UNDERGRADUATE RESEARCH INSTITUTE

DISCOVERY 2023

RESEARCH ABSTRACTS

EMBRY-RIDDLE
Aeronautical University

URI DISCOVERY
SCHEDULE OF EVENTS

FRIDAY, MARCH 31, 2023

Parents and Family Reception and Poster Session
Eagle Gym | 7:00 - 9:00 p.m.

SATURDAY, APRIL 1, 2023

URI Oral Presentations

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

ACADEMIC PROGRAM MEETINGS

College of Engineering
Activity Center | 9:45 - 11:00 a.m.

College of Aviation
Davis Learning Center | 9:45 - 11:00 a.m.

College of Arts and Sciences
Eagle Gym | 9:45 - 11:00 a.m.

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

URI Discovery Short Oral Presentations Linked to Star Faculty Showcase

Academic Complex Room 104 | 12:30 - 2:00 p.m.

ANETTE M. KARLSSON, PH.D.

Chancellor

Embry-Riddle
Aeronautical University
Prescott Campus

WELCOME

TO UNDERGRADUATE RESEARCH INSTITUTE (URI) DISCOVERY 2023

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 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 2023 events. During the 2022-2023 academic year, the Undergraduate Research Institute was able to award over 40 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 range from one on tube launched UAVs, to ones on fostering equity in engineering and bed bug control. Eagle Prize teams will compete or have already competed in regional and national competitions including the AIAA Design-Build-Fly, Dollar Per Foot Competition and VEX Robotics. In addition, a team of students from our Cyber Intelligence and Security Department developed and implemented an aviation-themed cyber challenge for regional high school students. 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

ANNE BOETTCHER

Assistant Dean of Research

UNDERGRADUATE RESEARCH INSTITUTE

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Katherine Wood, Business School

Luis Felipe Zapata Rivera, Electrical, Computer and Software Engineering

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Hunter Watson, JSX

Jolly Kapoor, American Airlines

Karolina Bergman, True Meridian

Nicole Chanes, Blue Origin

Sophia Schwalbe, United States Air Force

A SPECIAL NOTE OF THANKS TO ALL OF OUR MENTORS!

INVITED ORAL PRESENTATIONS

SATURDAY, 1 APRIL 2023

PREVIEW DAY WELCOME: AMANDA ZHU

Aviation Business Administration, College of Business, Security and Intelligence
Activity Center | 9:00 - 9:30 a.m.

ACADEMIC PROGRAM MEETINGS

COLLEGE OF ENGINEERING

Conor Smith and Peter Kavounas
Aerospace Engineering, College of Engineering
Activity Center | 9:45 - 11:00 a.m.

COLLEGE OF AVIATION

Simon Zemana and Eduardo Long Valenz
Aeronautics, College of Aviation
Davis Learning Center | 9:45 - 11:00 a.m.

COLLEGE OF BUSINESS, SECURITY AND INTELLIGENCE

Stephanie Way
Global Business and Supply Chain Management College of Business, Security and Intelligence
The Hangar | 9:45 - 11:00 a.m.

URI DISCOVERY POSTERS

FRIDAY, MARCH 31, 2023

Eagle Gym | 7:00 - 9:00 p.m.

1. **AIAA Design Build Fly**
   Kyle Abbas, Matthew Marandola, Lynn Parker, William Ryan, Luke Rondeau, Nick Barrick and Cody Vandenbosch
   Mentors: Johann Dorfling and Joseph Smith

2. **Launch UAV - A Tube Launched Capstone Project**
   Cameron Avent, Michael Finigian, Ian Ho, Andrew Hopwood, Peter Kavounas, Brandon Ragasa, Conor Smith and Adam Witusik
   Mentors: Brian Roth and Richard Mangum

3. **Probing the Multiplicity of Dusty Wolf-Rayet Stars with Multi-Wavelength Techniques***
   Hailey Beier and Kaitlyn Casciotti
   Mentors: Noel Richardson and Pragati Prahan

4. **Cygnus Suborbital investigation of Total Momentum Ratio**
   Benjamin Black and Zoe Brand
   Mentors: Daniel White

5. **Subaqueous LiDAR**
   Jacob Block, Kyler Castro, Ela Ozatay and Joshua Varghese
   Mentor: Matt Pavlina

6. **The VEX Robotics Club at Embry Riddle Aeronautical University, 2022 - 2023 Competition Season**
   Talise Brown, Piper Forcier, Kelly Hoffman and Francisco Zuniga
   Mentor: Joel Schipper

7. **Prescott Observation Team for Analyzing Telescopically Observed Spectra***
   Kaitlyn Casciotti, Hailey Beier, Marina Beltran, Bradley Rudy, Samantha Garcia Flores, Clarissa Pavao and Tri Phan
   Mentor: Noel Richardson

8. **Testing and Construction of a Short-Arm Interferometer and Low Frequency Prototype of Laser Interferometer Suspensions for Gravitational Wave Detection**
   Logan Caudle and Brandon Pillon
   Mentor: Michele Zanolin

Note: * indicates poster will be at the Observatory as part of the Astronomical Observatory Viewing Session

9. **The Impact of Taiwanese Semiconductor Production Policy on Global Economy and Foreign Relations**
   John Conrod, Deep Ganguly and Sebastien Bragg
   Mentor: Hong Zhan

10. **Eagle Space Flight Team Spaceshot-1**
    Dominyck Darlington, Chris Worrell, Benjamin Malone, Max Martin and Adrien Hobelman
    Mentors: Daniel White, Luis Felipe Zapata Rivera, Lestari Wahyu, Kathy Wood, Neil Sullivan and Andy Gerrick

11. **The Feasibility Hybrid 2-Stroke Piston and Turbine Engine to Improve Efficiency and Emissions**
    Lukus Debevec
    Mentor: Daniel White

12. **Identification of Fire-Retardant Chemicals via Instrumental Analysis**
    Caitlin Dillon, Lily Davis, Amaya Harper and Tianna Torrice
    Mentor: Rachael Schmidt

13. **Investigation of Stress Concentrations in Parts Manufactured with Fused Deposition Modeling**
    Hope Elmer and Alexandre Lasalarie
    Mentor: David Lanning

14. **Fundamental Research Startup Efforts Exploring the Validity of FlightStream**
    Joshua Filby and James Morris
    Mentor: Shigeo Hayashibara

15. **Lunar Power: Radioisotope Thermoelectric Generator**
    Logan Hiland, Noelle Kartvedt and Kartherine Rolle
    Mentor: Karl Heine

16. **The Spectroscopic and Visual Orbit of the Nitrogen-rich Massive Binary WR 138***
    Amanda Holdsworth
    Mentor: Noel Richardson

17. **Optimization and Application of a Gurney Flap for Production Cars**
    Aditya Hoskere and Sidthra Op
    Mentor: Lance Traub

18. **The Application and Optimization of a Morphing Airfoil Wing for Lightweight Aircraft**
    Aditya Hoskere and Sidthra Op

19. **Long-Distance Video and Telemetry Streaming**
    Zachary Howe and Somaralyz Grullon
    Mentor: Yabin Lao

20. **Semi-Autonomous Wheelless Robot Design for Small Celestial Body Exploration**
    Alexandre Lasalarie, Erika McSheehy, Estevan Flores, James Bass, Sheena Lean Espiritu, Zhenchuan Yan, Creighton Llopis, Alison Olivas, Carlie Zinder and Tyler Kwapniowski
    Mentor: Davide Conte and Richard Mangum

21. **Probing the Variability of the Supergiant Star Deneb***
    Teagan Laws
    Mentor: Noel Richardson

22. **A Multi-Wavelength Analysis of the Closest Colliding-Wind Binary: γ2 Velorum***
    Randy Loberger and Tri Phan
    Mentors: Noel Richardson and Pragati Pradhan

23. **Hydrogen - Oxygen Combustion for Medium Range Jet Engines**
    Joshua McBeth
    Mentor: Elliott Bryner

24. **Characterization of Oval Defects in Crystalline Optical Coatings**
    Breck Meagher
    Mentor: Ellie Gretarsson

25. **A Time-Frequency analysis of chirps in Gravitational Wave data**
    Jaxson Mitchell
    Mentor: Cameron Williams

26. **Centrifugal Nuclear Thermal Rocketry**
    Shannon Moore
    Mentors: Darrel Smith and Hayden West

27. **Classifying Quantum Adjacency Matrices**
    Hailey Murray, Isaiah Joy, Eric Babcock and Aiden Askew
    Mentors: Lara Ismert and Mitch Hamidi

28. **The Embry Riddle Suborbital Reusable Vehicle (ERAUSRV): Getting to Space Cheaper and More Often**
    Gaurav Nene, Cooper Eastwood, William Knoblauch and David Hadley
    Mentor: Andy Gerrick

29. **Development of Practical Earth-Mars Cycler Trajectories**
    Kyle Newlin
    Mentor: David Conte

Note: * indicates poster will be at the Observatory as part of the Astronomical Observatory Viewing Session

30. **CyberAero’23 Competition**
    Hannah Ohm, William Noujaim and Abigail Geiger
    Mentor: Krishna Sampigethaya

31. **Eagle Aero Sport**
    Eden Pfanner and Keelan Garde
    Mentor: Seth McNeill

32. **Controlled Rocket Landing System**
    Matthew Prescavage, Alexandre Lasalarie and Conner Thomas
    Mentor: Bradley Wall

33. **The Impact of Physically Motivated Calibration Errors on Search Pipeline Detection Parameters for Broadband Burst Signals**
    Alexee Providence
    Mentor: Michele Zanolin

34. **Engineering and Project Manager Collaboration Expands Virtual Learning**
    Rachel Reinsch and Emma Sanders
    Mentors: Heather Marriott and Reginald Parker

35. **SAE AeroDesign - Eaglenautics**
    Ty Rice and Patrick Bogan
    Mentor: Shigeo Hayashibara

36. **Design and Simulation of an Electromagnetic Railgun for High Velocity Impact Testing**
    Josiah Rodriguez, Rahm Bodick and Gianni Dragos
    Mentor: John Sevic

37. **Determining Optimal Harborage Crack Size for Bed Bugs**
    Monica Saenz, Lauren Hernandez and Kaita Hayashibara
    Mentor: Corraine McNeill

38. **X-Ray Binaries as Flashlights to Map the Universe through Stellar Wind Studies***
    Tristen Sextro and Calvin Sam
    Mentor: Pragati Pradhan

39. **New Short-Range Tests of Gravity**
    Janessa Slone and Jennifer James
    Mentor: Quentin Bailey

40. **Cygnus Suborbitals’ Flight Vehicle “Deneb”**
    Dalton Songer, Ben Black, Zoe Brand, Dawson Damish, Tom de Vries, Kyle Dutcher, Charles Flaherty, Duncan Shour and Jared Walker
    Mentor: Daniel White

41. **Precisions Measurements of Direction of Arrival and Graviton Effects from Gravitational Wave Bursts**
Zoe Spangler and Charles Wszalek
Mentor: Michele Zanolin

42. **What Drives the Variability in Luminous Blue Variables***
Becca Spejcher and Marina Beltran
Mentor: Noel Richardson

43. **Sensitivity of North American Monsoon Convective Precipitation Flooding in Arizona to the Atmospheric Boundary Layer and Circulation**
Brooke Sullivan
Mentor: Dorothea Ivanova

44. **Effects of Infrastructure on Collaboration in Classrooms**
Trey Talko, Alexia Richmond, Gabriel Novak and Angeline Masongsong
Mentor: Hadi Ali, Ashley Rea, Jonathan Adams

45. **G-Load Tester for Rocketry Avionics**
Jordon Wallen, Chase Thompson, Megan Montaño, Madison Rice and Tiffany Shattler
Mentor: Andy Gerrick

46. **Analysis and Breakdown of Organized Retail Crime: Trends, Methods, and Combating it**
Stephanie Way and Nicholas Van Vliet
Mentor: Allan Saquella

47. **EagleSat 2**
Hayden West, Calvin Henggeler, Hayden Roszell, Tyler Therman and Lillian Sudkamp
Mentor: Ahmed Sulyman and Kathy Wood

48. **Optimal Fabric Preference for Bed Bugs**
Raelyn Yoshioka
Mentor: Corraine McNeill

49. **The Effectiveness of Using Air Traffic Control (ATC) Lab to Increase Non-native English- Speaking Student Pilot's ATC Radio Communication Proficiency**
Zihui (Amanda) Zhu and Shen-Chi (Daniel) Chiu
Mentors: Stacey McIntire and Kyle Wilkerson

Note: * indicates poster will be at the Observatory as part of the Astronomical Observatory Viewing Session

URI DISCOVERY ORAL PRESENTATIONS

SATURDAY, APRIL 1, 2023

Academic Complex 1, Bldg. 74 Room 104 | 12:30-2:00 p.m.

Note: These presentations will be interspersed with the Star Showcase Presentations by Faculty

1. **AIAA Design Build Fly**
   Kyle Abbas, Matthew Marandola, Lynn Parker, William Ryan, Luke Rondeau, Nick Barrick and Cody Vandenbosch
   Mentors: Johann Dorfling and Joseph Smith

2. **Cygnus Suborbitals' Flight Vehicle "Deneb"**
   Benjamin Black, Zoe Brand, Dalton Songer, Dawson Damish, Tom de Vries, Kyle Dutcher, Charles Flaherty, Duncan Shour and Jared Walker
   Mentors: Daniel White

3. **Data Acquisition Semi-Autonomous Human Interaction Rover (DASHIR)**
   Jacob Brennan, David Calle, Jordan Dabney, Daniel DeSessa, Riley Espinosa, Sarrena Johnson, Nikolas King, Matthew Prescavage, Andrew Purkeypile and Thomas Sigdestad
   Mentors: Davide Conte and Richard Mangum

4. **Using Artificial Intelligence Imaging Systems to Detect Signs of Genocide from Low Earth Orbit**
   Karan Gaglani, Vishwas Tanguria, Max Martin, Ana Bader-Elenes, Blake Evans, Ryan Kendrick, Jonathan Mercado, Dylan Mires, Jeremy Nicholson and Vince Tran
   Mentors: Davide Conte, Richard Mangum and Erika Podest

5. **Convective Climatology for Southwestern United States**
   Greta Graeler
   Mentors: Curtis James, Mark Sinclair, Carter Humphreys, Ronny Schroede and Jay Park

6. **Coherent CAPTAIN-Mills**
   Zoe Morawek, Clarissa Pavao and Zachary Herzog
   Mentors: Darrel Smith

7. **Proximity Operation Maneuvers at Asteroidal Deep Space In-Situ Resource Utilization Stations**
   Andrew Purkeypile
   Mentors: Davide Conte

8. **Fostering Educational Equity in Engineering**
   Katrina Robertson
   Mentors: Ashley Rea, Jonathan Adams and Hadi Ali
9. **Project Anubis: Cold Gas Attitude Control System**
   Zachary Sadaghiani, William Surh, Evan Grilley, Karan Gaglani, Noah Peterson, Paul Brich, Bruce Noble, Jamison Pointdexter, Matthew Fagen, Ambar Das, Brendan King and Parker Scribner
   Mentors: Scott Post and Stephen Bruder
10. **Performing Pugachev's Cobra Maneuver with a Quadcopter**
   Adam Shapiro and Kammi Matsumoto
   Mentors: Ken Bordignon and Stacey McIntire
11. **Effects of Infrastructure on Collaboration in Classrooms**
   Trey Talko, Angeline Masongsong, Alexia Richmond, Gabriel Novak and Eli Martin
   Mentors: Hadi Ali, Ashley Rea and Jonathan Adams

AIAA DESIGN BUILD FLY COPPER TAILS

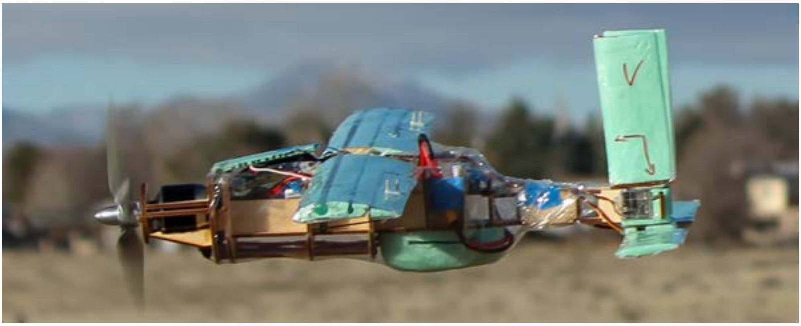
Kyle Abbas, Aerospace Engineering
Matthew Marandola, Aerospace Engineering
Lynn Parker, Aerospace Engineering
William Ryan, Aerospace Engineering
Luke Rondeau, Aerospace Engineering
Nick Barrick, Aerospace Engineering
Cody Vandenbosch, Aerospace Engineering

MENTORS

Johann Dorfling, Aerospace Engineering
Joseph Smith, Aerospace Engineering

The Design Build Fly team is a student-led organization on campus that competes in an annual competition hosted by the American Institute for Aeronautics and Astronautics (AIAA). Each year the team is tasked to develop an unmanned aerial vehicle (UAV) to achieve the mission given by AIAA. This year we are creating a UAV that would be capable of performing electronic warfare. The UAV must also be able to fit inside standard airline luggage dimensions with two sets of wings. There are four separate missions that the UAV must prove proficiency. First is proof of flight, we need to fly three laps of a flight course. Second, we need to carry a simulated electronic payload. In the final flight mission, we will fly with a simulated jamming antenna sticking vertically from the wing tip. This mission has created some odd drag characteristics at low speeds. The final mission is a ground mission in which the aircraft is loaded while supported at the wing tips. Our team typically goes through a rapid iterative design process, however, this year we have been more methodical in the initial design process. This has resulted in an excellent aerodynamic model. This has pushed us from planning on developing five aircraft to three (Aero, Integrated and Final). Our team is getting consecutively better with each year thanks to generational knowledge. This is allowing us to maintain the top 10 for the past two years.

COE PHILANTHROPY COUNCIL AWARD AND EAGLE PRIZE AWARD



LAUNCH UAV - A TUBE LAUNCHED CAPSTONE PROJECT

Cameron Avent, Aerospace Engineering, Aero, **Michael Finigian,** Aerospace Engineering, Aero, **Ian Ho,** Aerospace Engineering, Aero, **Andrew Hopwood,** Aerospace Engineering, Aero, **Peter Kavounas,** Aerospace Engineering, Aero **Brandon Ragasa,** Aerospace Engineering, Aero, **Conor Smith,** Aerospace Engineering – Aero, **Adam Witusik,** Aerospace Engineering, Aero

MENTORS

Brian Roth, College of Engineering Department
Richard Mangum, Humanities and Communication Department

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 this UAV 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

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

Hailey Beier, Astronomy
Kaitlyn Casciotti, Astronomy

MENTORS

Noel Richardson, Physics and Astronomy
Pragati Prahan, Physics and Astronomy

Wolf-Rayet (WR) stars represent a late-stage of evolution for massive stars. They have lost their outer hydrogen envelopes and have high mass-loss rates. Some of these stars are carbon-rich and have large infrared fluxes, which arise from dust surrounding the star. Dust should form in cold, dense conditions, but the stars' temperatures and their winds exceed 40,000K. There are different ideas about how dust is created in these systems, so we will be examining observations of all the Galactic dust-producing systems to determine the conditions under which dust can form - namely, does the dust production require a binary companion? It is not yet known if WRs could produce dust independently, but some dusty WR stars have appeared single in studies thus far.

It is thought that binary star interactions, where the O star strips the hydrogen envelope off the WC-star progenitor, could have formed these systems in the early Universe. If so, there could be a channel to create dust and new stars in the early universe before the first generation of stars exploded in supernovae. We are currently exploring the Swift/XRT archive to select observations with high enough S/N ratio for meaningful spectral analysis. We also plan to include the available infrared spectrum of the sources and begin comparison to see if binary is a primary driver for these processes and determine possible ways of creating dust.

IGNITE AWARD

SUBAQUEOUS LIDAR

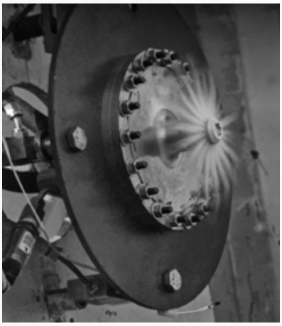
Jacob Block, Aerospace Engineering
Kyler Castro, Aerospace Engineering
Ela Ozatay, Aerospace Engineering
Joshua Varghese, Aerospace Engineering

MENTOR

Matt Pavlina, Electrical, Computer, and Software Engineering

Over the last 50 years, LiDAR has proven to be a potent tool for navigation not just on land, but in the sky, and famously in space on the Apollo 15 mission. Just over 10 years ago, a 3D LiDAR sensor would have cost around $75,000. Now, it is possible to find these sensors in most people's smartphones. With LiDAR sensors dropping in price, it is more practical for them to be used in lower cost implementations. One such implementation attempted by student researchers at Embry-Riddle was on an autonomous sailboat. We identified LiDAR to be the lowest cost method for obstacle detection. The use of SONAR is discouraged and restricted by governments, and what few sensors do exist are difficult to implement and cannot provide high-resolution view of the surrounding environment. However, the only place where LiDAR has yet to be widely adopted is underwater, where many complications restrict its efficacy. These complications include water being difficult for light to penetrate, limited options for waterproof LiDAR sensors, and no easy way to mount the system. Our team hopes to solve these problem by developing a LiDAR system that allows the sensor to gather data underwater and process it in real time. Accomplishing this in an affordable package will push marine research forward aiding other studies in implementing such a system.

IGNITE AWARD



INVESTIGATION OF TOTAL MOMENTUM RATIO

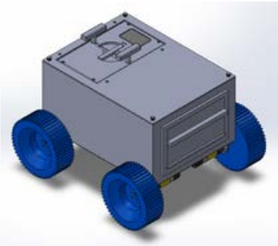
Zoe Brand, Mechanical Engineering

MENTOR

Daniel White, Mechanical Engineering

The goal of this project is to analyze the effect of total momentum ratio (TMR) on combustion performance for a pintle type injector. TMR is a parameter that can be used to characterize combustion stability and the kinematics of propellant combinations. Analyzing the TMR will help in the comprehension of how the engine is combusting propellant and if it is combustion as designed. Being able to study the effect of changing TMR will help understand if industry standard "rules of thumb" apply to our engine. Currently, a concern is that the engine is not mixing and combusting propellant efficiently enough to meet flight profile parameters. The goal set by the Mountain Spirit program dictates the engine will produce 1759lbf for 20 seconds of burn duration to get the rocket to 150,000ft. To meet these requirements, there needs to be a more comprehensive study into propellant mixing and combustion performance.

SPACE GRANT RESEARCH INFRASTRUCTURE AND IGNITE AWARD



DATA ACQUISITION SEMI-AUTONOMOUS HUMAN INTERACTION ROVER (DASHIR)

Jacob Brennan, Aerospace Engineering
David Calle, Aerospace Engineering
Jordan Dabney, Aerospace Engineering
Daniel DeSessa, Aerospace Engineering
Riley Espinosa, Aerospace Engineering
Sarrena Johnson, Aerospace Engineering
Nikolas King, Aerospace Engineering
Matthew Prescavage, Aerospace Engineering
Andrew Purkeypile, Aerospace Engineering
Thomas Sigdestad, Aerospace Engineering

MENTORS

Davide Conte, Aerospace Engineering
Richard Mangum, Humanities and Communication

Rovers have proven to be essential assets for space exploration because they accomplish tasks needed for scientific research. They also have the potential to directly aid astronauts on crewed missions. Data Acquisition Semi-Autonomous Human Interaction Rover (DASHIR) is a rover designed to aid in future crewed missions to the Moon and beyond by assisting in sample collection, equipment transportation, terrain navigation, data storage, and other commands given by the astronaut crew. DASHIR could potentially be used as a surface asset for NASA's Artemis program, launching on the Space Launch System (SLS), communicating with the planned Lunar Gateway, and assisting future astronauts stationed on Lunar bases. By performing some of the astronauts' tasks, DASHIR will allow the crew to optimize their time and conduct more scientific research. DASHIR will also mitigate risk by reducing the number of EVAs required by astronauts by completing many of their physical tasks, which will reduce the risk of injury and fatality throughout the duration of their mission. The DASHIR design is inspired by NASA's Perseverance and the Dune All-Terrain Rover developed by the University of Salento in Lecce, Italy.

THE VEX ROBOTICS CLUB AT EMBRY RIDDLE AERONAUTICAL UNIVERSITY, 2022 - 2023 COMPETITION SEASON

Talise Brown, Mechanical Engineering
Piper Forcier, Safety Science
Kelly Hoffman, Aerospace Engineering
Francisco Zuniga, Aerospace Engineering

MENTOR

Joel Schipper, Electrical and Software Engineering

VEX U is a competition hosted by the REC Foundation that allows university students to get engaged in hands-on engineering. Each year, teams are provided with a new competition, for which they need to design, build, and program robots specifically suited for. Between seasons, only the base field and robot size constraints remain consistent. Students compete in regional competitions in order to qualify for the World Championship Competition, which is the highest competition a team can compete in for VEX U. Competing allows students to gain engineering experience, networking opportunities, and competition experience.

The leadership structure of the club includes the president, vice president/treasurer, robot team leads, and build and programming leads.

EAGLE PRIZE AWARD

PRESCOTT OBSERVATION TEAM FOR ANALYZING TELESCOPICALLY OBSERVED SPECTRA

Kaitlyn Casciotti, Astronomy
Hailey Beier, Astronomy
Marina Beltran, Astronomy
Bradley Rudy, Unmanned Aerial Systems
Samantha Garcia Flores, Space Physics
Clarissa Pavao, Space Physics
Tri Phan, Astronomy

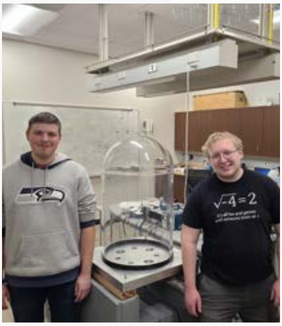
MENTOR

Noel Richardson, Physics and Astronomy

The Prescott Observation Team for Analyzing Telescopically Observed Spectra (POTATOS) has created a team of observers to utilize the campus observatory. POTATOS has recruited freshman and sophomores as volunteer members of the team who are learning to operate the telescope and reduce the data they collect. By teaching these skills earlier in their college careers, the students will be better prepared for creating and working on their own research projects in the upcoming years.

Over the course of the year, POTATOS has put together an operating manual for new observers to reference while observing. This, along with one on one instruction from certified members has allowed the team to get familiar with the telescope operating and safety procedure. POTATOS has observed about five massive binary systems. The team has created a software to calculate the orbital period of each system in order to determine how frequently to look at each system. By measuring the orbits of each O star binary system, we will be able to determine stellar parameters including radii, temperature, and masses.

IGNITE AWARD



TESTING AND CONSTRUCTION OF A SHORT-ARM INTERFEROMETER AND LOW FREQUENCY PROTOTYPE OF LASER INTERFEROMETER SUSPENSIONS FOR GRAVITATIONAL WAVE DETECTION

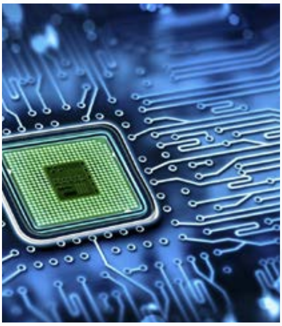
Logan Caudle, Space Physics
Brandon Pillon, Space Physics

MENTOR

Michele Zanolin, Physics and Astronomy

Our project is designed to understand the concepts needed for space based low frequency (1-10 Hz) gravitational wave astronomy. The first objective is a feasibility analysis for a small arm-length interferometer for the proposed use in a 3U class CubeSat. As such, determining the configuration and the components used will be the primary deliverable. Given the available resources and funding, a functional model of the interferometer is to be constructed in the optics lab to serve as a test bed and be used as a learning tool. Additional outcomes include the development of deployment mechanisms for in-orbit operations. Hence, the study will provide the necessary foundation to allow the ease of implementation of such a payload for a 3U class CubeSat. The second 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 design and potentially build a detector that is solely focused on the low-frequency range. Another aspect of this project will be to build a functional representation of the LIGO (Laser Interferometer Gravitational wave Observatory) 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



THE IMPACT OF TAIWANESE SEMICONDUCTOR PRODUCTION POLICY ON GLOBAL ECONOMY AND FOREIGN RELATIONS

John Conrod, Global Security and Intelligence Studies
Deep Ganguly, Global Security and Intelligence Studies
Sebastien Bragg, Global Security and Intelligence Studies

MENTOR

Hong Zhan, Global Security and Intelligence Studies

Advanced semiconductors are essential to commercial and military technologies worldwide. Taiwan Semiconductor Manufacturing Company (TSMC) accounts for 90% of the world's chip production. However, the supply chains that Taiwan uses for its chip industry are experiencing many types of threats. These threats include Chinese aggression like blockades and poaching, COVID-19 economic impacts, and a shortage of raw materials like germanium and silicon. Taiwan realizes the gravity of these threats and already has some policies in place to combat them. Taiwan must still work with its international partners to secure and grow these advanced semiconductor supply chains. Taiwan is in limbo between the U.S. and China and must cooperate with both superpowers to preserve its industry. This project will focus on the current and future policies that Taiwan will use to protect its supply chains and their global impact. The world relies on Taiwan for advanced semiconductors, so even a minor policy change could have ripple effects worldwide. Understanding the implications of these policies will better allow the U.S. to collaborate with Taiwan to expand and protect these supply chains by addressing these threats together. This will be done by establishing threats and current policies. Taiwan can also collaborate with the U.S. government, companies, and the military in the future to sustain the advanced semiconductor industry.

IGNITE AWARD

EAGLE SPACE FLIGHT TEAM SPACESHOT-1

Dominyck Darlington, Mechanical Engineering and Space Physics
Chris Worrell, Aerospace Engineering
Benjamin Malone, Aerospace Engineering
Max Martin, Aerospace Engineering
Adrien Hobelman, Aerospace Engineering

MENTORS

Daniel White, Mechanical Engineering
Luis Felipe Zapata Rivera, Computer, Electrical, and Software Engineering
Lestari Wahyu, Aerospace Engineering
Kathy Wood, School of Business
Neil Sullivan, Mechanical Engineering
Andy Gerrick, Mechanical Engineering

The first mission, termed SpaceShot-1, is to successfully fly a student-designed-and-built launch vehicle, with a payload, past the Kármán line. The Kármán line, marked at an altitude of 100 kilometers above Earth's mean equator, represents the internationally recognized boundary between Earth's atmosphere and space, denoting it as the benchmark an object must pass in order to be commonly accepted as having reached space. The members of the ESFT should be undergraduate students who are enrolled at Embry-Riddle Aeronautical University (ERAU) and who are assisted and advised by professors and industry professionals to ensure safety and mission success.

ESFT will design and build an 8-inch diameter solid propellant motor that is roughly 9 feet in length, a 6-inch diameter aeroshell, nose cone, fins, a recover system consisting of a marmon clamp release for parachute and drogue chute, and avionics system capable of tracking the rocket to the Karman Line.

The long-term goal of the ESFT is to provide ERAU with a suborbital launch vehicle on which experimental and research payloads can be reliably flown at low cost compared to current flight opportunities.

IGNITE AWARD AND COE PHILANTHROPY COUNCIL AWARD

THE FEASIBILITY HYBRID 2-STROKE PISTON AND TURBINE ENGINE TO IMPROVE EFFICIENCY AND EMISSIONS

Lukus Debevec, Aerospace Engineer

MENTOR

Daniel White, Mechanical Engineering

2-Stroke engines normally run dirty and exhaust a significant amount of unburnt gas, which is Typically addressed by specially designed exhaust systems. These redirect the pulses of the engine back into the combustion chamber to push some of the unburnt fuel back into the engine. But this only fixes the problem for a narrow range of the 2-stroke's operation. Our solution would instead remedy the natural inefficiency of a 2-stroke engine by igniting the unburnt fuel in a second combustion chamber which would then power a turbo-compressor on the 2-stroke engine. This would theoretically allow the 2-stroke engine to be much more efficient for its entire operating range. Which would make it more power dense, while also reducing the emissions of the engine.

EAGLE PRIZE AWARD

IDENTIFICATION OF FIRE-RETARDANT CHEMICALS VIA INSTRUMENTAL ANALYSIS

Caitlin Dillon, Forensic Biology
Lily Davis, Forensic Biology
Amaya Harper, Forensic Biology
Tianna Torrice, Forensic Biology

MENTOR
Rachael Schmidt, Biology and Chemistry

Fiber trace evidence is one of the most common forms of evidence found at a crimes Scene; these evidentiary items often have unique flame retardant chemical compositions or volatile chemical signatures. The retardant compounds on fiber samples can be used as an additional piece of evidence to trace a fiber from a victim to a source sample. In order to extract these chemical signatures, the following research uses scanning electron microscopy with energy dispersive spectroscopy (SEM/EDS), Fourier-transform infrared spectroscopy (FTIR), and gas chromatography-mass spectroscopy (GC/MS), using both liquid and volatile samples. The volatile analysis will be performed using solid-phase microextraction (SPME) which allows for nondestructive testing of samples. Testing using SPME and FTIR has revealed that the organic material of the sample makes up the majority of the analysis results. Samples undergo liquid-liquid extraction methods in acid and methanol to extract fire retardant chemical signature from the fiber sample. SPME fiber analysis is concluded, and further development of a liquid-liquid extraction method will continue to maximize the amount of fire-retardant chemicals removed from the fiber.

IGNITE AWARD

INVESTIGATION OF STRESS CONCENTRATIONS IN PARTS MANUFACTURED WITH FUSED DEPOSITION MODELING

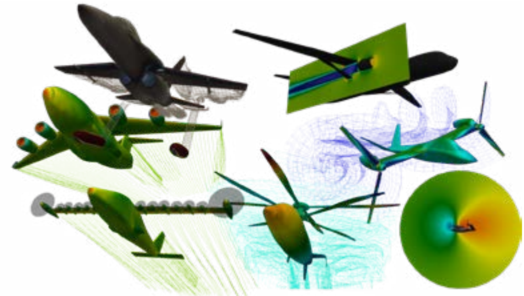
Hope Elmer, Aerospace Engineering
Alexandre Lasalarie, Aerospace Engineering

MENTOR

David Lanning, Aerospace Engineering

Fused Deposition Modeling (FDM), a type of additive manufacturing which deposits material layer-by-layer until completion, has experienced significant growth in recent years. FDM is a desirable manufacturing method due to the tailorability and customization which it offers. However, the lack of knowledge concerning the effects of various process parameters can hinder the full-scale implementation in product development. Additionally, there is little to no existing literature pertaining to the application of solid mechanics theories to predict the initiation of failure. The aim of this study is to demonstrate the effects of infill parameters combined with stress concentrations on the fracture of specimens manufactured using FDM. To investigate these effects, infill pattern is constrained to a 'gyroid' pattern, and the infill density is varied at 20%, 40%, and 60%. Two specimen geometries were chosen. The first set is a stress inducing hole at the center of the specimen where the hole diameter remains constant while specimen width is increased, effectively increasing the stress concentration factor. The second geometry consists of opposite semicircular edge notches, with a radius chosen such that the stress concentration factor remains constant compared to the first geometry. Solid mechanic theory predicts that the material's ultimate tensile strength (UTS) will be reduced by the stress concentration factor for the specimen UTS. However, initial results contradict this theory indicating potential reinforcement from the specimen geometry.

SPACE GRANT AWARD AND IGNITE AWARD



FUNDAMENTAL RESEARCH STARTUP EFFORTS EXPLORING THE VALIDITY OF FLIGHTSTREAM

Joshua Filby, Aerospace Engineering
James Morris, Aerospace Engineering

MENTOR

Shigeo Hayashibara, Aerospace Engineering

The exploration and validation of FlightStream's capabilities and aerospace analysis tools is to build a base for fundamental research startup efforts over subsequent research periods. All ensuing preparations will assist in the investigation of wing tip design and optimization for subsonic, both compressible and incompressible, and transonic aircraft using FlightStream, Vehicle Sketch Pad (OpenVSP), and Computer-aided Design software (CAD) to drive the study and validate results. FlightStream is a surface-vorticity flow solver designed to be powerful, reduce time between model, simulation, and result phases, and enhance the graphical user interface compared to existing Computational Fluid Dynamic (CFD) software. This study delves into the tools in which FlightStream is equipped, such as its viscous-coupled non-linear flow solver, boundary layer flow capture, propeller modeling, aeroacoustics, control-surface actuation, and its 6DOF motion module. Analysis and results from using these tools is compared to relevant experimental data to verify FlightStream is generating acceptable results and to conclude that FlightStream is a valid and effective design tool for the aerospace industry.

EAGLE PRIZE AWARD

CONVECTIVE CLIMATOLOGY FOR THE SOUTHWESTERN UNITED STATES

Greta Graeler, Applied Meteorology
Evan Bower, Global Security and Intelligence

MENTORS

Curtis James, Applied Aviation Sciences
Mark Sinclair, Applied Aviation Sciences
Carter Humphreys, NA
Ronny Schroeder, Applied Aviation Sciences
Jay Park, Unmanned Aircraft Systems

Convection over complex terrain has always been a challenge for meteorologists and computer algorithms to predict. This is a problem that meteorologists around the world need to solve because extreme convective events often cause property damage and loss of life. Convection in mountain climates is often responsible for severe weather, flash flooding, and critical fire weather. The National Center for Atmospheric Research has given Embry-Riddle Aeronautical University and the National Weather Service a grant to research where convection initiates, propagates, and dissipates over the Southwest Region of the United States. To find thunderstorm tracks, I run Multi-Radar, Multi-Sensing data through Monika Feldman's Thunderstorm Detection and Tracking algorithm in Python. If the thunderstorm cell exceeds a minimum reflectivity and area, the thunderstorm is added to a track list. The tracks' centroid location, area, and intensity of the cell is a function of time, Latitude and Longitude. These thunderstorm tracks are then used to create a statistical climatology using the mapping software, ArcGIS, of thunderstorm activity in the desert southwest. This research should give meteorologists a better idea of thunderstorm characteristics over complex terrain.

IGNITE AWARD

COHERENT CAPTAIN-MILLS: THE SEARCH FOR STERILE NEUTRINOS AND LIGHT DARK MATTER

Zachary Herzog, Space Physics
Zoe Morawek, Space Physics
Clarissa Pavao, Space Physics

MENTOR
Darrel Smith, Physics and Astronomy

The Coherent CAPTAIN-Mills (CCM) experiment at the Los Alamos Neutron Science Center (LANCE) is a state-of-the-art experiment that searches for sterile neutrinos. By measuring the gamma-ray background near the detector, the experiment will provide a better understanding of the interactions taking place, which can provide evidence of sterile neutrinos and light dark matter (LDM). The CCM experiment involves a proton beam hitting a tungsten target, releasing pions that decay into neutrinos and possible LDM particles that travel toward the 10-ton liquid argon detector. We measure the peak energies of the gamma-rays and determine what elements surrounding the CCM detector might contribute to the signals observed in the detector. A positive detection of sterile neutrinos could provide evidence for new physics beyond the basic building blocks of how matter interacts and help solve the mystery of dark matter, making our experiment a critical step towards uncovering the secrets of the universe.

IGNITE AWARD

LUNAR POWER: RADIOISOTOPE THERMOELECTRIC GENERATOR

Logan Hiland, Mechanical Engineering
Noelle Kartvedt, Aerospace Engineering
Kartherine Rolle, Mechanical Engineering

MENTOR

Karl Heine, Mechanical Engineering

With direction from Ultra Safe Nuclear Corporation (USNC) we will research and design a product to connect heat produced by radioisotopes with a thermoelectric generator. Our goal is to convert heat from EmberCore, a nuclear chargeable ceramic (NCC) device, into electricity for surface equipment on manned missions to the Moon. Because an inhabited lunar environment has unique demands like overcoming polar temperatures, radiation limits, and mass restrictions for launch, engineers must develop novel technologies. This project will contribute to the advancement of alternative energies as well as establishing the Moon as a hub for human space research and exploration. Currently, traditional batteries cannot supply power to Moon missions because they cannot function in the freezing temperatures during the lunar night cycle. EmberCore, however, uses radioisotopes to heat batteries without need for externally applied power; and we aim to increase available energy for lunar human-used surface equipment by transforming this heat into electricity. In the early phases of the project we researched the processes and materials involved in thermoelectric generators. The project is on going and we are beginning to implement conceptual designs to develop a preliminary design of a thermoelectric generator and simulate the energy conversions. Moving forward, we will test and run simulations in MonteCarlo Radiation Transport Software.

IGNITE AWARD

THE SPECTROSCOPIC AND VISUAL ORBIT OF THE NITROGEN-RICH MASSIVE BINARY WR 138

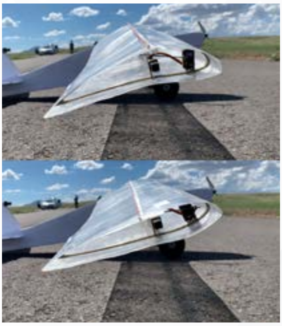
Amanda Holdsworth, Space Physics

MENTOR

Noel Richardson, Physics and Astronomy

Wolf-Rayet (WR) stars are massive stars that have lost their exterior envelopes due to stellar winds, and possibly binary interactions, however, they have yet to be understood well enough to be placed on the H-R diagram in the context of stellar evolution. In order to fully understand them, there must be direct constraints, namely measurements of their masses and luminosity. WR 138 is a nitrogen-rich WR star, whose empirical values have not been precisely determined. Its companion O-star, has not been well constrained either, due to the brightness of the WR star and its inclination. By using spectroscopic observations, a more accurate period and radial velocity of WR 138 will be determined, along with a developed 3-dimensional orbital model. These key parts will allow us to determine the empirical relations of WR 138, to determine how the star evolved, and where it fits on the HR diagram.

SPACE GRANT AWARD

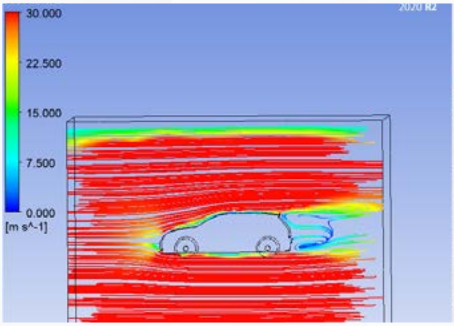


THE APPLICATION AND OPTIMIZATION OF A MORPHING AIRFOIL WING FOR LIGHTWEIGHT AIRCRAFT

Aditya Hoskere, Aerospace Engineering
Sidhtra Op, Aerospace Engineering

The Morphing Wing research project explores the optimization of a variable airfoil profile wing for lightweight aircraft with the need for exceptional short takeoff and landing characteristics. With the utilization of XFLR5 and FLOW5 and field testing, this project intends to explore the capabilities of the morphing wing. Furthermore, an examination of wing optimization for high climb performance when in its high lift configuration will be studied. The intention is the modification of the camber length during flight to allow the plane to possess a higher top speed while retaining its short takeoff and landing (STOL) characteristics. To be commercially viable, parameters such as fuel capacity, structural flexibility, and structural weightconcerns must be explored. The morphing wing will be developed
for the Just Superstol where the airfoil configurations will be alternated between NACA 9420 for an exaggerated camber transformation to a streamlined profile of NACA 0020. The expected outcomes include the optimization for reduced drag and higher top speed when the wing is in streamlined form.

IGNITE AWARD



OPTIMIZATION AND APPLICATION OF A GURNEY FLAP FOR PRODUCTION CARS

Aditya Hoskere, Aerospace Engineering
Sidhtra Op, Aerospace Engineering

MENTOR

Lance Traub, Aerospace Engineering

Gurney Flaps are one small but useful object that can affect the way air flows over a rigid body. Founded by Dan Gurney, the Gurney Flap is a small tab placed on the trailing edge of an airfoil or vehicle. Commonly found on F1 cars or airplane wings, the gurney flap has unique characteristic effects. Conceptually, the gurney flap directs the airflow over the surface to which it is attached by altering the size or shape of the surface appears to be. Ultimately creating more lift or downforce depending on the location of the gurney flap.

Conducted a series of analytical simulations using CFD on ANSYS, as well as field testing of a Volkswagen GTI with and without a gurney flap attached. The results obtained through the methods presented here signify an inconclusive result of the research conducted. While the results lead to further areas of investigation, they were not the type of results desired to produce an outcome able to increase the effectiveness of a car’s response to aerodynamic forces.

IGNITE AWARD

LONG-DISTANCE VIDEO AND TELEMETRY STREAMING

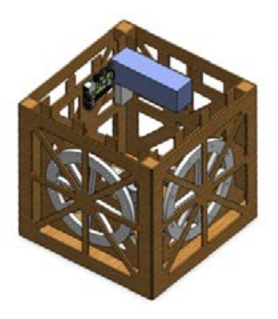
Zachary Howe, Aeronautics
Somaralyz Grullon, Mechanical Engineering Robotics Track

MENTOR

Yabin Liao, Aerospace Engineering

For satellite and UAV applications a radio link is established to receive real time telemetry. This link can be formed using a variety of frequencies and equipment, each with their own pro's and cons regarding effective range, data rate, and cost. We have developed a high-altitude balloon payload that analyzes these factors by comparing data transmission over two separate frequencies: 900MHz and 2.4GHz. Live video and telemetry will be broadcast over the 2.4GHz frequency. By using a Nivida jetson nano with sensors we can know and see the location of the payload in a 3D space and orientation. Additionally, telemetry will be sent over a 900MHz link using an RFD900+ Modem. These signals are received with high-gain antennas on a tracking ground station. An on-board SD card will also collect this same telemetry data to be compared with what is received. Overall, this experiment will characterize the quality and range of these radio links to guide future university aerospace projects.

SPACE GRANT RESEARCH INFRASTRUCTURE AWARD



SEMI-AUTONOMOUS WHEELLESS ROBOT DESIGN FOR SMALL CELESTIAL BODY EXPLORATION

Alexandre Lasalarie, Aerospace Engineering
Erika McSheehy, Aerospace Engineering
Estevan Flores, Aerospace Engineering
James Bass, Aerospace Engineering
Sheena Lean Espiritu, Aerospace Engineering
Zhenchuan Yan, Aerospace Engineering
Creighton Llopis, Software Engineering
Alison Olivas, Aerospace Engineering
Carlie Zinder, Aerospace Engineering
Tyler Kwapniowski, Aerospace Engineering

MENTORS

Davide Conte, Aerospace Engineering
Richard Mangum, Humanities and Communication

Project Inertia aims to create a semi-autonomous robot utilizing reaction wheels as a proof-of-concept for a space vehicle capable of movement in low-gravity, low-traction environments. Our design accounts for a payload space that would allow for an array of scientific instruments and assist in expanding the under-explored field of asteroid research. As of today, only the Hayabusa2 mission has successfully deployed two rovers to study an asteroid surface. Project Inertia's robot will use three reaction wheels, one for each degree of freedom, to move using the principle of conservation of momentum. The reaction wheels are brought to a high rotation rate and the motor is then abruptly shorted, which transfers the angular momentum of the reaction wheels to the robot's body. Project Inertia's guidance, navigation, and control (GNC) system makes this project unique as it will allow the robot to move semi-autonomously from its starting point to a predetermined target location. Should the robot be deployed in space, the GNC system would house an additional instrument to track and map its surroundings in real time and/or rely on a separate system such as a satellite. Testing of individual components, as well as testing of the integrated system in Earth's conditions and low-gravity conditions are being conducted at Embry-Riddle Aeronautical University. Preliminary testing consists of an obstacle course to prove the semi-autonomy of the design. Additionally, a 3-degree of freedom test bench is used to recreate the low gravity conditions of small celestial bodies.

IGNITE AWARD

PROBING THE VARIABILITY OF THE SUPERGIANT STAR DENEB

Teagan Laws, Astronomy

MENTOR

Noel Richardson, Physics and Astronomy

Deneb is the prototype of the supergiant stars called alpha Cygni variables. These stars are highly luminous OBA stars that exhibit low amplitude variations both in photometry and velocity. They exhibit non-radial pulsations when the surface of a star is contracting and expanding at the same time. The mechanism responsible for these variations eludes theory thus far but photometric and spectroscopic observations of the stars will aid in finding the source for stars such as Deneb. Photometric observation campaigns have been done with the BRITE-Constellation nanosatellites between 2014-2022, which will provide a clearer understanding of the photometric variability. Fourier transformations were done for each data set as part of the analysis process. We aim to compare these results to similar results from spectroscopic and photometric campaigns in the past to examine the driving mechanisms for variability while also considering recent interferometric results of Deneb.

IGNITE AWARD

A MULTI-WAVELENGTH ANALYSIS OF THE CLOSEST COLLIDING-WIND BINARY: γ2 VELORUM

Randy Loberger, Astronomy
Tri Phan, Astronomy

MENTORS

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

γ2 Velorum is a binary system that contains the nearest Wolf-Rayet (WR) star to us. The binary is well-constrained, being one of the three known WR binaries with a visual orbit. With an O star companion, both stars have strong stellar winds, making this an optimal binary to study the shocked gasses from the stellar winds as they collide. We are working to re-evaluate the archival and new optical spectroscopy of the system to establish the spectroscopic orbital elements to greater precision. With that in hand, we will then analyze archival X-ray measurements of the system along with new measurements from the NICER satellite on the ISS. Recent multi-wavelength results on the colliding wind binary WR 140 show that the cooling of the gas can switch between X-ray production to optical emission. Similar scenarios will be tested with this system.

SPACE GRANT AWARD AND IGNITE AWARD

USING ARTIFICIAL INTELLIGENCE IMAGING SYSTEMS TO DETECT SIGNS OF GENOCIDE FROM LOW EARTH ORBIT

Max Martin, Aerospace Engineering
Ana Bader-Elenes, Aerospace Engineering
Blake Evans, Aerospace Engineering
Karan Gaglani, Aerospace Engineering
Ryan Kendrick, Aerospace Engineering
Jonthan Mercado, Aerospace Engineering
Dylan Mires, Aerospace Engineering
Jeremy Nicholson, Software Engineering
Vishwas Tanguria, Aerospace Engineering
Vince Tran, Aerospace Engineering

MENTORS

Davide Conte, Aerospace Engineering
Richard Mangum, Humanities and Communication
Erika Podest, NA

Genocide is an under-reported issue across the world, partly due to the difficulty regarding reporting and collecting evidence. Reconnaissance and Documentation (RAD) proposes deploying a satellite, Leza, in low- Earth orbit (LEO) that will capture images of countries on the United Nations (UN) genocide watchlist to look for signs of genocide remotely. RAD will utilize an Artificial Intelligence Image-Recognition Software (AIIS, pronounced "eyes") to determine if the observed countries display signs of past, ongoing, or future genocide. Once AIIS is confident about an observed region displaying signs of genocide, the images will be reviewed to ensure AIIS is working as intended and distribute any images of potential genocide out to media. The primary mission objectives for RAD 2.1 were to develop AIIS along with an orbit to support Leza's launch as a secondary payload. Additional mission objectives included the capability to continue training AIIS after Leza's launch. RAD 2.1 split AIIS into two components AIIS-1 and AIIS-2 to facilitate a realistic execution of this project. AIIS-1 is intended to filter out images that do not contain signs of human activity while AIIS-2 will perform the analysis on images filtered by AIIS-1 to determine whether the images display signs of genocide. By developing and testing the technologies and concepts needed to develop and launch Leza, RAD 2.1 enabled students to gain research and development experience for making a remote-sensing satellite. Overall, RAD aims to promote global awareness of genocide propagating across the world throughout its development and project execution stages.

IGNITE AWARD

HYDROGEN - OXYGEN COMBUSTION FOR MEDIUM RANGE JET ENGINES

Joshua McBeth, Aerospace Engineering

MENTOR

Elliott Bryner, Mechanical Engineering

We take a dive into the wonderful world of Hydrogen combustion by looking into the possibility of using it as a fuel for jet engines for commercial flight. Our team studies H_2/O_2 flames to locate a system that will function without the need for completely new engines. H_2/O_2 combustion produces completely clean energy with no emissions other than H_2O so that makes it a very desirable entity. The aim of our team is to develop a system that will be able to be retrofitted into a jet engine reducing costs for the airlines and allowing aircraft to adopt this system a lot faster. We also aim to target medium ranged aircraft - A320's, B737's - because this is the most used type of aircraft domestically across the US. Using careful analysis methods and a comprehensive understanding of heat exchangers and the chemical properties of elements such as air, O_2 and H_2, we hope to be able to extract oxygen out of the air midflight in order to produce a mixture of H_2 and O_2. It is a highly combustible fluid which produces a large amount of energy we can turn into thrust to propel the aircraft.

IGNITE AWARD

CHARACTERIZATION OF OVAL DEFECTS IN CRYSTALLINE OPTICAL COATINGS

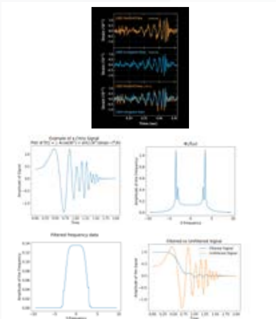
Breck Meagher, Space Physics

MENTOR

Ellie Gretarsson, Aerospace Engineering

Crystalline AlGaAs optical coatings are candidates for future upgrades to gravitational wave (GW) detectors. These coatings are shown to significantly decrease noise in ultra-stable cavities in comparison to traditional amorphous coatings. However, large area AlGaAs coatings develop oval defects during the manufacturing process. This project aims to complete a systematic study of the surface of one of these coatings on a scale more similar to the tens of centimeters in diameter mirrors utilized in GW interferometry. By characterizing the size distributions of oval defects on the surface of crystalline optical coatings using scanning election microscopy (SEM), this project is gaining information on the nature of these defects.

SPACE GRANT AWARD AND IGNITE AWARD



A TIME-FREQUENCY ANALYSIS OF CHIRPS IN GRAVITATIONAL WAVE DATA

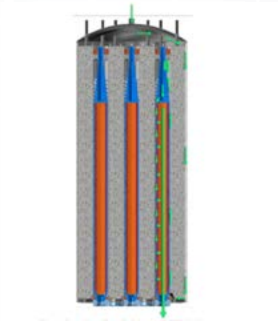
Jaxson Mitchell, Space Physics

MENTOR

Cameron Williams, Mathematics

Gravitational waves, first hypothesized as a result of Einstein's general theory of relativity, were first measured by the Laser Interferometer Gravitational-Wave Observatory (LIGO). These gravitational waves measured from LIGO consist of black hole mergers and information of the inspiraling black holes can be determined such as their mass. The gravitational waves in this case are a specific example of chirps, which is a highly-oscillatory frequency within a signal. This project consists of branching off previous results of a generalization of the Fourier Transform to be able to construct a software library to analyze these waves and generalizing important results in signal processing such as the Shannon sampling theorem to create a strong mathematical foundation for analyzing chirp data, with a focus in extracting chirps from gravitational waves and filtering unwanted noise from the data.

SPACE GRANT AWARD



CENTRIFUGAL NUCLEAR THERMAL ROCKETRY

Shannon Moore, Space Physics

MENTORS

Darrel Smith, Space Physics
Hayden West, Space Physics

The purpose of this project is to research and develop a viable means of Nuclear Thermal Propulsion (NTP), by creating a simulation that models heat transfer in the fuel element. Nuclear Thermal Propulsion has many benefits, namely that it is nearly twice as efficient as traditional chemical propulsion systems and will deliver astronauts and supplies to Mars 20-25 percent faster than chemical propulsion systems. This will save time but also lives in the developing martian colonies if critical supplies and personnel can be delivered to Mars 30 to 60 days sooner than normal. Despite these benefits there are many technical challenges that need to be overcome in order to develop a NTP engine, but the purpose of this project is to investigate the viability of a Centrifugal Nuclear Thermal Propulsion (CNTP) system which (will be safer and simpler than traditional NTP). This is because, CNTP uses passively storable propellants such as ammonia, hydrazine or methane, and also uses liquid fuel contained in rotating cylinders (instead of traditional solid fuel elements). The initial stage of this project will use a one-dimensional computer simulation in either Python or MATLAB to create a heat transfer model for hydrogen and ammonia inside the combustion chamber of the CNTP engine.

Picture accredited to Micheal Houts

SPACE GRANT AWARD

CLASSIFYING QUANTUM ADJACENCY MATRICES

Hailey Murray, Space Physics
Isaiah Joy, Space Physics
Eric Babcock, Software Engineering
Aiden Askew, Engineering

MENTORS

Lara Ismert, Mathematics
Mitch Hamidi, Mathematics

A finite directed graph consists of a finite set of vertices and an adjacency matrix that describes when there is an edge from one vertex to another. A quantum graph replaces the finite vertex set with a finite-dimensional matrix algebra and replaces the adjacency matrix with a quantum adjacency matrix, which is a function on the matrix algebra. In this talk, we classify certain classes of quantum adjacency matrices by computing their eigenvalues and determining when they are (quantum) regular or when they are homomorphisms. Additionally, we study relationships that arise between the eigenvalues of a quantum graph's quantum adjacency matrix and its corresponding quantum edge checker, which is analogous to a graph's edge matrix and is used to determine the quantum graph's "edges."

THE EMBRY-RIDDLE SUBORBITAL REUSABLE VEHICLE (ERAUSRV): GETTING TO SPACE CHEAPER AND MORE OFTEN

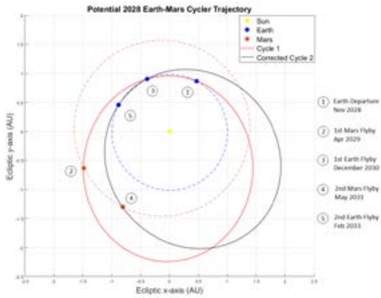
Gaurav Nene, Aerospace Engineering
Cooper Eastwood, Aerospace Engineering
William Knoblauch, Mechanical Engineering
David Hadley, Mechanical Engineering

MENTOR

Andy Gerrick, Mechanical Engineering

This program is a high-performance testbed for flight demonstration of student-developed hardware and software. The program provides students, in all engineering disciplines and majors, with unique opportunities to design, fabricate, and launch novel flight hardware, data acquisition systems, and sensor design concepts. The vehicle is inherently an ecosystem of individual components that can be tested and improved by students frequently. Students also have an opportunity to leverage the vehicle's flight through several unique environments to conduct scientific research. The goal is to surpass the Karman line where new/unproven technology can be implemented at low risk and with a predictable cost and schedule. The quick turnaround between flights and the number of vehicles ready to launch at any given time ensures a short mission life cycle that can make experimentation significantly more affordable for the next generation of aerospace engineers.

IGNITE AWARD



DEVELOPMENT OF PRACTICAL EARTH-MARS CYCLER TRAJECTORIES

Kyle Newlin, Aerospace Engineering

MENTOR

Davide Conte, Aerospace Engineering

NASA and similar space-fairing organizations have long expressed goals to send crewed missions to Mars before the year 2035. Likeminded ambitions have also driven some to believe that humanity's long-lasting presence could also be established on the red planet in the near future. In preparing for these events, the ability to develop trajectories capable of regularly transporting payloads between the two planets has become exceedingly meaningful.

A previously proposed solution to this is the Aldrin Cycler, which would be capable of "cycling" between both Earth and Mars without expending propellant to maintain its orbit. However, this trajectory and those like it make large simplifications to the Solar System's geometry that limits their real-life practicality. Our research aims to utilize the primary concepts behind cycler orbits to develop, optimize, and configure possible preliminary spacecraft trajectories using state-of-the-art planetary data.

In order to develop a robust computational structure, the implementation of several orbital mechanics functions and optimization schemes are necessary. Moreover, 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 we're currently working on will supply optimal, yet practical, mission trajectories spanning across the next 10+ years, including necessary maneuvers needed to maintain such orbits.

CYBERAERO'23 COMPETITION

Hannah Ohm, Cyber Intelligence and Security
William Noujaim, Cyber Intelligence and Security
Abigail Geiger, Cyber Intelligence and Security

MENTOR

Krishna Sampigethaya, Cyber Intelligence and Security

The goal of our project is to inspire K-12 students to learn about cybersecurity while they are still in high school. Currently, there is a need for skilled individuals entering the cyber workforce. There is a massive gap between computer skills learned in high school and the knowledge needed for a secondary education in computer science majors. Furthermore, there is a dearth of in-person cyber events that can truly engage and motivate high schoolers in various cybersecurity and intelligence areas. Because of this, many students feel intimidated to be entering a degree program they have never experienced.

In order to address the above needs, we have developed and will host a competition, called CyberAero, designed to both educate and impassion students to pursue an education and career in cybersecurity, no matter their current level of education. Aviation cybersecurity is in the forefront of news today and this competition will showcase the need for more talent and workforce in this topic area. The competition will be structured so that various knowledge, skills, and abilities of each individual participant is tapped and evaluated. This year we are including the addition of an interactive learning day to help bridge the gap between those schools with computer science programs/classes and those without.

CBSI PHILANTHROPY COUNCIL AWARD

EAGLE AERO SPORT

Eden Pfanner, Aerospace Engineering
Keelan Garde, Aerospace Engineering

MENTOR

Seth McNeill, Computer, Electrical and Software Engineering

Eagle Aero Sport is an undergraduate engineering team at the Prescott, AZ campus whose main objective is to build and modify an experimental Van's RV-12 aircraft. The organization allows its members to receive hands-on experience with multiple different aspects of aircraft manufacturing and engineering. While building the aircraft, members learn about aircraft assembly, flight-testing, aerodynamic and electrical engineering, management of production operations, safety management, marketing, problem solving, and team building skills. In addition to building the basic blueprint of the aircraft, Eagle Aero Sport is modifying and adding unique flight test instrumentation so that research can be performed by Embry-Riddle students and staff in the future. These new instruments will allow students to study aerodynamic, structural, and performance data during flight. Over the years, the team has conducted engine, electrical systems, and mechanical systems tests. Eagle Aero Sport aims to complete the project in the near future to allow future students to realize and apply their flight dynamics knowledge from the classroom by analyzing data from the personalized aircraft.

EAGLE PRIZE AWARD

CONTROLLED ROCKET LANDING SYSTEM

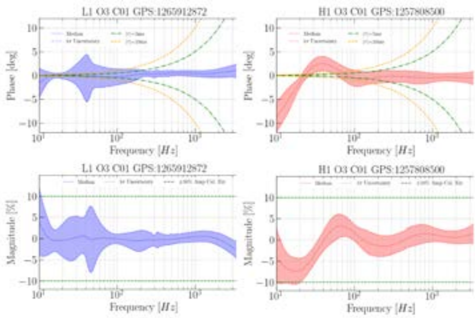
Matthew Prescavage, Aerospace Engineering
Alexander Lasalarie, Aerospace Engineering
Conner Thomas, Unmanned Aircraft Systems

MENTOR

Bradley Wall, Aerospace Engineering

Rocketry has been around for a long time now, however, very few advances have been made. A typical model rocket launch takes between 10 and 60 seconds to reach max altitude. After this, a parachute is ejected from the nose cone and the rocket blows in the wind until landing. The higher the rocket flies, the farther it will land. For the smallest model rockets, this may involve a short walk across a field, however, for larger rockets, it may involve a long search and even loss of the rocket entirely. This project will design a rocket that can safely return to a predetermined location. Having the ability to land the rocket where it started would allow the user to not have to walk to retrieve the rocket. The engineering solution is simply to attach a deployable quad-copter to a rocket that will be used to fly the rocket back to the launchpad after the rocket achieves maximum altitude. This would be achieved via a pilot from the Unmanned Aerial Systems (UAS) club that will fly the rocket to the landing zone. The design consists of four carbon fiber arms attached to the main fuselage of the rocket with motors and propellors on the end of each arm. This will allow for the rocket to be controlled from its peak to the ground, demonstrating the feasibility of the design to develop into a larger project in the future.

COE PHILANTHROPY COUNCIL AWARD



THE IMPACT OF PHYSICALLY MOTIVATED CALIBRATION ERRORS ON SEARCH PIPELINE DETECTION PARAMETERS FOR BROADBAND BURST SIGNALS.

Alexee Providence, Aerospace Engineering

MENTOR

Michele Zanolin, Physics and Astronomy

This project focuses on improving the detection and reconstruction of gravitational waves generated by core collapse supernovae (CCSNe), which present as time-dependent strain that can be detected by the interferometer. To extract and maintain the integrity of these gravitational wave (GW) signals, the response of the interferometer must be taken into account through calibration. In the calibration process, the output of the interferometer is modeled, measured, and applied to the physical response of the detector to convert the measured light intensity from the interferometer to gravitational wave strain. Thus, the accuracy and precision of the reconstructed gravitational wave signal is dependent on the accuracy of the detector's response model. Data analysis groups have used signal processing techniques to account for calibration errors in the past; however, these methods are only suitable for narrow band GWs. However, for broadband GWs signals emitted from core collapse supernovae, a different approach is required as the evolution and magnitude of the calibration errors as a function of frequency become significant. This project aims to continue the development of the software required to conduct the analysis as well as propose the method to the collaboration for widespread adoption. A plugin (code) was developed that is able to accept the detector-dependent frequency calibration errors, allowing for an accurate estimation of the impact on cWB detection parameters unique to each waveform from the list of supernova gravitational waveform candidates. These improvements will allow for the extraction of more accurate information from these signals.

IGNITE AWARD

PROXIMITY OPERATION MANEUVERS AT ASTEROIDAL DEEP SPACE IN-SITU RESOURCE UTILIZATION STATIONS

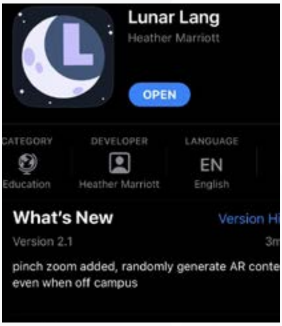
Andrew Purkeypile, Aerospace Engineering

MENTOR

Davide Conte, Aerospace Engineering

Given a transfer from Earth to an asteroid, the goal is to determine a probability distribution of rendezvous trajectories and the associated velocity changes required to correct them to a desired trajectory. Once an appropriate asteroid is selected, it is necessary to determine a trajectory from Earth to the asteroid. The transfer orbit was determined by solving Lambert's Problem. Position vectors for Earth and an asteroid will be acquired using ephemeris data from NASA JPL's Horizons System. A time of flight and associated departure and arrival dates will be determined. Using the transfer semi-major axis from the solution to Lambert's Problem, departure and arrival velocities can be calculated. Velocities are required for the purpose of determining rendezvous maneuvers when arriving at the asteroid sphere of influence (SOI). The methods to be used to calculate the relative motion and rendezvous are those developed by G.W. Hill in the 1870s and Clohessy-Wiltshire in the 1960s and involve linearizing the Newtonian equations of motion for the relative motion between two bodies. This simplification technique is part of Linear Orbit Theory and allows for analytical computation of relative motion. It also provides deeper insight into the nature of the motion. The resulting equations are referred to as the Hill-Clohessy-Wiltshire (HCW) equations. Determination of a trajectory probability distribution will be achieved using Body Plane (B-Plane) targeting methods and an associated error ellipse.

SPACE GRANT AWARD



ENGINEERING AND PROJECT MANAGER COLLABORATION EXPANDS VIRTUAL LEARNING

Rachel Reinsch, Global Security and Intelligence
Emma Sanders, Global Security and Intelligence

MENTORS

Heather Marriott, Electrical, Computer, and Software Engineering Department
Reginald Parker, Global Security and Intelligence Studies Department

Lunar Languages is an application developed by Embry-Riddle Aeronautical University upper-level software engineering students to provide an interactive and fun way to learn spoken languages and computer science components, including Python coding and vocabulary, Russian language vocabulary, and Mandarin vocabulary terms. Lunar Languages promotes educational growth via a hand-held, interactive gaming interface designed to promote multi-purpose learning with endless applications.

Students from Software Engineering and Games and Simulation partnered with project managers from Global Security and Intelligence who earned the Certified Associates in Project Management (CAPM) to expand vocabulary, and develop graphics and support systems of the application.

This application provides students of all majors and levels with free access to a digital database of vocabulary terms via gamification interface, promoting memorization and practical language-learning via participation in augmented reality, accessible on the Apple App Store and Google Play. Recently, software developers added Russian language vocabulary, randomized questions presented to the user, added pinch and zoom functions, implemented sounds for correct answers, and created a high-level class diagram for developers to understand the app processes. Further development includes collaboration with the COE to expand code for Mandarin vocabulary, expand map support to increase the accessibility and range of the application, and update the sims and graphics designs for the app.

Collaboration between project managers and the COE allows students to create a realistic plan to expand the digital infrastructure of this app and design diverse educational resources for individuals studying linguistics and computer science at all levels.

IGNITE AWARD

SAE AERODESIGN - EAGLENAUTICS

Ty Rice, Aerospace Engineering
Patrick Bogan, Aerospace Engineering

MENTOR

Shigeo Hayashibara, Aerospace Engineering

Learning the design process of creating an aircraft is one of the most valuable things we can learn as aerospace engineering students and through Eaglenautics we have been able to do this. Our team will be utilizing a balsa wood model aircraft in order to gain inspiration and learn more about the actual construction of aircraft. Through 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. The Eaglenautics team will also be creating initial designs, models, and structures for our own unique aircraft, in preparation for next year's competition. We are utilizing this year to learn and prepare for next year's competition by creating a model airplane to practice our construction skills, and to learn new design elements that can be incorporated into our design. 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 2023-2024 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

FOSTERING EDUCATIONAL EQUITY IN ENGINEERING

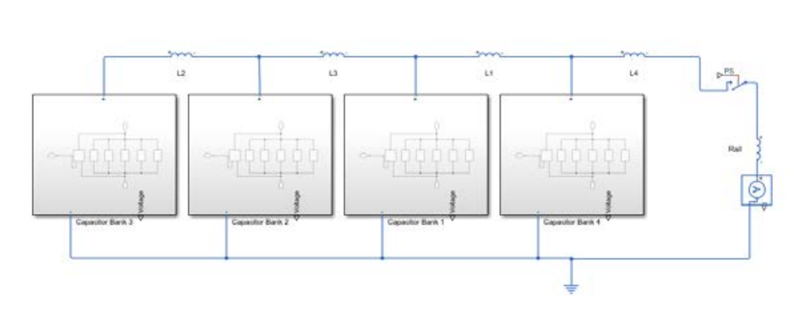
Katrina Robertson, Mechanical Engineering

MENTORS

Ashley Rea, Humanities and Communication
Jonathan Adams, Humanities and Communication
Hadi Ali, Aerospace Engineering

Many have identified the marginalization of women that occurs within STEM education, and this research seeks to identify concrete ways in which educators might intervene to create more inclusive learning environments. Researchers in engineering education have evaluated the ways in which the curriculum can be altered to be more inclusive (Dewsbury, 2019), and assessed the outcomes of having diverse teams in the classroom (Oti et al., 2022). In technical and professional communication, researchers have developed taxonomies for understanding communication infrastructure (Adams, 2022) and found that inclusion is not only practiced by people and society, but in the methods that classrooms are conducted and tangibly constructed. However, there is still a need for further research on the social construct of STEM fields and how they have notably become male dominated. To that end, our study seeks to gain firsthand insight from female and gender diverse students and faculty members regarding their experiences in academia. Participants share perspectives and pieces of advice on how we can adjust course curriculum and methodology to establish a more inclusive setting within the introductory engineering courses at the university. This qualitative study seeks to answer: (1) What types of marginalization do women students experience while communicating their work in introductory engineering courses? (2) What strategies do they currently use to circumvent that marginalization?, and (3) What strategies might instructors implement to assist women students in circumventing these moments more effectively?

SPACE GRANT AWARD AND IGNITE AWARD



DESIGN AND SIMULATION OF AN ELECTROMAGNETIC RAILGUN FOR HIGH VELOCITY IMPACT TESTING

Josiah Rodriguez, Aerospace Engineering
Rahm Bodick, Aerospace Engineering
Gianni Dragos, Computer Engineering

MENTOR

John Sevic, Electrical, Computer and Software Engineering

The concept of launching a projectile with electromagnetic forces has been around for more than a century, but intensive research efforts were only initiated in the last 30 years. The results of such efforts led to standardizations in design, allowing for a simpler, more versatile approach and application in electromagnetic launchers. Our team will take advantage of such standardizations to devise and develop an electromagnetic railgun that can be utilized for orbital velocity impact testing, an emerging field as space infrastructure expands. This field of testing currently requires complex gas guns, which are often expensive and limit research to graduate-level. Not only can a railgun be a cheaper alternative, but it can also open research opportunities in this field to undergraduates. Because the railgun uses only electromagnetic forces to propel an object to high speeds, it is possible for undergraduate-level research to afford and construct such a device. The team for this project will be producing simulated data of the railgun design, along with constructing a testbed for future undergraduate research. The power supply is a vital component of the railgun, as it provides a shaped current pulse to the rails. This pulse of current is important as the force applied to a projectile is proportional to current squared. The targets for the simulated data will be inductance gradient, efficiency, and projectile velocity, modified based on a set range of charge voltages. With this, the team hopes to create a foundation for undergraduates to explore railgun development.

IGNITE AWARD

DETERMINING OPTIMAL HARBORAGE CRACK SIZE FOR BED BUGS

Monica Saenz, Applied Biology
Lauren Hernandez, Applied Biology
Kaita Hayashibara, Applied Biology

MENTOR

Corraine McNeill, Biology

Bed bugs (Cimex lectularius), are cryptic, nocturnal insects that spend 90% of their time in a harborage. Harborages can include crack and cervices within the home. The purpose of this research was to determine whether adult bed bugs preferred a certain crack size for harborage. Factors such as aggregation, non-aggregation, gender, and hunger status were further evaluated to determine bed bug preferred nesting locations. Eight drill bit sizes were used to make the cracks: 1/16, 5/64, 3/32, 7/64, 1/8, 5/53, 3/16, and 7/32. Drill bit sizes 7/32, 1/8, and 3/16 were preferred for bed bugs aggregated in groups of 10. Harborage preference varied due to gender and hunger status. The majority of fed males in aggregation (33%) preferred harborages with the drill bit size 7/32, while the majority (27%) of starved males preferred drill bit size 1/8. In comparison, the majority of fed females (30%) and the majority of starved females (26%) in aggregation both preferred the drill bit size of 3/16. Regardless of gender and hunger status, the majority of lone bed bugs preferred drill bit size 3/16 (37.25% fed males; 22.73% starved males; 31.48% fed females; and 25.17% starved females). Overall, knowledge of optimal crack size can provide great benefits for enhancing bed bug monitoring tools by increasing trap captures.

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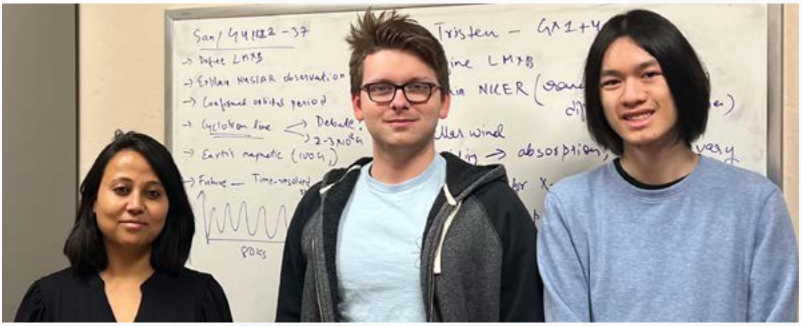


X-RAY BINARIES AS FLASHLIGHTS TO MAP THE UNIVERSE THROUGH STELLAR WIND STUDIES

Tristen Sextro, Astronomy
Calvin Sam, Astronomy

MENTOR

Pragati Pradhan, Physics and Astronomy

Low Mass X-ray Binaries (LMXBs) comprise a low mass star and a compact object (neutron star/black hole) orbiting around a common center of mass. In such systems, X-rays are generated through the intense collision of star material on the surface of the compact object. Our study focuses on two LMXBs, GX 1+4 and 4U 1822-37 using data from two X-ray detectors, NICER and NuSTAR. NICER takes short observations throughout the orbit collecting X-ray photons of energy ranging from 0.2 to 12 keV. NuSTAR takes one long observation of the target in X-rays ranging from 3 to 79 keV.

Using X-ray data of GX 1+4 from NICER, we confirmed a strong presence of iron throughout the stellar wind accompanied with large absorption of X-rays. We plan to measure the size of clumps by measuring the X-ray extinction, through spectro-timing analysis. In addition, we have also analyzed the hard X-ray data from NuSTAR of the LMXB 4U 1822-37. We have confirmed the existence of cyclotron resonance scattering near 29 keV conveying magnetic field strength of 2-3 x 10^12 Gauss. The orbital period of ~21 kiloseconds is also seen clearly in the X-ray light curves. In the future, we are going to use time resolved spectroscopy to look at the cyclotron line variation with spin phase of the neutron star. Ultimately, continuous observation and analysis of these systems can be utilized to build a comprehensive picture of the complex physics at play in these X-ray binary systems.

SPACE GRANT AWARD

PERFORMING PUGACHEV'S COBRA MANEUVER WITH A QUADCOPTER

Adam Shapiro, Aerospace Engineering
Kammi Matsumoto, Aeronautics

MENTORS

Ken Bordignon, Aerospace Engineering
Stacey McIntire, Aeronautical Science

The goal of this project is to demonstrate Pugachev's cobra maneuver using a quadcopter. Pugachev's cobra maneuver is traditionally performed by fixed-wing fighter jets. To perform the maneuver, the aircraft initiates an aggressive pitch-up maneuver followed by a return to normal flight. This results in rapid deceleration which can allow the aircraft to get behind a pursuing aircraft and gain the upper hand in a dogfight. With the rapid adoption of quadcopters in military applications, knowledge of the cobra maneuver's feasibility and dynamics when applied to quadcopters may prove useful. The first step of this project was the creation of a Simulink simulation to gain a better understanding of the dynamics involved when performing the cobra maneuver with a quadcopter. A simulation and animation were created last semester, demonstrating that the maneuver is possible in theory. A simplified drone model was used for the simulation, and a control law created to perform the maneuver. The next step is to perform the maneuver with a real quadcopter. Telemetry data will be obtained from the quadcopter to provide quantitative data for the maneuver. This data will be compared to the Simulink simulation to gauge the accuracy of the simulation.

COA PHILANTHROPY COUNCIL AWARD

NEW SHORT-RANGE TESTS OF GRAVITY

Janessa Slone, Space Physics
Jennifer James, Space Physics

MENTOR

Quentin Bailey, Physics and Astronomy

New Short-Range Tests of Gravity was a project that explored theoretical physics at an advanced level for undergraduate research students. Our goal was to reach a new modified signal for the Newtonian Potential Energy between two masses with the hope of leading to the possible use of a new formula for Lorentz Violations in short-range gravity tests. Over both the 2021-2022 school year and the beginning of Fall 2022, members conducted and solved equations relevant to them in obtaining the Newtonian Potential. Janessa has studied and worked on deriving as well as manipulating the field equations to which Jennifer uses in solving equations for the weak-gravity Newtonian limit and producing the signal for a modified formula. A paper on the work of New Short-Range Tests of Gravity has been published in Classical and Quantum Gravity in January 2023.

*This work was supported by the NASA Space Grant during the 2021-2022 school year provided by the Undergraduate Research Institute based at Embry-Riddle Aeronautical University Prescott. It is based upon work supported by the National Science Foundation which supported this research prior to that of URI.

CYGNUS SUBORBITALS' FLIGHT VEHICLE "DENEB"

Dalton Songer, Aerospace Engineering
Ben Black, Mechanical Engineering
Zoe Brand, Mechanical Engineering
Dawson Damish, Mechanical Engineering
Tom de Vries, Aerospace Engineering
Kyle Dutcher, Mechanical Engineering
Charles Flaherty, Mechanical Engineering
Duncan Shour, Mechanical Engineering
Jared Walker, Mechanical Engineering

MENTOR

Daniel White, Mechanical Engineering

Cygnus Suborbitals supports the Mountain Spirit program with a team of nine undergraduate students. The purpose of the Mountain Spirit program is to promote rocketry on campus and educate undergraduate students in the Rocket Development Lab (RDL) through hands-on opportunities. In addition, the Mountain Spirit program aims to launch a rocket, which utilizes solid and liquid-fueled rocket propulsion systems, into space. Cygnus Suborbitals is developing a liquid bipropellant flight vehicle called "Deneb." Deneb is the second step in Mountain Spirit's four-step process that will culminate in the space-shot vehicle.

Cygnus Suborbitals aims to design, build, and fly Deneb to at least 30,000 feet in altitude while competing in the Dollar Per Foot Challenge held by Friends of Amateur Rocketry. In achieving this, Cygnus Suborbitals will prove that Embry-Riddle Aeronautical University and the RDL can build and fly a high-performance liquid flight vehicle. The knowledge gained from this project will be documented and passed down to the students developing the next Mountain Spirit vehicle. In addition, the earnings from the competition will be utilized to financially support the Mountain Spirit program in its future developments.

EAGLE PRIZE AWARD

PRECISIONS MEASUREMENTS OF DIRECTION OF ARRIVAL AND GRAVITON EFFECTS FROM GRAVITATIONAL WAVE BURSTS

Zoe Spangler, Space Physics
Charles Wszalek, Space Physics

MENTOR

Michele Zanolin, Physics and Astronomy

Gravitational Waves (GWs) at the fundamental level are expected to be the collected effect of individual particles named “gravitons”. Similarly to the case of electromagnetic radiation, we expect that there are specific scenarios that the granularity of the individual particles forming the radiation will have measurable effects. Thus, if a graviton is captured (namely, the wave function collapses) by one of the LIGO interferometers, the same graviton cannot collapse in the other interferometer. When a positive excess happens at one interferometer, those same gravitons will give a negative effect at the other. We then subtract the signal reconstruction of one detector from the other, which will lead to a cancellation of the common particle signal and an amplification of the fluctuations. This process is done using the algorithm Coherent WaveBurst (cWB). When observing GWs from Core Collapsed Supernovae (CCSN), the form is stochastic due to the turbulent nature of a supernova’s collapse. The main problem this inconsistency presents is increased uncertainty in directional reconstruction calculations. The current technique utilizes the difference in time-of-arrival of a single polarization between detection sites. However, due to different antenna patterns, each observatory may detect different polarizations. If the signals are shifted in time, the skewed time-of-arrival data will skew the reconstruction calculations. This paper will quantify the maximum delay that is possible between two polarizations.

IGNITE AWARD

WHAT DRIVES THE VARIABILITY IN LUMINOUS BLUE VARIABLES

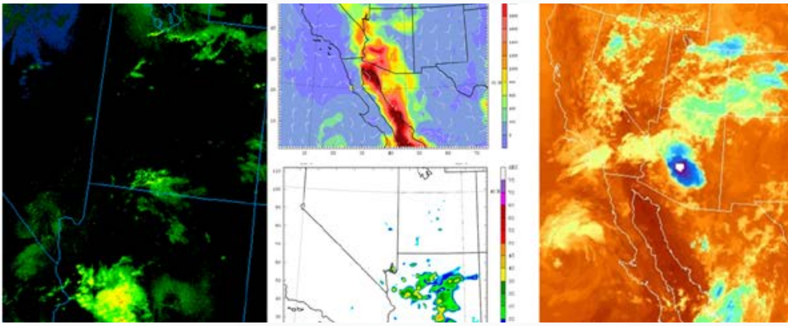
Becca Spejcher, Astronomy
Marina Beltran, Astronomy

MENTOR

Noel Richardson, Physics and Astronomy

Luminous blue variable stars (LBVs) are evolved massive stars with strong winds and large variability. The cause of the variability of these stars is not yet understood. We used photometric data from TESS to study 30 LBV candidates in the Large Magellanic Cloud. The light curves extracted from TESS were compared to ASAS-SN light curves of the same star to rule out any instrumental errors with TESS. We then performed Fourier transforms on the corrected TESS data using Period04, allowing us to find the characteristic time scales of the variability. Using a non-linear fitting routine, we then measure the properties of the Fourier transform. From these parameters, we intend to explore how stellar characteristics, such as luminosity, correlate with properties of stellar variability. This can then be used to infer if internal gravity waves or stochastic processes such as subsurface convection drive the changes that we observe photometrically. We will also be using spectra from the 30 original LBVs plus 9 Galactic LBVs to look at their wind strengths, wind speeds, and radial velocities. Adding the Galactic LBVs will help us determine if the driving mechanisms for variability in LBVs change based on metallicity.

IGNITE AWARD



SENSITIVITY OF NORTH AMERICAN MONSOON CONVECTIVE PRECIPITATION FLOODING IN ARIZONA TO THE ATMOSPHERIC BOUNDARY LAYER AND CIRCULATION

Brooke Sullivan, Applied Meteorology

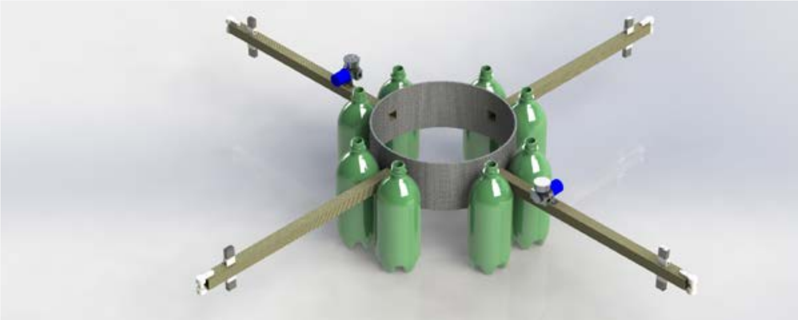
MENTOR

Dorothea Ivanova, Applied Aviation Sciences

In September 2014, remnants of Hurricane Norbert brought record-setting rainfall that swept across the Southwest U.S. Flash flooding in Phoenix caused major damage to infrastructure, roadways, and many human casualties including two fatalities. The Phoenix flash flood of September 7-8th, 2014 resulting from the hurricane Norbert is investigated in this Weather Research and Forecasting (WRF) modeling study. Our goal is to simulate the general features of the boundary layer in Arizona prior and during the flash flood events and to study the related hazardous weather patterns. Remnant storm bands from Norbert crossed the core Phoenix metropolitan area, and a record 5.51 inches of rain fell over the Chandler area in just under seven hours. This was the highest recorded rainfall amount since 1895 for the Chandler area. Warmer than normal sea surface temperatures helped to maintain the intensity of the storm. According to NOAA, this was a once in 200 year period event.

Our WRF modeling study supports the hypothesis that higher than usual for early September SSTs significantly enhanced the intensity of Norbert and influenced rainfall rates and intensity of the flash flood. To test this, we investigate boundary layer and the atmospheric circulation in Arizona before and during the heavy rain events. Both the boundary layer water content and CAPE over Maricopa County, and the atmospheric circulation over Arizona changed dramatically over the course of the numerical simulations. WRF ARW (Advanced Research WRF model) successfully simulated the boundary layer properties and CAPE during the flood.

SPACE GRANT AWARD



PROJECT ANUBIS: COLD GAS ATTITUDE CONTROL SYSTEM

Hojin Surh, Aerospace Engineering, **Zachary Sadaghiani,** Aerospace Engineering
Evan Grilley, Aerospace Engineering, **Karan Gaglani,** Aerospace Engineering
Noah Peterson, Aerospace Engineering, **Paul Brich,** Aerospace Engineering
Bruce Noble, Aerospace Engineering, **Jamison Pointdexter,** Aerospace Engineering
Matthew Fagen, Aerospace Engineering, **Ambar Das,** Aerospace Engineering
Brendan King, Aerospace Engineering, **Parker Scribner,** Aerospace Engineering

MENTORS

Scott Post, Aerospace Engineering
Stephen Bruder, Electrical, Computer and Software Engineering

Project Anubis' main objective is to design, fabricate, and fly a cold gas thruster attitude control vehicle in a stable hover for a short duration. This project will serve as a testbed to develop an active attitude control system for the Mountain Spirt Program. The project is a cost-effective approach in building a drone-like vehicle with two contra-rotating propellers for altitude control and using eight cold gas thrusters for pitch and roll attitude control. This project will utilize Dead Band control theory. The control algorithm will be programmed in MATLAB Simulink and compiled to a Raspberry Pi that will send commands to our thrusters and receive orientation data. Project Anubis has been broken down into four different phases of testing. For the first phase, the goal is to gain an understanding of the thrust characteristics from the thruster. The next phase will be an initial test of the attitude control software in one degree of freedom of motion. Following that will be tested on two degrees of motion. Our final phase will be our flight test to achieve a stable hover flight. For this URI application, the expected outcome is to finish our first two phases of testing, I.e., the thruster characteristics and testing the attitude control system on one degree of freedom. As a project under the Rocket Development lab (RDL), this project will help the students put attitude control theory into practice and become experts within the organization for other future projects.

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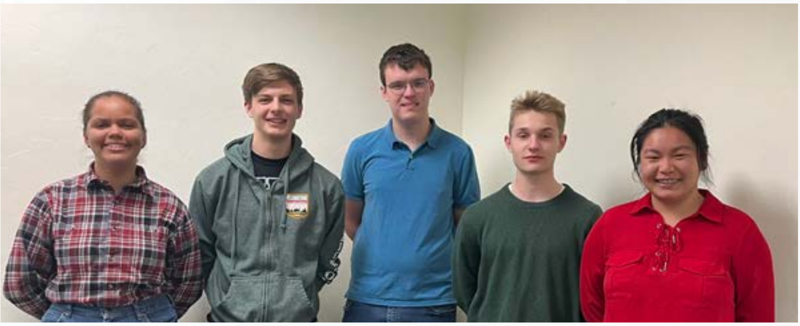


EFFECTS OF INFRASTRUCTURE ON COLLABORATION IN CLASSROOMS

Trey Talko, Aerospace Engineering
Alexia Richmond, Aerospace Engineering
Gabriel Novak, Aerospace Engineering
Angeline Masongsong, Aerospace Engineering

MENTORS

Hadi Ali, Aerospace Engineering
Ashley Rea, Humanities and Communication
Jonathan Adams, Humanities and Communication

The Innovative Spaces project will focus on finding the factors of a classroom that generate collaboration and communication. We intend to identify these factors by creating a questionnaire that will be modeled after existing collaboration scales for businesses and medical professionals. The questions will gather quantitative data about the number of times an object is used and qualitative data about how effective the item was at helping students and professors communicate ideas. This questionnaire will be completed by students and professors that have classes in traditional classrooms and classrooms that are modified to better suit student communication during group projects. This will allow differences between modified and traditional rooms to be analyzed to determine the benefit of changing a room's composition. The project will also take a measure of how malleable sections of the classroom environment are (chairs are easily movable; however, computers are not) and how that affects the abilities of students to collaborate as well. The projected outcome of the project is that the features that generate collaboration and communication will be identified and that the malleability of those factors can be used to project how quickly they could be implemented into more rooms on campus.

IGNITE AWARD

G-LOAD TESTER FOR ROCKETRY AVIONICS

Jordon Wallen, Mechanical Engineering
Chase Thompson, Mechanical Engineering
Megan Montaño, Aerospace Engineering
Madison Rice, Mechanical Engineering
Tiffany Shattler, Mechanical Engineering

MENTOR

Andy Gerrick, Mechanical Engineering

Not having a way of testing the avionics systems of solid propellant rockets causes the loss of both valuable data and money that was put into the resources used to build the rocket. This could all be caused by the avionics package failing during a launch. The proposed centrifuge design can produce and sustain fifty G's of acceleration for a minimum of thirty seconds to properly simulate the force experienced during a solid propellant rocket launch. The centrifuge will connect with a test article provided by the user which will mimic the onboard avionics compartment of a rocket. This will allow the users to observe what the effects of fifty G's would be on the avionics systems during a launch. Rocketry organizations will be able to use the results of the test to make changes to the avionics prior to an actual launch which will reduce the chances of the avionics separating during ascent, saving money spent on fuel and resources needed to build the rocket and increasing the chances of a successful launch in the future. The overall result of building the proposed centrifuge will be a reduction in failed rocket launches, and in turn the amount of money spent on fuel and resources will be lower. As well, the research opportunities will broaden without concern of a catastrophic setback such as a failed launch.

EAGLE PRIZE AWARD

ANALYSIS AND BREAKDOWN OF ORGANIZED RETAIL CRIME: TRENDS, METHODS AND COMBATING IT

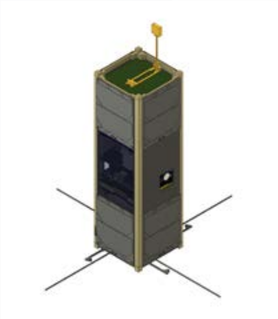
Stephanie Way, Global Business and Supply Chain Management
Nicholas Van Vliet

MENTOR

Allan Saquella, Global Security and Intelligence Studies

Organized Retail Crime(ORC) has been on the rise and has become an increasing concern for retailers as individual incidents increase in value and even violence with Organized Retail Criminals having more violent confrontations with retail employees. This research aims to understand and analyze ORC and those who commit it so targeted strategies can be developed and implemented to stop its rise. This research differs from typical retail strategies and research on ORC by focusing on the human aspect of why people commit ORC and what methods they employ. By understanding and looking at the problem from this human perspective there may be ways to decrease its prevalence without more locks, cameras, or guards. Through background research and interviews there is an increasing focus on fighting ORC by either better partnership with law enforcement and policy makers in order to punish Organized Retail Criminals or stricter controls on retail goods to prevent the merchandise from leaving the store in the first place. This research aims to prevent Organized Retail Crime in the first place, reducing the need for the other two strategies by tackling ORC in a new more preventative way. The objective of this project is to develop strategies for discouraging ORC without resorting to increased technological security measures. This research involves Interviewing people associated with ORC who both commit and combat it as well as looking at ORC data to find patterns or correlations between things like locations, dates, and times.

CBSI PHILANTHROPY COUNCIL AWARD AND IGNITE AWARD



EAGLESAT 2

Hayden West, Space Physics
Calvin Henggeler, Computer Engineering
Hayden Roszell, Software Engineering
Tyler Therman, Computer Engineering
Lillian Sudkamp, Aerospace Engineering

MENTORS

Ahmed Sulyman, Electrical, Computer and Software Engineering
Kathy Wood, School of Business

The EagleSat 2 spacecraft is a small cube satellite system with a conglomerate of several subsystems used to conduct scientific experiments about radiation science in LEO. The system will be able to collect and transmit data collected to the ground station at the Embry-Riddle Aeronautical University Prescott campus. Including two experiments called the Memory Degradation Experiment and the Cosmic Ray Payload. The satellite has 4 main critical subsystems; the Electrical Power Systems, Communications, On Board Computer, and Altitude Determination and Control System.

SPACE GRANT RESEARCH INFRASTRUCTURE

OPTIMAL FABRIC PREFERENCE FOR BED BUGS

Raelyn Yoshioka, Applied Biology

MENTOR

Corraine McNeill, Biology

Bed bugs (Cimex lectularius) are cryptic, nocturnal insects that prefer to aggregate in color specific harborages. Although it has been documented that bed bugs prefer coarse surfaces to smooth surfaces, there is very little research that exists on what fabric textures they prefer. In this study, four different red fabrics (100% polyester fleece, 100% polyester knit, 100% polyester microfiber, 600-count 100% Egyptian cotton) were used to determine fabric texture preferences for male and female adult bed bugs. This was accomplished by conducting 362 behavioral bioassays involving four fabric options. The four fabric harborages were randomly placed in a circle in the middle of a petri dish, so that bed bugs had an equal chance of choosing any of the four harborages. An individual bed bug was placed in the center of the four fabric options and given 10 minutes to make a choice. The majority of males (33% and 30%) preferred Egyptian cotton and knit fabric textures respectively, compared with microfiber and fleece. The majority of females (37% and 34%) also preferred Egyptian cotton and knit respectively compared with microfiber and fleece. Understanding bed bug fabric preferences can lead to a novel form of bed bug control that would allow the pest control industry to design traps enhanced by fabric textures.

IGNITE AWARD

THE EFFECTIVENESS OF USING AIR TRAFFIC CONTROL (ATC) LAB TO INCREASE NON-NATIVE ENGLISH-SPEAKING STUDENT PILOT'S ATC RADIO COMMUNICATION PROFICIENCY

Zihui (Amanda) Zhu, Aviation Business Administration
Shen-Chi (Daniel) Chiu, Aeronautics

MENTORS

Stacey McIntire, Aeronautical Science
Kyle Wilkerson, Applied Aviation Sciences

With the significant number of international flight students in the United States, finding alternative teaching methods for non-native English-speaking student pilots to surmount the language barrier, overcome radio communication challenges, and enhance flight training safety are critical. This research project aims to help foreign student pilots to improve their radio communication skills before and at the early stage of flight training by utilizing and expanding the current Air Traffic Control (ATC) Lab resource at Embry-Riddle Aeronautical University (ERAU) Prescott campus. The project created a well-designed ATC lab program that combines the current lab resource and uses flight simulation technology to help English as Second Language (ESL) student pilots without flight training experience overcome the language barrier in radio communication and flight training. The project focused on the quantitative aspect of the results and analyzed and evaluated the data through multiple data analysis methods. The result approved the ATC lab's effectiveness in increasing ESL student pilots' ATC radio communication proficiency.

COA PHILANTHROPY COUNCIL AWARD AND IGNITE AWARD

THANK YOU TO OUR DONORS

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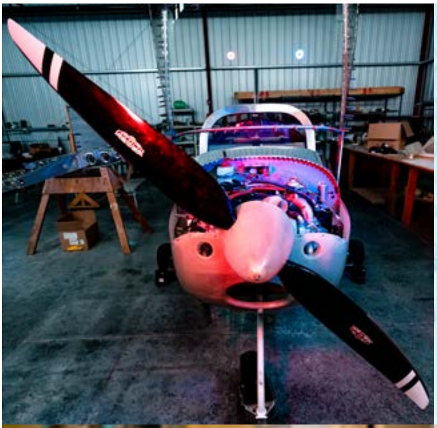

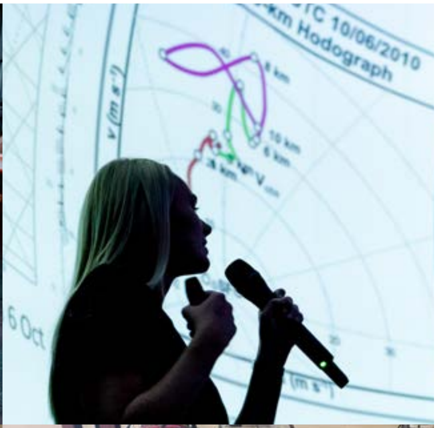

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