have begun integrating therapy and facility dogs into their campuses to provide therapeutic support. A facility dog, distinct from a therapy dog, operates within a single setting, offering continuous therapeutic services. This study focuses on one higher education institution’s facility dog and its effect on students' mental health. Through a two-phase data collection process involving 20 participants, the study employs pre-surveys, the Coleman Dog Attitude Scale (C-DAS), the State-Trait Anxiety Inventory State (STAIS-5), and Trait (STAIT-5) measures, along with biometric data collected via Whoops® bands. Participants will engage in regular contact with Higbee, with their anxiety levels and biometric data monitored before and after interaction periods. The study aims to correlate students' perceptions of and actual biometric responses to regular contact with a facility dog, providing insights into the potential mental health benefits of such interventions in higher education settings.

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COLD CASE UNITS: THE BEST PRACTICES FOR AGENCIES

Alena Zeni, Global Security and Intelligence Studies

MENTOR

Steven Hooper, Global Security

The US Department of Justice reported a statistic from the FBI Uniform Crime Report that estimated in 2017, only 62% of murders and 35% of sexual assaults were able to be solved. They also reported that experts looking at the data estimate that our country has 250,000 unsolved murders, increasing by 6,000 a year. With that estimate, in 2023, there are at least 286,000 unsolved murders in the US. The Department of Justice also cited a case of the Metropolitan Police in the District of Columbia, who, in 2017, had 170 solved cold cases solved after only 5 years of having a designated squad, showing that allocating resources to this cause produces results. The National Institute of Justice states that, “Experience has shown that cold case programs can solve a substantial number of violent crime cold cases, including homicides and sexual assaults.” Despite this, only 7% of agencies have designated units at time of publishing. In a list of recommendations from NIJ about creating and maintaining a cold case unit, they list 23 items for agencies to consider. The goal of this research is to look into agencies with cold case units to see what solutions have worked for them and what agencies might be able to do in order to further successful units. We will also be looking at case studies to compare outcomes and make recommendations.

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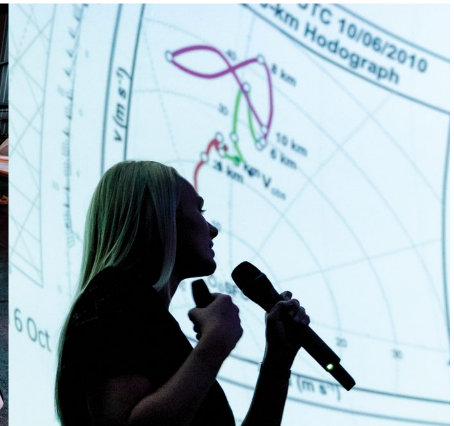

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