UNDERGRADUATE RESEARCH INSTITUTE

DISCOVERY 2022

RESEARCH ABSTRACTS

EMBRY-RIDDLE Aeronautical University

URI DISCOVERY
SCHEDULE OF EVENTS

FRIDAY, MARCH 25, 2022

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

SATURDAY, MARCH 26, 2022

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 & Sciences
Eagle Gym | 9:45 - 11:00 a.m.

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

ANETTE M. KARLSSON, PH.D.

Chancellor

Embry-Riddle
Aeronautical University
Prescott Campus

WELCOME TO URI DISCOVERY 2022

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!

Warm Regards,

ANETTE M. KARLSSON, PH.D.
Chancellor

ANNE BOETTCHER

Director

Undergraduate Research
Institute and Honors Program

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 2022 events. During the 2021-2022 academic year, the Undergraduate Research Institute was able to award a total of 29 Ignite research/scholarship grants and eight Eagle Prize competition grants, with an additional 10 projects funded through 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 space debris identification, to ones on identification of fire-retardant chemicals and applications of augmented reality in teaching. Eagle Prize teams will compete or have already competed in regional and national competitions including the including AIAA Design-Build-Fly, NASA RASC-AL and VEX Robotics. In addition, a team of students from our Cyber Intelligence & 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
Director,
Undergraduate Research Institute
and Honors Program

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UNDERGRADUATE RESEARCH INSTITUTE

Anne Boettcher, Director, **Alexandria Taylor** and **Tyler Levoy,** Student Research and Outreach Coordinators

A SPECIAL NOTE OF THANKS TO ALL OF OUR MENTORS!

INVITED ORAL PRESENTATIONS

ORAL PRESENTATIONS, MARCH 26

Preview Day Welcome: Parker Landon
Computer Engineering, College of Engineering and
Space Physics, College of Arts and Sciences
Activity Center | 9:00 - 9:30 a.m.

ACADEMIC PROGRAM MEETINGS

ORAL PRESENTATIONS, MARCH 26

COLLEGE OF ENGINEERING

Lorenzo Kearns
Computer Engineering, College of Engineering
Activity Center | 9:00 - 9:30 a.m.

Margaret Nicoli
Aerospace Engineering, College of Engineering
Activity Center | 9:45 - 11:00 a.m.

COLLEGE OF AVIATION

Bradley Riedle and Jordan Smith
Aeronautics, College of Aviation
Davis Learning Center | 9:45 - 11:00 a.m.

COLLEGE OF ARTS AND SCIENCES

Megan Peatt
Astronomy, College or Arts and Sciences
Eagle Gym | 9:45 - 11:00 a.m.

Remington Davis
Industrial & Organizational Psychology, College of Arts and Sciences
Eagle Gym | 9:45 - 11:00 a.m.

COLLEGE OF BUSINESS, SECURITY & INTELLIGENCE

Hannah Ohm and William Noujam
Cyber Intelligence and Security Department,

Archer Bazaure-Dilts
Global Business and Supply Chain Management,
College of Business, Security and Intelligence

The Hangar | 9:45 - 11:00 a.m.

URI DISCOVERY POSTERS

(Number Corresponds to Poster/Demonstration Number)

FRIDAY, MARCH 25, 2022

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

1. **Tip Driven Rotor System**
   Kevin Allyas
   Mentor: Gary Costentino
2. **Proposal to Augment the U.S. Army Light Scout Aircraft and Unmanned Aerial Reconnaissance Systems**
   Cameron Beard
   Mentor: Johann Dorfling
3. **Space Debris Characterization using Machine Learning Methods**
   Anson Biggs and Ana Bader-Elenes
   Mentors: Mehran Andalibi and Ron Madler
4. **The Effects of Equivalence Ratio During Shutdown of a Rocket Engine on Hardware Longevity**
   Benjamin Black
   Mentor: Elliott Bryner
5. **Monitoring Environmental Trends in Levels of Influenza Virus and SARS-CoV-2 in Prescott, AZ**
   Jade Blackert and Daniella Cowles
   Mentor: Hillary Eaton
6. **Eaglenautics: SAE Aero West Design Competition Team**
   Steven Booth, Jessica Millard and Celin Rawther
   Mentor: Shigeo Hayashibara
7. **Thermal Analysis of the Temperature Gradient Across Pintle Injector Face**
   Zoe Brand
   Mentor: Elliott Bryner
8. **Studying Aspects of Teamwork and Communication |in a Virtual Reality Environment**
   Remington Cole Davis and Jaacob Pledger
   Mentor: Heather Lum
9. **Identification of Fire-Retardant Chemical Treatments via Instrumental Analysis**
   Caitlin Dillon
   Mentor: Rachael Schmidt

10. **MyBody Safety System**
    Diego Draguicevich and Nicholas Rodriguez
    Mentor: Sameer Abufardeh

11. **AIAA Design Build Fly Humanitarian UAV**
    Michael Finigian, Kyle Abbas, David Fryer, Kyle Bartholomew, Jacob Kaufman, William Ryan, Tyler Kwapniowski and Adam Witusik
    Mentors: Joseph Smith and Johann Dorfling

12. **Overcoming Physiological Challenges of Microgravity in Space**
    Arantza Garcia Perez, Jennifer Inions and Ethan Carlson
    Mentor: Stephen Waples

13. **A Climatology of Convective Cells in the Southwest**
    Greta Graeler and Jay Park
    Mentor: Curtis James, **Co-Authors:** Carter Humphreys, Ronny Schroeder, Mark Sinclair and Andrew Taylor

14. **Airline Innovation Project**
    Nicholas Hight and Emma Rasmussen
    Mentor: Stathis Kefallonitis

15. **EagleSat-II Memory Degradation Experiment**
    Shane Howe and Calvin Henggeler
    Mentor: Ahmed Sulyman

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

17. **Arizona Pilot's Association Passport Project**
    Danielle Jamieson, Shannon Dohrman, Christopher Hylton, Jacob Christensen, Paige Cody, Paige Thompson, Cordaellia Farrell and Ashton McDonald
    Mentors: Reginald Parker and Heather Marriott

18. **Debris Acquisition and Deorbit System (DADS)**
    Michael Klooster, Britney Alvarez, Jefferson Bahe, Pedro Mena Barranco, Erik Harang, Lance Klussmann, Michael Mooney and Eleanor Pahl
    Mentors: Davide Conte and Richard Mangum

19. **Quantizing the Unseen: GIG Undergraduate Optical Research**
    Parker Landon
    Mentor: John Pavlina

20. **Prescott Observation Team for Analyzing Telescopically Observed Spectra**
    Alexis Lane, Andrea Daly, Krister Barclay, Clarissa Pavao, Lauren Perez, Amara Williams, Hailey Beier, Kaitlyn Casciotti, Samantha Garcia-Flores, Abiagael Parks, Caitlyn Ooms, Tri Phan, Zachary Ramsey and Bradley Rudy
    Mentor: Noel Richardson

21. **Low Frequency Prototype of Laser Interferometer Suspensions for Gravitational Wave Detection**
    Yuka Lin and Skylar Kemper
    Mentor: Michele Zanolin

22. **A Climatological Analysis of Convection in the Trentino Region of the Italian Alps**
    Jackson Macfarlane and Greta Graeler
    Mentor: Curtis James

23. **Eagle Aero Sport - Aircraft Construction & Research**
    Ivana Martinez, Bailey Cortright, Evan Hefflin, Tucker Kreisler, Ben Malone, Adam Witusik, Carson Karle, Camron Avent, Kyle Abbas and Mark Soerheide
    Mentor: Gregory Reverdiau

24. **Evaluating the Effectiveness of Simulated Flight into Inadvertent IMC**
    Elizabeth Mitchell
    Mentor: Dawn Groh

25. **Small Arm-Length Interferometry for U-Class Spacecraft**
    Shannon Moore and Logan Caudle
    Mentor: Michele Zanolin

26. **Portable Utility Pallet by Embry-Riddle**
    Connor Murphy, Teresa Jimenez Nickerson, Marcus Mifsud, Brady O'Hayer, Jason Johnson, Carlos Rodriguez and Lucas Tuff
    Mentors: Daniel White and Rick Mangum

27. **Aerodynamics of a Gurney Flap on Production Enthusiast Cars**
    Codey Neises and Aditya Hoskere
    Mentor: Amzad Hossain

28. **Optimized Navigation for Autonomous Sailing**
    Margaret Nicoli and Lorenzo Kearns
    Mentor: Matt Pavlina

29. **CyberAero'22 Competition**
    Hannah Ohm, Victoria Plinski and William Noujaim
    Mentor: Krishna Sampigethaya

30. **How Does Dust Form Around Carbon-Rich Wolf-Rayet Stars?**
Megan Peatt and Emelito Medina
Mentor: Noel Richardson

31. **EagleSat II- Attitude Determination and Control System**
Grayson Peeler
Mentor: Ahmed Sulyman

32. **Radiation vs Pixel Intensity Testing and Back-end Data Analysis Setup / EagleSAT II Mission Planning**
Tri Phan
Mentor: Ahmed Sulyman

33. **Demystifying the Uses and Misuses of Technology During the 2019 Bolivian Election**
Vicky Ross
Mentor: Thomas Field

34. **EagleSat HWIL Simulation**
Samuel Sandelin
Mentor: Ahmed Sulyman

35. **Effect of Cambered Leading-Edge Extensions and Strakes on High Lift Producing Wings**
Jaron Sherwood
Mentor: Shigeo Hayashibara

36. **Project ApART: Advancing Learning and Training Technology Through the Use of Augmented Reality**
Joshua Snow
Mentor: Derek Fisher

37. **What Drives the Variability in Luminous Blue Variable Stars?**
Rebecca Spejcher and Marina Beltran
Mentor: Noel Richardson

38. **The EagleSat II: Fabrication Final Developments**
Lillian Sudkamp
Mentor: Ahmed Sulyman

39. **Novel Hybrid Approach to Launching Small Payloads to Sub-Orbital Space**
Kevin Sweet, David Anderson, Ambroise Juston, Zhaoyu Wang, Nikolas Rodnunsky, Julian Turner and Ethan Barsky
Mentors: Richard Lehman and Keke Wang

40. **Assessing the Viability of Asteroid Refueling on the Way to Mars**
    Julian Treat
    Mentor: Davide Conte

41. **Masks Mightier Than the Sword: Analyzing the Effects of Global Shocks on Human Conflict**
    Nicholas Van Vliet and Danny Breslin
    Mentor: Tyrone Groh

42. **Design and Characterization of Liquid Fuel Spray Injector**
    Rebekah Weigand
    Mentor: Elliott Bryner

43. **VEX Robotics**
    Hayden West, Laura Vandiver, Talise Brown and Mayra Bibiano
    Mentor: Joel Schipper

44. **OD Laser**
    Olivia Womack and Ethan Carlson
    Mentor: Daniel White

URI DISCOVERY ORAL PRESENTATIONS

SATURDAY, MARCH 26, 2022

The Hangar | 2:00 - 3:00 p.m.

1. **Interactive Planetarium Project**
   Eric Babcock, Cody Park and Johann Van Hilst
   Mentor: Michael Van Hilst

2. **Team Keryx: Project LifeLink**
   Robert Belz-Templeman, Evan Hefflin, Jessica Millard, Ariana Anderson, Jacob Hindmarsh and Corey Washburn
   Mentor: Johann Dorfling

3. **Thermal Analysis of the Temperature Gradient Across Pintle Injector Face**
   Zoe Brand
   Mentor: Elliott Bryner

4. **Reconnaissance and Documentation**
   Cayli Farias, Terra Gordon, Sharik Joseph, Julia Kjenstad, Michael Lauber, Dakota Ross, Logan Hill, Dominick Uzzardo and Richard Harold
   Mentor: Davide Conte

5. **Hydrogen Fuel Application in Aerospace**
   Ethan Garber, Max Martin, Paul Farrah and Matthew Prevatt

6. **Investigation of Infill Pattern on Parts Manufactured with Fused Deposition Modeling**
   Logan Hill, Trey Brown, Alexandre Lasalarie and Hope Elmer
   Mentor: David Lanning

7. **Debris Recognition and Identification Platform — "DRIP"**
   Joseph Johnson, Trenton Bandy, Tyler O'Donnell-Paccione, Evelia Zapien Ramos, Rowan Molitor, Megan Chavez, and Maddy Devaney
   Mentor: Davide Conte

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

9. **EagleSat II: Satellite Communication Development in an Undergraduate Environment**
   Joshua Parmenter and Hayden Roszell
   Mentor: Ahmed Sulyman

10. **Investigation of Long-Distance Video and Telemetry Streaming**
    Nicodemus Phaklides and Zachary Howe
    Mentors: Yabin Liao and Douglas Isenberg

11. **Structural Dynamics Modelling of Complex Structures Using LSTM Recurrent Neural Networks**
    Biswas Poudel
    Mentor: Yabin Liao

12. **Analysis of Cosmetics as Trace Evidence**
    Gabriella Reece, Makenzie Bartlett, Alison Flynt and Gabrielle Pingleton
    Mentor: Teresa Eaton

13. **A UX Participatory Design Study: Understanding the Local Scene of Writing/Designing at ERAU-Prescott**
    Clarissa Winks and Marcos Osuna
    Mentors: Erin Cromer Twal and Heather Lum

TIP DRIVEN ROTOR SYSTEM

Kevin Allyas, Mechanical Engineering

MENTOR

Gary Costentino, Aerospace Engineering

The Tip-Driven Rotor System (TDRS) Project is a product designed for KRyanCreative, LLC (KRC), as the basis of a Levitated Annular Rotor System (LARS) for commercial and tactical military vertical takeoff and landing (VTOL) vehicles. Conceptually, this design will greatly increase power density and lift capacity over conventional shaft-centric helicopters. The design also enables variable rotational velocity control that can greatly expand the VTOL flight envelope. The LARS innovatively leverages electromagnetism and superconductive levitation in the transfer of energy from vehicle source to aerodynamic lifting surface. The benefits of LARS include: the reduction of wing tip vortices due to a closed rotor system, the elimination of friction of major moving parts and the elimination of electrical losses due to superconductivity. KRC is designing an aircraft capable of carrying one intermodal shipping container as a payload using six LARS. KRC and Embry-Riddle Aeronautical University (ERAU) in Prescott, AZ have agreed to collaborate on the development of LARS in the form of a senior capstone design project which was not completed due to the COVID-19 pandemic and has been continued as a project for undergraduate research ever since.

The current objective of the LARS TDRS is the display of a properly running/operating system. The demonstrator should be capable of meeting the threshold requirements set forth by KRC; generate and sustain, through electromagnetic means, sufficient angular velocity to the rotating assembly to create a useful amount of thrust.

IGNITE AWARD

INTERACTIVE PLANETARIUM PROJECT

Eric Babcock, Software Engineering
Cody Park, Software Engineering
Johann Van Hilst, Software Engineering

MENTOR

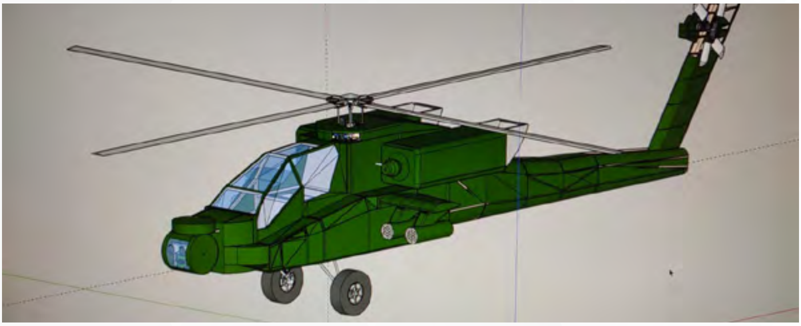
Michael Van Hilst, Electrical, Computer and Software Engineering

The Interactive Planetarium Project will design and build the software framework for connectivity between the Digistar 6 planetarium projection software and the smartphones of all audience members in the Jim and Linda Lee Planetarium. The goal of this project is to make planetarium shows more participatory, add a feature to our planetarium shows that many other universities do not yet have, and create a framework for future students and faculty to build from. To demonstrate our technology, we will make a real-time competitive trivia game able to support 60 concurrent users (number of expected audience members in the planetarium).

The framework created by the Interactive Planetarium Project will serve as a unique opportunity that will allow future students to explore and create more complex interactive software within the planetarium with mass scale audience participation. The project will also be an additive to the current STEM Outreach program, gaining the attention of outside communities to this new experience provided at the Jim and Linda Lee Planetarium, with the potential to be used not just for video games played by the audience but also for interactive planetarium shows, surveys or group activities.

This project is based on modern web programming paradigms as well as research in the Human-Computer Interaction space. Smartphones are ubiquitous and the ability for them to interact with the world around us is a frontier that is still being explored. This project aims to explore how smartphones can make shows and performances more engaging and participatory.

IGNITE AWARD



PROPOSAL TO AUGMENT THE U.S. ARMY LIGHT SCOUT AIRCRAFT AND UNMANNED AERIAL RECONNAISSANCE SYSTEMS

Cameron Beard, Aerospace Engineering

MENTOR

Johann Dorfling, Aerospace Engineering

The U.S. Army currently has a gap in its aerial reconnaissance capabilities, with the OH-58D Kiowa completing its phase transition to the AH-64E. Since the Army has done away with its rotary-wing scout aircraft, it currently relies on the AH-64E attack helicopter (an aircraft not designed for such a role), in tandem with UAS RQ-7Bs and MQ-1C Grey Eagle. These aircraft use the MUM-T (Manned-Unmanned Teaming) system, which allows AH-64E pilots to control the camera and weaponry of the drones while both aircraft are in flight. The draw back to this system lies in two categories; 1) the inability for a heavy attack aircraft to perform highly-maneuverable in a light-reconnaissance mission, and 2) The inability for either the RQ-7B or the MQ-1C to be used without perfect weather conditions, increasingly constant maintenance, limited flight range (RQ-7B), and the inability of the aircrafts' weaponry capabilities to be used in a close air-support (CAS) setting in which the OH-58D has been traditionally used. This research project will explore an alternative to this gap, combining the reconnaissance advantages of current UAS systems with the capabilities of current-use and previous light scout aircraft.

Current project progress has been made on CAD modeling, airframe construction, electronic wiring, and MATLAB programming. Phase 1 of the project uses an existing model of an AH-64E due to existing specifications, that will be used to integrate flight, weapons, communications and existing army systems as a rotary-wing reconnaissance aircraft proof of concept.

TEAM KERYX: PROJECT LIFELINK

Robert Belz-Templeman, Aerospace Engineering
Evan Hefflin, Aerospace Engineering
Jessica Millard, Aerospace Engineering
Ariana Anderson, Aerospace Engineering
Jacob Hindmarsh, Aerospace Engineering
Corey Washburn, Aerospace Engineering

MENTOR

Johann Dorfling, Aerospace Engineering

First responders such as wildland firefighters, search and rescue crews, and disaster relief workers often operate in cellular-service-denied environments. This lack of long-range communication channels greatly inhibits the spread of vital information. Project LifeLink is Team Keryx's capstone project designed to solve this issue as well as meeting the course goals of AE 420/421. The course goals for AE 420/421 are to utilize the skills and knowledge obtained in prior classes to design, develop, build, and test an aircraft tailored to a specific challenge. The students will work together in an organized structure and process to prepare them for industry after graduation. Project LifeLink is divided into three parts: the aircraft, a communications payload that will interact with the first responders, and a ground station that assists with communication. Team Keryx is responsible for the aircraft design, and a separate computer/electrical/software engineering capstone team is concurrently designing a communications payload that will be installed into the aircraft. For this project, Team Keryx will be designing and building a wind tunnel model to verify aerodynamic predictions and a vertical flight demonstrator to verify performance and payload integration functionality.

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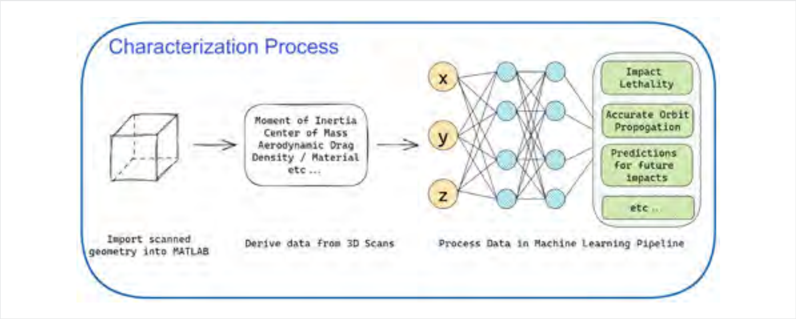

SPACE DEBRIS CHARACTERIZATION USING MACHINE LEARNING METHODS

Anson Biggs, Aerospace Engineering
Ana Bader-Elenes, Aerospace Engineering

MENTOR

Mehran Andalibi, Mechanical Engineering
Ron Madler, Aerospace Engineering and Dean of College

Orbital debris is a form of pollution that is growing at an exponential pace and puts current and future space infrastructure at risk. Satellites are critical to military, commercial, and civil operations. Unfortunately, the space they occupy is increasingly becoming more crowded and dangerous, potentially leading to a cascade event that could turn orbit around the Earth into an unusable wasteland for decades proper mitigation is not introduced. Unfortunately, existing models employed by NASA rely on a dataset created from 2D images and are missing many crucial features required for correctly modeling the space debris environment. Our approach uses high-resolution 3D scanning to fully capture the geometry of a piece of debris and allow a more advanced analysis of each piece. This approach, coupled with machine learning methods, will allow advances to the current cutting edge. Physical and photograph-based measurements are time-consuming, hard to replicate, and lack precision. 3D scanning allows much more advanced and accurate analysis of each debris sample, focusing on properties such as moment of inertia, cross-section, and drag. With these additional properties, we stand to substantially increase our understanding of the space debris environment through advanced characterization of each piece of debris. Once the characteristics of space debris are more thoroughly understood, we can begin mitigating the creation and danger of future space debris by implementing improved satellite construction methods and more advanced debris avoidance measures.

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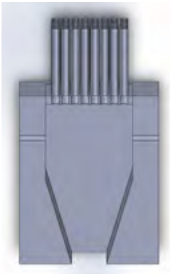

THE EFFECTS OF EQUIVALENCE RATIO DURING SHUTDOWN OF A ROCKET ENGINE ON HARDWARE LONGEVITY

Benjamin Black, Mechanical Engineering

MENTOR

Elliott Bryner, Mechanical Engineering

During the shutdown or purge period after firing of a rocket engine it is critical to understand what equivalence ratios are desirable and implement a shutdown sequence so that the hardware is subjected to the lowest thermal and mechanical loading. Furthermore, it is essential that hazards to the test technicians caused by this method be minimized. The initial study was conducted into combustion mechanics, to understand how the reactants would ideally behave at varying equivalence ratios and in both pre-mixed and diffusion flame combustion. Using this foundation an analytical model for a Propane-Oxygen flame was created and tested using a scale combustion chamber and a pre-mixed gaseous flame. Finally, the pressure and exhaust gas temperature data will be used to create a solution to be implemented for further full-scale testing on a Kerosine-LOX liquid rocket engine.

SPACE GRANT RESEARCH INFRASTRUCTURE

MONITORING ENVIRONMENTAL TRENDS IN LEVELS OF INFLUENZA VIRUS AND SARS-COV-2 IN PRESCOTT, AZ

Jade Blackert, Forensic Biology
Daniella Cowles, Forensic Biology

MENTOR

Hillary Eaton, Biology and Chemistry

Every year, the Centers for Disease Control and Prevention and state health agencies collect surveillance data for cases of influenza. During the flu season of 2019, SARS-CoV-2, which causes the symptoms known as COVID-19, caused a global pandemic. In turn, the surveillance and testing data showed a dramatic drop in influenza case numbers compared to previous years. Influenza is one of the deadliest viruses in human history, so it seems unlikely that this drastic change would occur due to the emergence of a similar virus. This research is designed to show that the prevalence of influenza in the community of Prescott, Arizona is much the same as during most flu seasons and is comparable to the prevalence of SARS-CoV-2. To do so, environmental sampling of a gas station, courthouse, urgent care center, a Walmart and a university library was conducted to obtain a base-level of viral RNA present on various highly touched surfaces throughout the fall and winter viral respiratory season, which runs from October through April each year. RNA extraction to isolate the viral RNA present in the environment was performed. Levels of viral RNA present were quantified through real-time quantitative reverse transcription polymerase chain reaction (RT-qPCR). The results of the RT-qPCR will be interpreted to quantify the levels of influenza and SARS-CoV-2 RNA present on the sampled environmental surfaces. This data will be compared to an analysis of the public health data throughout the 2021-2022 viral respiratory season.

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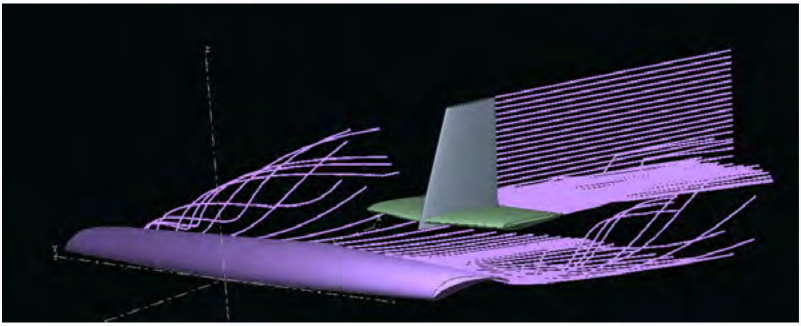


EAGLENAUTICS: SAE AERO WEST DESIGN COMPETITION TEAM

Steven Booth, Aerospace Engineering
Jessica Millard, Aerospace Engineering
Celin Rawther, Aerospace Engineering

MENTOR

Shigeo Hayashibara, Aerospace Engineering

Eaglenautics is an engineering club affiliated with Embry-Riddle Aeronautical University. Every year, Eaglenautics participates in the SAE Aero West Design Competition. This competition challenges teams to design a competitive R/C scale aircraft from the ground up. Eaglenautics tackles this challenge by using a modified design-build-fly (DBF) process by adding a simulation step after the design step. Simulation software allows for a faster convergence to a design before the build process starts. Eaglenautics utilizes simulation programs like XFLR5 and OpenVSP to aid with the design of the aircraft to save time building multiple aircraft iterations. This process is especially helpful for Eaglenautics because of the size and complexity of the aircrafts. The competition requires teams to design a heavy lift aircraft that must carry steel plates and a minimum of one soccer ball. Due to these competition requirements, this year's aircraft has a 6.8 ft wingspan and a length of about 6.4 ft. The gross take-off weight of the aircraft will be about 30-32 lbf. The process that Eaglenautics follows to design aircraft more closely mimics a typical design process of companies in the Aerospace industry. This in turn provides students with experience that is applicable to Capstone projects and jobs in the Aerospace industry. In the picture is an example of the aircraft's finale iteration of the wing and vertical and horizontal stabilizers in XFLR5. An XFLR5 simulation was performed that showed the streamlines of the air leaving the wing and control surfaces.

EAGLE PRIZE AWARD

THERMAL ANALYSIS OF THE TEMPERATURE GRADIENT ACROSS PINTLE INJECTOR FACE

Zoe Brand, Mechanical Engineering

MENTOR

Elliott Bryner, Mechanical Engineering

Proper analysis of the temperature gradient across the pintle injector face is a complicated surface to acquire a reading from. Complications arise from the extreme temperatures seen on the combustion side mixed with the ambient temperatures seen on the fuel side of the injector. The orientation of temperature sensor placement is critical to mitigate hot spots and not disrupt the thermal flow through the injector face. The installment of the temperature sensors is also a critical issue since a new medium would need to be added to keep the sensor in place. The goal of this research is to figure out the correct orientation of temperature sensors to acquire an accurate depiction of the thermal gradient.

SPACE GRANT RESEARCH INFRASTRUCTURE

STUDYING ASPECTS OF TEAMWORK AND COMMUNICATION IN A VIRTUAL REALITY ENVIRONMENT

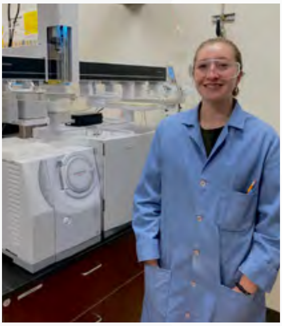
Remington Cole Davis, Industrial Organizational Psychology
Jaacob Pledger, Human Factors Psychology

MENTOR

Heather Lum, Department of Behavioral and Social Sciences

This study aims to look at levels of teamwork and communication in virtual reality gaming systems. Researchers hope to analyze participants' communication during the study with the assistance of Virtual Reality. This will allow an experimental view of how subjects interact together when presented with a difficult situation that requires communication to be their top priority if they wish to succeed as a team. Researchers believe that this experiment will allow a better look into the human element of Virtual Reality. This data will prove useful for a variety of applications beyond this study including, but not limited to, consumer, military and computer-based training simulations.

IGNITE AWARD



IDENTIFICATION OF FIRE-RETARDANT CHEMICAL TREATMENTS VIA INSTRUMENTAL ANALYSIS

Caitlin Dillon, Chemistry

MENTOR

Rachael Schmidt, Biology and Chemistry

Fiber trace evidence is one of the most common forms of evidence found at a crime scene; these evidentiary items often have unique flame retardant chemical compositions or volatile chemical signatures. The retardant compounds can be used as an additional piece of evidence to trace a fiber from a victim to a source sample. This analytical comparison will require the use of specialized equipment available at the Prescott campus of Embry-Riddle Aeronautical University. This equipment and instrumentation includes 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 non-destructive testing of samples. Each instrument allows for a different means of flame retardant identification in carpets and fibers. This project aims to determine the feasibility of creating a universal testing protocol to match any flame retardant compounds present in an unknown or trace evidentiary sample to a known or crime scene sample.

IGNITE AWARD

MYBODY SAFETY SYSTEM

Diego Draguicevich, Software Engineering
Nicholas Rodriguez, Computer Engineering

MENTOR

Sameer Abufardeh, Electrical, Computer and Software Engineering

To any university, the safety of students, faculty, and staff when on campus is paramount. To enhance safety, many campuses have "safety stations" of some sort scattered throughout. However, campuses such as Embry-Riddle Prescott also have hiking trails nearby. Safety pillars on hiking trails would be prohibitively expensive to build and maintain, and would also be less useful due to a longer response time for security officers. The MyBody System seeks to resolve these issues by introducing a system which is affordable, self-enclosed, solar powered and easy to maintain. The system would achieve this via custom wireless speakers disguised as rocks. This system would be able to play a loud sound such as a police siren when activated via either an app on a phone or some sort of wearable device. While an attacker might not be completely deterred, any hesitation on their part would give would-be victims precious seconds to reach safety.

IGNITE AWARD

RECONNAISSANCE AND DOCUMENTATION

Cayli Farias, Mechanical Engineering
Terra Gordon, Aerospace Engineering
Sharik Joseph, Aerospace Engineering
Julia Kjenstad, Aerospace Engineering
Michael Lauber, Aerospace Engineering
Dakota Ross, Aerospace Engineering
Logan Hill, Aerospace Engineering
Dominick Uzzardo, Aerospace Engineering
Richard Harold, Software Engineering

MENTOR

Davide Conte, Aerospace Engineering

The Reconnaissance and Documentation (RAD) mission aims to utilize a Low Earth Orbit satellite using machine learning enabled image recognition and optical remote sensing to observe countries currently experiencing Stage Nine of the United Nations' Ten Stages of Genocide. The primary objective of the RAD satellite, Leza, is to observe high-risk countries at adequate spatial and temporal resolutions to capture evidence of genocide. The secondary objective of Leza is to process images on-board, so flagged images serving as evidence may be distributed to proper authorities, the United Nations, and mainstream media outlets as soon as possible. Using remote sensing to survey the surface of the planet is far from a new concept but using it to uphold current international human rights laws is revolutionary. Evidence gathered during the operational lifetime of the satellite could be used not only to persecute those inflicting chaos, but also to push for new policies on the international level.

A prototype system that will test the machine learning software on the ground before utilization aboard Leza includes a drone, Olorun, and testing payload, OWL. The Olorun drone will act as a testing platform for image recognition software developed as part of the OWL payload. OWL will use a pre-trained neural net to evaluate if 3D modeled test beds of simulated evidence of genocide can be identified. This prototype will also analyze the capability to downlink images of interest and discard irrelevant photos. Testing of the Olorun and OWL will be completed in April 2022.

IGNITE AWARD

AIAA DESIGN BUILD FLY HUMANITARIAN UAV

Michael Finigian, Aerospace Engineering
Kyle Abbas, Aerospace Engineering
David Fryer, Aerospace Engineering,
Kyle Bartholomew, Aerospace Engineering
Jacob Kaufman, Aerospace Engineering
William Ryan, Aerospace Engineering
Tyler Kwapniowski, Aerospace Engineering
Adam Witusik, Aerospace Engineering

MENTOR

Joseph Smith, Aerospace Engineering
Johann Dorfling, Aerospace Engineering

Every year AIAA issues a challenge to any undergraduate universities willing to meet it: to build an unmanned aerial vehicle (UAV) designed to mission and product characteristics. This year the UAVs are to carry two different payloads in four missions with varying objectives, take-off distances, flight times and flight distances. The two payloads are large plunger syringes and mock vaccine vial packages. The Embry-Riddle Prescott team has decided that the best way to approach these competitions is to split responsibilities evenly between four integrated product teams (IPTs); Aerodynamics, Structures, Propulsion and Missions. In the early stages of the design process, Missions is responsible for deciding the objectives of the team's design considering the mission constraints. This year Missions recommended the UAV carry 4 packages and 50 syringes due to energy constraints and to balance quantity against loading time. The Aerodynamics IPT is responsible for weighing the concerns of the Missions, Structures, and Propulsion teams to develop a configuration for the UAV. This year the Aerodynamics IPT decided on a high "Hershey bar" wing with an aspect ratio of 7, a conventional tail, and tricycle landing gear. While Structures is modeling and building the plane, Propulsion does research for their recommendation of the motors and propellers, which are then mounted on various prototypes to test their viability. This year Propulsion recommended Sunny Sky V4014 motors and 10x16E propellers. The team is currently refining the integrated prototypes, with delivery mechanisms built by the Missions IPT.

EAGLE PRIZE AWARD

HYDROGEN FUEL APPLICATION IN AEROSPACE

Ethan Garber, Aerospace Engineering
Max Martin, Aerospace Engineering
Paul Farrah, Aerospace Engineering
Matthew Prevatt, Aerospace Engineering

How can hydrogen fuel technology be applied to aerospace? In our presentation, we will detail the process of reverse electrolysis and how it can be optimized and applied to aircraft. In our ongoing design project, the development of an autonomous aircraft to monitor forested areas that are susceptible to wildfires, we have designed the aircraft to be powered by a series of hydrogen fuel cells. Since we have decided to design and produce our own fuel cell system for our aircraft, we are going to be displaying the research we have done on hydrogen electric systems parallel to the design of the aircraft as a way of demonstrating the usage in aerospace. We will also take the opportunity to highlight certain areas that we are optimizing in the propulsion system and present current models and states of the aircraft.

IGNITE AWARD

OVERCOMING PHYSIOLOGICAL CHALLENGES OF MICROGRAVITY IN SPACE

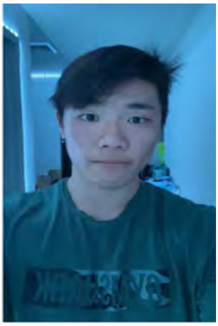
Arantza Garcia Perez, Forensic Biology
Jennifer Inions, Applied Biology
Ethan Carlson, Aerospace Enginnering

MENTOR

Stephen Waples, Biology and Chemistry

Space is a microgravity environment that poses many complex challenges. Among such challenges are the physiological effects of microgravity on the human body, such as bone and muscle atrophy. While in space, astronauts submit to a strict, time-consuming exercise regimen to maintain muscle mass and prevent bone demineralization. An exercise apparatus has been designed to combat this dilemma by addressing the physiological and psychological aspects of physical fitness. This apparatus combines the flexibility of cables with the simplicity of the flywheel to allow astronauts to perform a vast range of exercises, mimicking both machine work and free weights. This versatility allows astronauts to focus on many muscle groups with minimal focus on the potential challenges of a low gravity environment. The interactive interface of the apparatus provides a means of motivation and social support during fitness training to parallel working out in a group or with a trainer on Earth. A fitness schedule has also been created to complement the designed exercise apparatus. The fitness schedule focuses on a balance between concentric and eccentric muscle contraction exercises, strengthening over 90% of all human muscle groups that affect the skeletal structure of the astronauts' physical health.

SPACE GRANT AWARD

A CLIMATOLOGY OF CONVECTIVE CELLS IN THE SOUTHWEST

Greta Graeler, Applied Meteorology
Jay Park, Unmanned Aircraft Systems

MENTOR

Curtis James, Applied Aviation Sciences

CO-AUTHORS

Carter Humphreys, Flagstaff National Weather Service Forecast Office
Ronny Schroeder, Applied Aviation Sciences
Mark Sinclair, Applied Aviation Sciences
Michael Kaplan, Applied Aviation Sciences
Andrew Taylor, Central Illinois National Weather Service Forcast Office

Convection in mountainous climates is often responsible for severe weather, flash flooding, and critical fire weather. This study investigates the initiation and propagation of convective cells in the Southwestern United States. To identify convective cell tracks, we apply an automatic detection and tracking algorithm to Multi-Radar, Multi-Sensor (MRMS) precipitation data. Any convective cell exceeding minimum reflectivity and area thresholds during a 7-year period (2015-2021) are tracked, and centroid location, area, and intensity of the cell are recorded in time and space. These cell tracks enable the creation of a climatology of convection using statistical clustering. The study also uses reanalysis data to reveal which atmospheric variables influence convective cell initiation and propagation as a guide to National Weather Service forecasters. So far, the results are consistent with terrain influences. Mountainous regions have more convection and convection initiation in their vicinity than regions without mountains. However, the area occupied by the cells tends to be larger over the adjacent valleys. The results of this research will help give meteorologists a clearer understanding of thunderstorm behavior in complex terrain.

AIRLINE INNOVATION PROJECT

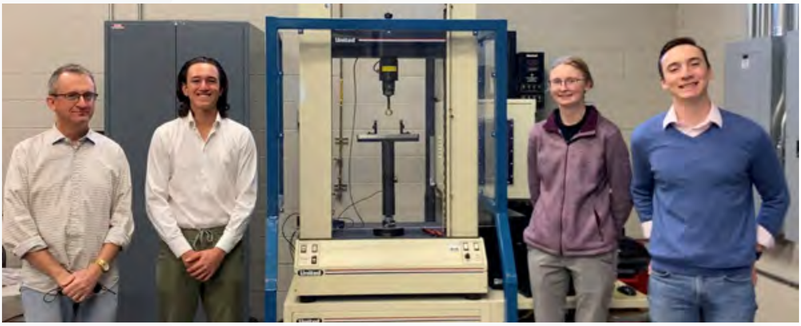
Nicholas Hight, Business Administration
Emma Rasmussen, Aviation Business Administration

MENTOR

Stathis Kefallonitis, School of Business

The goal of this project is to take a closer look into how customers perceive the product of flying on an airline such as JSX and then take that knowledge to find ways to improve the passenger experience. This project will also expose students to biometric sensory technology. This technology allows researchers to examine the emotions of people, which is useful in understanding how specific changes may affect the passenger experience. Identifying how different passenger touchpoints can enhance the experience is a key component of this study. By gaining a deeper understanding of how people may think about certain changes we can then use that information to make educated recommendations. Ultimately our suggestions will lead to potential improvements in the experience for JSX passengers. The mindset of these changes is that to maximize the customer's perceived value, you must create positive and memorable touchpoints. Examples of these touchpoints include what type of food the passenger is served during the flight, how the interior of the cabin is designed and what sort of services the customer receives before and after the flight. Adjusting simple things like these can greatly improve the experience of passengers and can also lead to higher ticket sales.

IGNITE AWARD



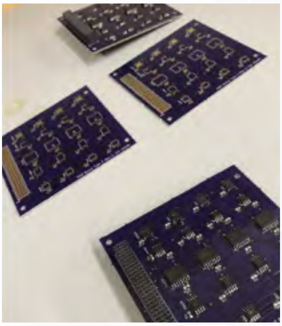
INVESTIGATION OF INFILL PATTERN ON PARTS MANUFACTURED WITH FUSED DEPOSITION MODELING

Logan Hill, Aerospace Engineering
Trey Brown, Aerospace Engineering
Alexandre Lasalarie, Aerospace Engineering
Hope Elmer, Aerospace Engineering

MENTOR
David Lanning, Aerospace Engineering

Fused Deposition Modeling (FDM), a common method of additive manufacturing, has experienced significant growth in recent years. A barrier to the widespread use of FDM is that a part's material properties depend upon the process parameters used during production. While certain process parameters have been examined in the existing literature, the effects of various infill patterns at varying infill densities have not been fully explored. One aim of this study is to determine which infill patterns improve a part's mechanical properties and to observe how these mechanical properties change as infill density increases. This study also observes the effect of stress concentrations in FDM parts in the context of various infill patterns. Infill patterns are examined based on their tensile properties, which are determined via standard tensile testing. The infill patterns observed are rectilinear, honeycomb, cubic, concentric and gyroid with infill densities of 20%, 40%, 60% and 80%. Trends indicate that at higher infill densities specimens are stronger and stiffer. Additionally, certain infill patterns are more effective at carrying axial loads and certain infill patterns may improve bonding, increasing overall strength and stiffness. Finally, stress concentrations in FDM parts do not appear to behave in accordance with traditional theory. The same infill patterns and infill densities are also examined in bending. Bending properties are obtained with a three-point bend test.

IGNITE AWARD



EAGLESAT-II MEMORY DEGRADATION EXPERIMENT

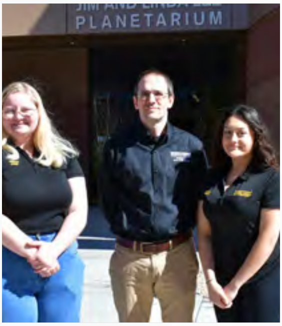
Shane Howe, Aerospace Engineering
Calvin Henggeler, Computer Engineering

MENTOR

Ahmed Sulyman, Electrical, Computer and Software Engineering

Onboard the EagleSat-II satellite is one of the experimental payloads called the Memory Degradation Experiment (MDE) designed to test the degradation of 5 different kinds of computer Random Access Memory (RAM) under the conditions of space radiation. Memory types are FRAM (Ferroelectric RAM), SRAM (Static RAM), MRAM (Magnetoresistive RAM), Flash memory, and EEPROM (Electronically Erasable Programable Read Only Memory). Testing of RAM modules is done my writing a random bit string onto the memory modules then reading from those modules at numerous time intervals until a new bit string is read made after a while. And comparing the read data from the originally written information. The experiment detects and locates any bit flips, or errors, in the written bit strings after being read to determine the degradation of that memory module.

SPACE GRANT RESEARCH INFRASTRUCTURE



NEW SHORT-RANGE TESTS OF GRAVITY

Jennifer James, Space Physics
Janessa Slone, Space Physics

MENTOR

Quentin Bailey, Physics and Astronomy

New Short-Range Tests of Gravity is a project in theoretical physics where the goal is to calculate a modification to the Newtonian gravitational force between two masses. Recently, physicists worldwide have been searching for new physics beyond Einstein's General Relativity, and for new-short distance forces. The theoretical work in this project makes use of a general framework for describing signals from new physics, called the Standard-Model Extension (SME), which allows for generic violations of Lorentz Symmetry (a fundamental principle in modern physics). The modified formula calculated from this framework can be used by experimental groups worldwide that are searching for new short-range forces in precision experiments. The results show a new kind of modification to gravity could be measured at short distance ranges less than a millimeter.

Over both Fall and Spring of the 2021-2022 school year, both members conducted and solved equations relevant for this calculation. Janessa Slone is calculating, from an action principle in the SME framework the field equations needed to calculate the modified Newtonian potential energy formula. Jennifer James is solving the (partial differential equations) in the weak gravity, or Newtonian limit, using Green function methods. The features of the results so far are explained in this presentation.

SPACE GRANT AWARD

*This work was also supported by the National Science Foundation grant #1806871.

ARIZONA PILOT'S ASSOCIATION PASSPORT PROJECT

Danielle Jamieson, Shannon Dohrman,
Global Security & Intelligence Studies Studies
Christopher Hylton, Aviation Business Administration
Jacob Christensen, Cyber Intelligence & Security
Paige Cody, Ashton Mcdonald,
Simulation Sciences, Games & Animation Science
Paige Thompson, Cordaellia Farrell,
Software Engineering

MENTOR

Heather Marriott, Electrical, Computer and Software Engineering

Reginald Parker, Global Security & Intelligence Studies Studies

The Arizona Pilots Association (APA) in conjunction with Arizona Experimental Aircraft Association Chapters, the Arizona Office of Tourism, and the Arizona Airports Association is implementing an Arizona Airport Passport Program. The Arizona Airport Passport Program is designed to promote general aviation's use of 56 of Arizona's public-use airstrips and airports. At the same time, the program is intended to help improve education and safety by encouraging pilots to practice approaches and landings in different environments. The program also aims to promote tourism. This app-based program is open to all FAA licensed pilots and will log visits to Arizona's public-use airports, museums, and attractions. The app will track progress as pilots reach pre-set milestones.

The APA has reached out to Embry-Riddle Aeronautical University (ERAU), a leader in all things aviation, for help regarding the application development. By enlisting ERAU's help, students working on the project will be able to apply software development skills and project management standards that they have learned in the classroom to a real project which will produce a meaningful product for the customer. At Discovery Day, we will be showcasing our application as well as the Project Report that displays our progress made throughout the semester. The two pillars of our presentation at completion will be the software development of the application and the Project Management Institute Standards that were employed to ensure project completion.

IGNITE AWARD

DEBRIS RECOGNITION AND IDENTIFICATION PLATFORM - “DRIP”

Joseph Johnson, Aerospace Engineering
Trenton Bandy, Aerospace Engineering
Tyler O’Donnell-Paccione, Aerospace Engineering
Evelia Zapien Ramos, Aerospace Engineering
Rowan Molitor, Aerospace Engineering
Megan Chavez, Aerospace Engineering
Maddy Devaney, Aerospace Engineering

MENTOR

Davide Conte, Aerospace Engineering

Due to the high velocities of debris and spacecraft in orbit, collision with small objects can cause catastrophic mission failure, costing the satellite provider hundreds of thousands of dollars. Currently, it is estimated that there are over one million pieces of space debris, ranging from 1 cm to 10 cm, in Low Earth Orbit. With no detection systems focused on tracking this size range, and debris generation events constantly occurring, this small space debris remains a growing threat. DRIP serves as a solution to detect and analyze these pieces of debris. Performing as a hosted on-orbit payload and utilizing two optical sensors, DRIP will capture images of space debris. Python will be utilized on Raspberry Pi 4Bs to analyze the captured images and ensure these photos are taken synchronously. This enables future ranging through triangulation as well as verification that the images are viable for data collection before storing them for later analysis. MATLAB will then be used, on an off-board computer, to analyze the images to determine debris characteristics such as size. This system will be tested in a mock space environment that mimics the low lighting conditions of space. DRIP will establish a software proof-of-concept for a system that can utilize image processing for debris detection as an on-board satellite payload.

IGNITE AWARD

DEBRIS ACQUISITION AND DEORBIT SYSTEM (DADS)

Michael Klooster, Aerospace Engineering
Britney Alvarez, Aerospace Engineering
Jefferson Bahe, Aerospace Engineering
Pedro Mena Barranco, Aerospace Engineering
Erik Harang, Aerospace Engineering
Lance Klussmann, Aerospace Engineering
Michael Mooney, Aerospace Engineering
Eleanor Pahl, Aerospace Engineering

MENTORS

Davide Conte, Aerospace Engineering
Richard Mangum, Humanities and Communications

Space debris poses a threat to future space exploration. Over 40% of satellites in orbit are considered non-functional, and this debris can collide with satellites that are active, thereby disabling or destroying the active satellites. Multiple attempts at deorbiting debris have been tested in space, including harpoon penetration, net collection, and deorbit tape attachment. Many of these methods focus on decreasing the time of deorbit for the debris, so that the debris burns up in atmosphere. The DADS (Debris Acquisition and Deorbit System) team, a senior design capstone, is designing a system that will mitigate the impact of space debris in Sun Synchronous Orbit (SSO) at an altitude of 600–800 km around Earth. Further, the system will minimize the creation of new debris during performance, and the system must also be capable of deorbiting multiple pieces of debris while attached to an existing bus system. To do this, DADS will employ a launch system, the Archer, to transfer a projectile, the Arrow, to pierce representative nanosat and microsat-sized debris. The system's unique, untethered projectile system, powered by springs, will transfer the Arrow to the debris. In testing this design, the Arrow will be launched downward towards the Earth, at least 1.5 feet from the target. The testing site will be an improvement of one of the cinderblock structures by the RC Field at ERAU.

IGNITE AND EAGLE PRIZE AWARDS

QUANTIZING THE UNSEEN: GIG UNDERGRADUATE OPTICAL RESEARCH

Parker Landon, Computer Engineering and Space Physics,

MENTOR

John Pavlina, Electrical, Computer and Software Engineering

Optical research has been at the forefront of today's scientific endeavors. Concepts like fiber-optic communications, laser weapon defense systems, and this project, laser interferometry, continually influence modern technologies. Interferometry is foundational to graduate-level physics research, and this project is the stepping-stone for most beginner graduate students. This project will be focusing on Radio Frequency (RF) Control Systems Engineering for equipment design and development. The team has already built the initial Amplitude Modulation (AM) servo and has implemented it into the optics chain for testing. This project is a continuation of the previous project "Controlling the Unseen" and aims to characterize a diode laser and tune the current controller for it. By doing this we will modulate the laser output to fall within the quantum noise level. Quantum noise, appearing sometimes as shot noise, is signal uncertainty due to quantum effects. The highest signal noise content comes from temperature fluctuations; therefore, a model of temperature-dependent current will be used for the controller. By feeding back the laser input into an optimized controller, GIG will be able to decrease the effects of additional external factors (i.e., thermal noise, vibrations, and power supply fluctuations).

SPACE GRANT AWARD

PRESCOTT OBSERVATION TEAM FOR ANALYZING TELESCOPICALLY OBSERVED SPECTRA

Alexis Lane, Andrea Daly, Krister Barclay, Lauren Perez, Amara Williams, Hailey Beier, Kaitlyn Casciotti, Tri Phan, Astronomy

Clarissa Pavao, Abiagael Parks, Caitlyn Ooms, Zachary Ramsey, Bradley Rudy, Samantha Garcia-Flores, Bradley Rudy, Space Physics

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 to collect data and train new observers. By teaching these skills earlier in their college careers, students are better prepared for creating and working on their own research projects in upcoming years. This year, POTATOS has collected spectroscopic data on three massive O-star binary systems: LZ Cep, AO Cas and UW CMa. In addition, a reduction program is being created to prepare the data for analysis. POTATOS has partnered with an astronomy capstone student and the PS 332 Techniques in Observational Astronomy class to determine the stellar parameters including orbital period, stellar radii, temperatures and masses.

IGNITE AWARD

PROBING THE VARIABILITY OF THE SUPERGIANT STAR DENEB

Teagan Laws, Space Physics

MENTOR

Noel Richardson, Physics and Astronomy

Deneb is the prototype of alpha Cygni variables. Alpha Cygni variables 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. These variations are common for massive stars and are observed in most hot supergiants and overluminous supergiants such as luminous blue variables. The mechanism responsible for the variations eludes theory and observers but photometric and spectroscopic observations will aid in finding the source for Deneb. We observed the star with multiple techniques in 2021 and show the beginning part of this analysis.

IGNITE AWARD

LOW FREQUENCY PROTOTYPE OF LASER INTERFEROMETER SUSPENSIONS FOR GRAVITATIONAL WAVE DETECTION

Yuka Lin, Skylar Kemper, Space Physics

MENTOR

Michele Zanolin, Physics and Astronomy

In recent years, the Laser Interferometer Gravitational-Wave Observatory (LIGO) has been developing more advanced ground-based laser interferometers which utilizes complex suspension systems to detect various levels of low frequency gravitational waves (GW's). Our experiment utilizes a torsion pendulum and a laser set up to model the LIGO suspension detector which will be utilized for understanding how to maximize the sensitivity of laser interferometer to low frequency (1-20 Hz) GW's, which are often produced by binary stars and core-collapse supernovae. The first purpose is to experimentally characterize the transfer function of the torsion pendulum with respect to ground vibrations. The second goal is to investigate ways to distinguish low frequency torsion and translations from low frequency gravitational waves. The knowledge that comes out of this experiment will help to distinguish ground noise events from gravitational waves events, which will be a major step in being able to detect them in the low frequency regime.

SPACE GRANT AWARD

A CLIMATOLOGICAL ANALYSIS OF CONVECTION IN THE TRENTINO REGION OF THE ITALIAN ALPS

Jackson Macfarlane, Greta Graeler, Applied Meteorology

MENTOR

Curtis James, Applied Aviation Sciences

Convection over complex terrain has always been a forecasting challenge because it is not accurately predicted by regional forecast models. Severe convection and flash flooding events are common in complex terrain in the European Alps as in many mountainous climates, causing property damage and loss of life. This study analyzes the initiation and propagation of convective cells over the Trentino region in the southern Italian Alps. We identify convective cells using a storm tracking algorithm and the operational TAASRAD-19 radar reflectivity dataset. A terrain mask is applied to the dataset, and both dry days and maintenance days are excluded. Cells that exceed minimum reflectivity (40 dBZ) and minimum area (4 km^2) thresholds are tracked by the algorithm for over 9 years of radar archives. The tracks produced by the algorithm contain each cell's ID, centroid location, area, and maximum intensity over time. Tracks are then compiled as frequency maps using statistical clustering tools in a GIS software package. The frequency maps allow analysis of climatological factors involved in the initiation and propagation of convection in relation to terrain forcing. Maps showing cell intensity, size, direction of propagation, and initiation location are also analyzed, gaining insight into the behavior of convection in the Trentino region of Italy. The results of this study can be used as a source of guidance for international research efforts in the area.

IGNITE AND SPACE GRANT AWARD

EAGLE AERO SPORT - AIRCRAFT CONSTRUCTION & RESEARCH

Ivana Martinez, Aerospace Engineering
Bailey Cortright, Unmanned Aircraft Systems
Evan Hefflin, Aerospace Engineering
Tucker Kreisler, Aeronautical Science
Ben Malone, Aerospace Engineering
Adam Witusik, Aerospace Engineering
Carson Karle, Aerospace Engineering
Camron Avent, Aerospace Engineering
Kyle Abbas, Aerospace Engineering
Mark Soerheide, Global Business & Supply Chain Management

MENTOR

Gregory Reverdiau, Applied Aviation Sciences

Eagle Aero Sport is the first undergraduate aircraft build team at any university, and it's being done here at Embry-Riddle Aeronautical University. Since the team's inception in 2015, we have constructed 80% of a Vans RV-12 which is a single-engine, two-seater, light-sport aircraft. We are also adding experimental aircraft systems such as pressure sensors, accelerometers, and strain gages throughout the aircraft to investigate the effects of flight on the aircraft in real-time. Over the years we have conducted several successful tests, such as engine run tests, Electrical systems tests, and mechanical tests of flight surfaces. Eagle Aero Sport allows students of all disciplines to gain priceless hands-on experience in all aspects of aircraft production, including aircraft assembly, engineering, production operations, and project management. The team has helped hundreds of students pursue and express their love for aviation and hopes to continually provide invaluable lessons to future team members.

EAGLE PRIZE AWARD

EVALUATING THE EFFECTIVENESS OF SIMULATED FLIGHT INTO INADVERTENT IMC

Elizabeth Mitchell, Aeronautical Science – Helicopter

MENTOR
Dawn Groh, Aeronautical Sciences

Within the realm of aviation, specifically helicopters, there is a clear abundance of accidental flight under Visual Flight Rules (VFR) into Instrument Meteorological Conditions (IMC). This issue is much more catastrophic when compared to the airplane counter piece of aviation, seeing that helicopters on average have 56 seconds to recover after Inadvertent IMC entry compared to airplanes' 176 seconds. This issue is also one of the top three causes of fatal helicopter accidents. To lower that number a short course, using a Virtual Reality (VR) simulator, has been created and will be used at the Helicopter Association International (HAI) Heli-Expo 2022. Information like pilot currency, flight hours, certification, scenario reaction and flight outcome will be collected during the use of this course. This data will be passed on to the United States Helicopter Safety Team (USHST) and HAI for further improvement and increased awareness.

IGNITE AWARD

SMALL ARM-LENGTH INTERFEROMETRY FOR U-CLASS SPACECRAFT

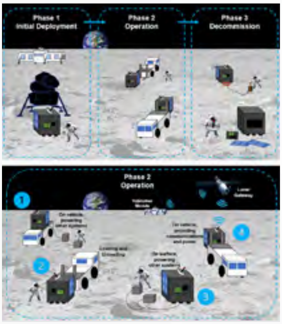
Shannon Moore, Space Physics
Logan Caudle, Space Physics

MENTOR

Michele Zanolin, Physics

Recent developments in space-based laser interferometer have shown that considerable improvements in the sensitivity of gravitational wave observatories can be achieved while mitigating many of the drawbacks encountered in ground-based detectors. The purpose of this study is to evaluate the feasibility of implementing a short-arm length cavity interferometer as a payload for U-Class spacecraft. Placement of the payload in Low Earth Orbit would provide an environment free of any ground or external vibrational disturbances and greatly improve the low frequency sensitivity when compared to that of ground-based detectors. However, given the space constraints of U-Class spacecraft, optical configurations, such as the Michelson Fabry-Perot interferometer, will be tested to increase the operating sensitivity of the interferometer. Further analysis will also be done to ensure the integrity and enable in-orbit operation of the experiment. Factors such as atmospheric pressure, outside debris, unwanted vibrations and solar wind will need to be accounted for when data collecting and constructing a small-scale toy model. Such a model would include factors including the interferometer payload, on board data systems, and any control sources. More advanced electrical systems that include solar panels to allow a self-sustaining power supply, given the orientation of the satellite, are calculated to precision. In summary, this research project will analyze the viability and precision of implementing a small-scale interferometer into a U-Class Spacecraft that will be placed in Low Earth Orbit.

SPACE GRANT AWARD



PORTABLE UTILITY PALLET BY EMBRY-RIDDLE

Connor Murphy, Aerospace Engineering
Teresa Jimenez Nickerson, Aerospace Engineering
Marcus Mifsud, Aerospace Engineering
Brady O'Hayer, Aerospace Engineering
Jason Johnson, Aerospace Engineering
Carlos Rodriguez, Aerospace Engineering
Lucas Tuff, Aerospace Engineering
Daniel White, Mechanical Engineering

MENTOR

Rick Mangum, Humanities and Communication

Near future lunar exploration and colonization will require the creation and implementation of support systems intended to facilitate mission operations and the construction of infrastructure on the lunar surface. The portable utility pallet theme from NASA RASC-AL presents the unique challenge of designing a system that can function as both a deployable power source and a communications array. This system will be essential to the success of future lunar operations and define important design methodologies that will be needed for long-term interplanetary surface missions. The portable utility pallet by Embry-Riddle (PUP-ER) aims to deliver a design that satisfies the requirements imposed by NASA RASC-AL, as well as construct a scale prototype as a proof of concept. The lunar surface presents an inherently hostile environment to sensitive electronics and mechanisms that future assets will have to be designed to withstand. The primary mission goals of this project are to provide a source of power and communications to systems and astronauts on the Moon, to create a robust system capable of surviving launch and landing, and to withstand the harsh lunar environment for a service life of ten years. The constraints for PUP-ER, provided by NASA RASC-AL, include a stowed volume less than 2 m by 2 m by 2 m, an overall mass less than 2000 kg, the capacity to maintain a 50 Mbps communication link with the Lunar Gateway Station, the ability to be moved and redeployed, and an operational lifetime of 10 years.

EAGLE PRIZE AWARD

AERODYNAMICS OF A GURNEY FLAP ON PRODUCTION ENTHUSIAST CARS

Codey Neises, Aerospace Engineering
Aditya Hoskere, Aerospace Engineering

MENTOR
Amzad Hossain, Mechanical Engineering

Dan Gurney developed the Gurney Flap concept in the 1960s. Since the gurney flaps' invention, its primary application has been to enhance lift characteristics of a wing. A short, separated region of high pressure upstream of the gurney flap is accompanied by two counter-rotating vortices formed downstream. Thus, the Gurney Flap artificially increases the effective camber, increasing lift. Gurney flaps have been a practical solution for airplanes, racecars, wind turbine blades and turbomachinery, but have not been fully explored. Although research has been conducted to increase lift or decrease the pressure drag for a conventional NACA airfoil, the applications for production road cars are unknown. Given the operating speeds of a car, the low to high Reynold's envelope has not been explored. The objective of this research is to optimize the design of a gurney flap for an airfoil-less production car by changing its position, sizing, angle, perforation, and perforation density to maximize lift, minimize pressure drag and settle downstream turbulence. CFD analysis will be conducted for obtaining specific properties and scaling ratios to aid in building a prototype for the wind tunnel. Once the wind tunnel testing is concluded, the optimized design will be constructed and mounted on a car for field testing. The expected outcomes are to (i) understand the aerodynamic characteristics of a car with and without the proposed gurney flap and (ii) to propose a design and operational parameters of the Gurney Flap for the tested car.

IGNITE AWARD

OPTIMIZED NAVIGATION FOR AUTONOMOUS SAILING

Margaret Nicoli, Aerospace Engineering
Lorenzo Kearns, Computer Engineering

MENTOR

Matt Pavlina, Electrical, Computer, and Software Engineering

The Optimized Navigation for Autonomous Sailing team focuses on developing hardware and software-based system to operate an autonomous sailing vessel. The vessel will be capable of self-maneuvering to user-defined waypoints through various wind conditions and obstacles. The system will improve upon previous designs and research to include adaptive path generation for obstacle and weather avoidance. While most modern naval transportation is not sail-based there are still many benefits to research in autonomous sailing. The focus on sail-powered travel provides an environmentally friendly approach to maritime navigation. Autonomous systems significantly reduce operational costs, incentivizing companies to use these smaller sail-based vessels for applicable research and transportation needs. Researchers will be able to attach their required instrumentation to an unmanned vessel and deploy without hiring a crew or operating it themselves. The goal of this project is to finalize a scalable “black-box” system that can be applied to a variety of different-sized sailing vessels. The black-box system will include a variety of sensors that will gather information on the rudder angle, wind speed and direction, boat speed, position, angle of the boat relative to the water, object detection and general data collection. The black box will use these inputs to make maneuvers and path corrections to avoid dangers such as storms and rock beds.

EAGLE PRIZE AWARD

CYBERAERO'22 COMPETITION

Hannah Ohm, Cyber Intelligence & Security
Victoria Plinski, Cyber Intelligence & Security
William Noujaim, Cyber Intelligence & Security

MENTOR

Krishna Sampigethaya, Cyber Intelligence & 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. Hence, K-12 students do not have enough of an education in computers or security while they're in high school to later pursue a major degree program in cybersecurity.

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. One half of the competition will be based on solving cyber challenges as a team, helping students learn to collaborate and work together in a field that is largely focused on individual work. The other half will focus on individual skills allowing a deep immersion experience for each student.

EAGE PRIZE AWARD

EAGLESAT II: SATELLITE COMMUNICATION DEVELOPMENT IN AN UNDERGRADUATE ENVIRONMENT

Joshua Parmenter, Computer Engineering
Hayden Roszell, Software Engineering

MENTOR

Ahmed Sulyman, Electrical, Computer & Software Engineering Department

EagleSat II is a student-led organization designing and constructing a 3U CubeSat to host a dual-payload scientific research mission. Of primary importance to the mission is a reliable communication infrastructure. Mission requirements specify lower data throughput than conventional modern satellites, meaning EagleSat II can design a cheaper and simpler satellite that will fit our needs. One of the most important aspects of the satellite is the communication infrastructure, or the means in which the satellite and the ground station share telemetry and telecommand information. This communication infrastructure is a software-intensive, complex task that requires a group of motivated engineers to complete; and to achieve this, different management strategies, including Agile framework, were employed to help busy students maximally contribute to the team. This included group coding sessions, fast-paced and focused meeting times, and asynchronous accountability reporting. This strategy resulted in realized maximum throughput of undergraduate technical capability, proving that an undergraduate university has the capability to produce real-world, reliable software for the space sector.

SPACE GRANT RESEARCH INFRASTRUCTURE

HOW DOES DUST FORM AROUND CARBON-RICH WOLF-RAYET STARS?

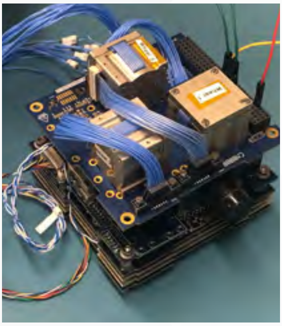
Megan Peatt, Astronomy
Emelito Medina, Astronomy

MENTOR

Noel Richardson, Physics and Astronomy

Some evolved massive stars, called Wolf-Rayet stars, are seen to produce dust. These systems have a star that has lost all its hydrogen and may exist in a binary system. Our group is trying to understand the dust production mechanisms in the binary systems. One system, WR137, is being analyzed with data from the Stratospheric Observatory for Infared Astronomy (SOFIA), and it will also be an early target for James Webb Space Telescope this summer. We are determining the elements of the spectral lines and analyzing dust production early in the formation of the system. We are also looking at many of these systems with the IGRINS spectrograph, both at Lowell's Discovery Telescope and at Gemini-South Observatory to examine the binary fraction for the dust producing systems. We have found evidence for a new companion in at least one of these systems, WR112, which has a suggested binary period from previous analyses, but has not had a direct detection of the companion star.

IGNITE AWARD



EAGLESAT II- ATTITUDE DETERMINATION AND CONTROL SYSTEM

Grayson Peeler, Aerospace Engineering

MENTOR

Ahmed Sulyman, Electrical, Computer & Software Engineering

The EagleSat II Attitude Determination and Control System (ADCS) is one of the main bus systems onboard the planned EagleSat II CubeSat. The goal of EagleSat II mission is to study the origins of high energy particles and their effects on solid state storage. This information will be useful for the future of space travel. The ADCS will be responsible for determining and controlling the orientation of the satellite in orbit. Satellite orientation will be determined using a variety of sensors including sun and nadir cameras and a magnetometer. A combination of magnetorquers and reaction wheels will be used to control the satellite's angular velocity and orientation. It will also be used to enter and hold local orientations such as a Y-Thompson spin. The ADCS unit will acquire and maintain multiple orientations during the mission's lifespan for the purpose of data collection, power generation and ground communication.

SPACE GRANT RESEARCH INFRASTRUCTURE

INVESTIGATION OF LONG-DISTANCE VIDEO AND TELEMETRY STREAMING

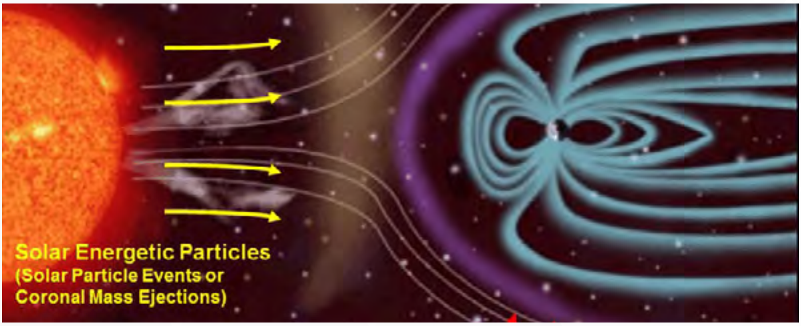
Nicodemus Phaklides, Electrical Engineering
Zachary Howe, Aeronautical Sciences

MENTOR

Yabin Liao, Aerospace Engineering
Douglas Isenberg, Mechanical 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 pros and cons regarding effective range, data rate and cost. We've developed a high-altitude balloon payload that analyzes these factors by comparing data transmission over three separate frequencies: 900MHz, 1.3GHz, and 2.4GHz. Live video and telemetry will be broadcasted over the 1.3GHz and 2.4GHz frequencies using an Eagle Tree Vector and Raspberry Pi Zero W respectively. 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 applications.

SPACE GRANT RESEARCH INFRASTRUCTURE



RADIATION VS PIXEL INTENSITY TESTING AND BACK-END DATA ANALYSIS SETUP / EAGLESAT II MISSION PLANNING

Tri Phan, Astronomy

MENTOR

Ahmed Sulyman, Electrical, Computer & Software Engineering

The EagleSat II Satellite has come to its final stages of preparation for launch. Because of various design issues, the satellite will no longer be able to charge its batteries while also observing the sun as initially intended, thus resulting in our maximum observing time of the sun being limited during each orbit. However, there is still the possibility of research during the time period in which the earth is in between the satellite and the sun. There are many potential targets in the nearby galaxy that we may receive cosmic ray data from. This target exploration depends strongly on the research exploring the relationship between the pixel counts detected from the cameras used for Cosmic Rays and the known radiation given off by radiation sources. We use the variety of radiation sources available to us from Embry Riddle to record pixel counts and based on our knowledge of the radiation sources and their emitting energies, we correlate these two data sets to understand the significance of the data we receive from the camera while in space, and from the sensitivity decide on our mission plans.

SPACE GRANT RESEARCH INFRASTRUCTURE

STRUCTURAL DYNAMICS MODELLING OF COMPLEX STRUCTURES USING LSTM RECURRENT NEURAL NETWORKS

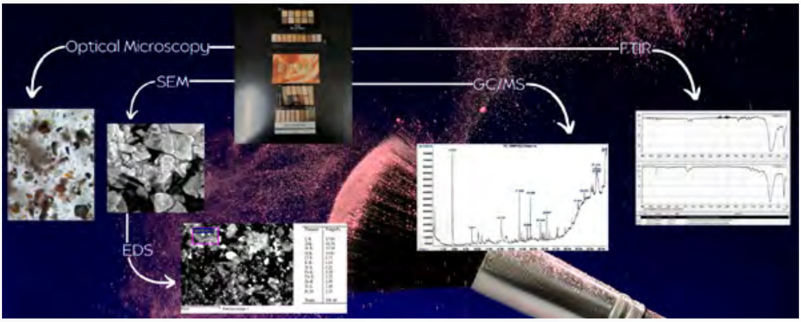
Biswas Poudel, Mechanical Engineering

MENTOR

Yabin Liao, Aerospace Engineering

Many engineering structures are subjected to dynamic loads which can have severe effects on the structural strength and life of the entire system. Continuous vibrations of structural components can lead to fatigue failure and in extreme cases, they can fail rapidly due to resonance. Therefore, study and analysis of vibrations are important to predict and avoid such disasters. However, most of the engineering structures are complex in geometry which makes it almost impossible to create an analytical model. Deep learning is a popular approach of finding an accurate model based on system data through training. Then, the trained model can be used to predict the system response with an input. Recurrent Neural networks can learn things, recognize patterns, and make decisions after they have been fed with lots of data set. Long Short-Term Memory network (LSTM) is predominately used to learn and process long-term dependencies between time series of data which makes it a suitable tool to use for modeling vibrational systems based on time-history of vibration responses. Training such a model with a large set of vibrational data and enough hidden units enables it to predict the response of a dynamic structure. This method has been applied to a cantilever beam with a point load at the free end and yielded excellent results. This will enable a vibrational analysis of complex structures to be easier and less time-consuming. The effect of training data size and the number of hidden units on the accuracy of the model was also studied.

IGNITE AWARD



ANALYSIS OF COSMETICS AS TRACE EVIDENCE

Gabriella Reece, Forensic Biology
Makenzie Bartlett, Forensic Biology
Alison Flynt, Forensic Biology
Gabrielle Pingleton, Forensic Psychology

MENTOR

Teresa Eaton, Biology and Chemistry

According to Locard's exchange principle when two items come into contact, there is an exchange of microscopic, or trace material. This can include inks, fibers, fingerprints, bodily fluids, and cosmetic particles left behind at crime scenes. Analyzing trace evidence allows forensic investigators to develop a complete picture of a crime. As criminals become increasingly aware of trace evidence, and try to avoid leaving it, new methods for analysis must be developed. The goal of this project is to develop a method to easily distinguish the morphological and chemical characteristics of various cosmetic samples including eyeshadow palettes, bronzers, highlighters, and lipsticks. Scanning electron microscopy (SEM), gas chromatography mass spectrometry (GC/MS), energy dispersive spectroscopy (EDS), and Fourier-transform infrared (FTIR) spectroscopy techniques can be utilized to determine unique elemental, morphological, and spectroscopic properties to differentiate between cosmetic residues. Once the data is collected, it will be analyzed using the Statistical Package for the Social Sciences (SPSS) that includes Hierarchal Cluster Analysis (HCA) and K-means clustering. By combining these analytical techniques, investigators may be able to trace a lipstick stain or eyeshadow smudge back to a manufacturer, and possibly an individual.

IGNITE AWARD

FATIGUE RISK MANAGEMENT: SLEEP AND MENTAL HEALTH

Bradley Riedle, Aeronautics
Jordan Shaw, Aeronautics

MENTOR

Stacey McIntire, Aeronautical Sciences

The development of risk management systems in aviation has accumulated into thousands of research papers and dispersed into millions of available data points to be observed. Air Methods, one of the largest air medevac companies in the country, has reached out to Embry-Riddle Aeronautical University (ERAU) for help in redeveloping a Fatigue Risk Management System (FRMS). This system will cover Air Method's individual needs concerning a sleep efficiency evaluation tool and the importance of mental health and resiliency education to combat fatigue in their pilots, clinicians, and mechanics. For the sleep component in this FRMS, qualitative and quantitative research practices take place. The creation of a sleep evaluation tool required qualitative research into industry best practices and standards of sleep. The quantitative research is still in progress and will be utilized by future ERAU students to analyze a percentile change in sleep-induced fatigue. Air Methods has also recognized their pilot's mental health as a top priority and asked for help in identifying the best tools and techniques to help their pilots improve their mental resilience. This process will cover the different techniques other first responders use to handle distressing situations which could be used to help Air Method's pilots and clinicians. Furthermore, mental health scholars and professionals will be interviewed to get a better understanding on how to effectively implement mental health techniques into the Air Methods company. Over the next few years, ERAU capstone teams will continue to adjust and improve upon this research.

DEMYSTIFYING THE USES AND MISUSES OF TECHNOLOGY DURING THE 2019 BOLIVIAN ELECTION

Vicky Ross, Cyber Intelligence & Security Studies

MENTOR

Thomas Field, Behavioral and Social Sciences

The 2019 Bolivian Election is a useful case study for human interaction with technology and the implementation of technology within elections. The 2019 preliminary tally count, also known as the preliminary results and transmission system process (TREP), is shrouded in mystery, accusations of fraud and procedural neglect. Previous statistical and technical research shows that although there were many instances of neglect during the design, testing and management phases, there were no instances of fraud within the electoral process. The literature and technical analysis use resources from key organizations such as the Organization of American States, the University of Salamanca, and the Center for Economic and Policy Research. The output of this project is to discern that there was no technical or statistical basis for the accusations of fraud.

IGNITE AWARD

EAGLESAT HWIL SIMULATION

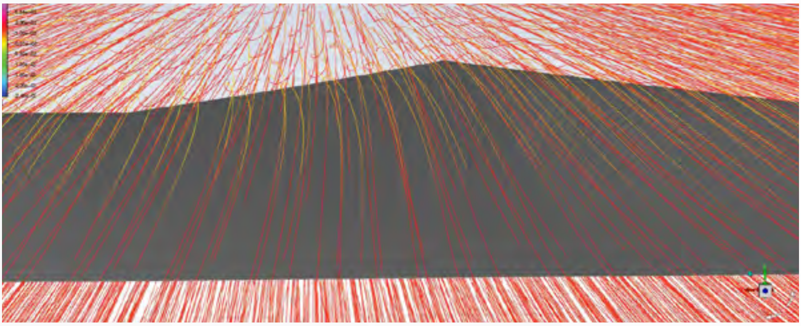
Samuel Sandelin, Aerospace Engineering

MENTOR

Ahmed Sulyman, Electrical, Computer and Software Engineering

Testing is a major part of the development of any satellite, and CubeSats are no different. The goal of this project through EagleSat is to develop a test platform for testing power draw, charging, and simulating the power input from solar panels as if the satellite was in orbit. We also plan to have a way of testing various other aspects of the satellite in a similar manner to provide a potentially more accurate testing environment. Having this simulation be modifiable and on mostly standalone hardware allows us to be more direct with testing than a basic software-only simulation running on a standard computer, giving us the ability to do things such as connecting power directly to solar panel inputs, sending example research data over wires to their respective components, and other tests that EagleSat subteams might want. The ability to test various aspects of the satellite will allow the EagleSat team to simulate a multitude of scenarios and operation schedules and better verify that the satellite is ready for launch.

SPACE GRANT RESEARCH INFRASTRUCTURE



EFFECT OF CAMBERED LEADING-EDGE EXTENSIONS AND STRAKES ON HIGH LIFT PRODUCING WINGS

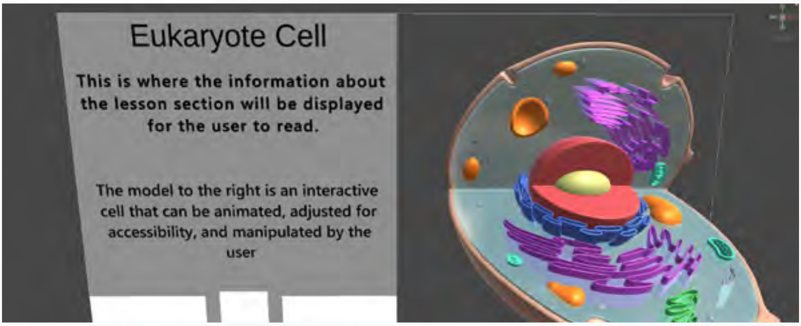
Jaron Sherwood, Aerospace Engineering

MENTOR

Shigeo Hayashibara, Aerospace Engineering

CFD methods were utilized to investigate and model the effects of cambered strakes on high lift aircraft. The lift generation due to the leading-edge vortices caused by delta wings is well documented and is the basis for current strake designs on high-speed aircraft for performance enhancement at low speeds. The purpose of this CFD study was to determine if these vortices could be induced by a pressure differential between the upper and lower surfaces without any positive angle of attack. Variations in strake camber were analyzed to observe the performance changes due to changes in upper and lower surface pressure differentials. The lift and drag results were analyzed to prove if this behavior provided performance benefit on the lift produced by a wing without significant drag increases.

IGNITE AWARD



PROJECT APART: ADVANCING LEARNING AND TRAINING TECHNOLOGY THROUGH THE USE OF AUGMENTED REALITY

Joshua Snow, Simulation Science, Games & Animation

MENTOR

Derek Fisher, Mathematics

Project ApART (Applications of Augmented Reality in Teaching) intends to identify areas of study where a more hands-on approach would benefit the student and create an immersive environment to complement that area. Students can use augmented reality to improve a given lesson's safety, comprehension, and cost-effectiveness within the many complex subjects they are expected to learn. The example for the prototype is a high school biology class. The introductory module is the topic of cells, a concept that is very difficult to communicate due to the limited hands-on avenues. Using ApART students can hold cells in their hands and examine their different components. This project seeks to create an interactive space where users can comfortably observe lessons and complete a virtual lab to further develop understanding. The concept of this project is inspired by Project JET, where the goal of development was to give students of a 400 level Aeronautical Science class the ability to interface with a specific aircraft and its multiple subsystems. ApART seeks to place anything that could help the user understand a concept in the hands of that user. As the technical prototype demonstrates with the cell models, even a lesson can be enhanced with the immersive capabilities of augmented reality.

IGNITE AWARD

WHAT DRIVES THE VARIABILITY IN LUMINOUS BLUE VARIABLE STARS?

Rebecca 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 variability of these stars is not yet well understood. We are using photometric data from NASA's Transiting Exoplanet Survey Satellite (TESS) to study 30 LBV candidates in the Large and Small Magellanic Clouds. The light curves extracted from TESS will be compared to the All-Sky Automated Survey for SuperNovae (ASAS-SN) light curves of the same stars. This is to rule out any instrumental errors with TESS. We can then perform Fourier Transforms on the corrected TESS data which allows us to find the time scales of variability. Using the results from the Fourier analysis we can begin to understand the driving mechanisms of our candidates by comparing them to known LBVs such as P Cygni.

SPACE GRANT AWARD

THE EAGLESAT II: FABRICATION FINAL DEVELOPMENTS

Lillian Sudkamp, Aerospace Engineering

MENTOR

Ahmed Sulyman, Electrical, Computer and Software Engineering

The EagleSat II is a 3U CubeSat being developed at Embry-Riddle Aeronautical University Prescott. The scientific goals of the EagleSat II are to detect cosmic ray particles and to study the degradation of various types of RAM due to solar radiation. As the launch date is rapidly approaching, Spring 2023, many teams have reached the final stages of their development. This was especially true for the Fabrications team, a combination of the former fabrications team and the former structures team. With the final structure and board designs for the satellite ordered, the Fabrications team is focused on the final testing and assembly of the satellite. This presentation will review the steps the EagleSat II teams took to get to this point. The discussion will then address the final stages of the EagleSat II's development, including simulations, the final design, and the assembly of the satellite, with a focus on the final structural designs and board assembly.

SPACE GRANT RESEARCH INFRASTRUCTURE

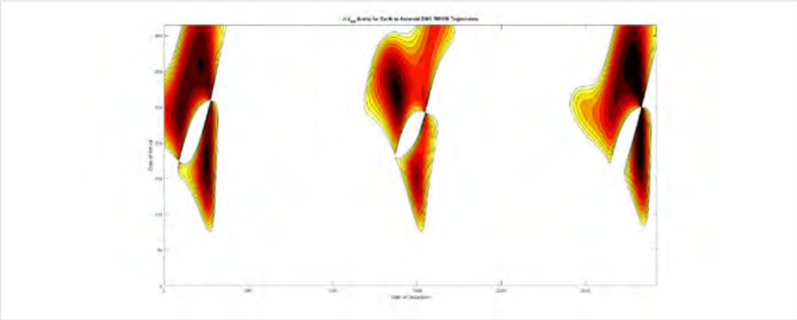
NOVEL HYBRID APPROACH TO LAUNCHING SMALL PAYLOADS TO SUB-ORBITAL SPACE

Kevin Sweet, Aerospace Engineering
David Anderson, Aerospace Engineering
Ambroise Juston, Aeronautical Sciences
Zhaoyu Wang, Aerospace Engineering
Nikolas Rodnunsky, Mechanical Engineering
Julian Turner, Mechanical Engineering
Ethan Barsky, Aeronautical Sciences

MENTOR
Keke Wang, Mathematics
Richard Lehman, Engineering

Validating a rocket/balloon hybrid approach to launching small payloads to sub-orbital space will provide more frequent, inexpensive access to space for small payloads. The push for cost effective space vehicles has motivated alternative novel approaches to launch paradigms, such as the design and construction of the first undergraduate space plane assisted by a weather balloon. Prior undergraduate attempts to reach space using multistage solid rockets or large single stage rockets have been complex and expensive. The production of the large solid-propellant rockets is an expensive undertaking that requires specialized propellant manufacturing, mixing, and testing facilities that either do not exist or are of limited availability. Rocket-balloon hybrids, or rockoons, appear to be a viable alternate approach. Such hybrids reduce the size, mass, and cost of the rockets needed to reach space, thus allowing for a cost-effective and novel approach to space flight. The role of the balloon is to lift the rocket above the majority of the atmosphere to enable most effective use of the rocket stage. In combination, the hydrogen balloon will reach an altitude of 30 km followed by the launch of the rocket to 100 km. Datcom and Simulink flight software are used with empirical data and simulation models to produce a nearly optimized mission and design. Using this creative approach, the project outcomes will include development of new technology, such as weather balloon launch platforms and low mass rockets, for cost-effective flights that will be highly useful on campus and beyond this project.

IGNITE AWARD



ASSESSING THE VIABILITY OF ASTEROID REFUELING ON THE WAY TO MARS

Julian Treat, Aerospace Engineering

MENTOR

Davide Conte, Aerospace Engineering

There is significant interest in large-scale mission to Mars. Earth-Mars Trajectories present a significant mass cost in propellant. For a reference mission using Methane and Oxygen propellant, the transfer consumes approximately 3.9 tons of propellant for every ton of material delivered to Martian orbit. Several Near-Earth-Asteroids have water present in ice formations or bonded to hydrated minerals, and many more have carbon present in minerals. It is possible that rocket propellant could be refined from these. A rendezvous with one of these asteroids could reduce the total mass required in Low-Earth Orbit for an Earth-Mars Mission. Any mass savings of sufficient margin could translate to significant monetary gains in saved launch costs. By analyzing a wide range of transfer profiles to these asteroids, the potential savings and viability of an asteroid refueling station is evaluated.

IGNITE AWARD

MASKS MIGHTIER THAN THE SWORD: ANALYZING THE EFFECTS OF GLOBAL SHOCKS ON HUMAN CONFLICT

Nicholas Van Vliet, Global Security & Intelligence Studies
Danny Breslin, Global Security & Intelligence Studies

MENTOR

Tyrone Groh, Global Security and Intelligence

The pandemic caused by the novel coronavirus, SARS-CoV-2, offers an opportunity to see how a global shock influences localized conflict and instability. COVID-19 is the most recent event that has impacted every part of the world in some way and almost every aspect of our lives. The impact was as direct as the loss of life caused by the virus, to even more non-direct ramifications like economic recession caused by worker shortages, and lockdowns. We wonder how COVID-19 played a role in conflict and instability across the world through its effects on various aspects of our lives, mainly inequality. By measuring conflict trends from the time periods surrounding COVID-19 and its spread using databases like ACLED (Armed Combat Location Event Data), John-Hopkins, and other forms of open-source intelligence, the researchers can get a clear picture on the state of instability in areas around the world during the spread of COVID-19. Combining this understanding of conflict with aspects of inequality like access to healthcare and exposure due to economic factors which were influenced by COVID-19, a line can be drawn linking COVID-19 to instability and conflict. The need for this project arises from rampant instability which plagues many parts of our world today. Understanding this instability and what can augment it either in a positive or a detrimental manner is critical for aid workers and governments around the world to anticipate and respond effectively to shocks which affect their areas of control.

IGNITE AWARD

DESIGN AND CHARACTERIZATION OF LIQUID FUEL SPRAY INJECTOR

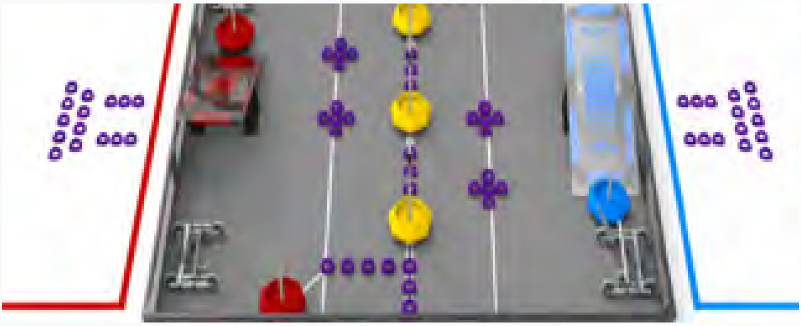
Rebekah Weigand, Mechanical Engineering

MENTOR

Elliott Bryner, Mechanical Engineering

The focus of this work is on the fluid behavior of the injection and mixing zone of an afterburner. Turbine exhaust gas is diffused into the afterburner, fuel is injected, and the temperature of the flow is increased by combustion. Afterburners are used in jet engines to increase thrust on demand by adding thermal energy to the nozzle exhaust stream. The goal of this research is to characterize the atomization and spray distribution of the injected fuel droplets. This work can be used in the design afterburner fuel spray bars or rings.

SPACE GRANT RESEARCH INFRASTRUCTURE



VEX ROBOTICS

Hayden West, Space Physics
Laura Vandiver, Mechanical Engineering
Talise Brown, Aerospace Engineering
Mayra Bibiano, Aerospace Engineering

MENTOR

Joel Schipper, Electrical, Computer & Software Engineering

VEX U is a competition hosted by the REC Foundation for university students to get engaged in hands-on engineering. The competition changes every year with the only constants being the size of the field, the tools and parts teams can use, and the size constraints of the robots. Students compete in regional competitions 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, the gold and blue team leads, the programming leads, and the build team leads. VEX U at Embry-Riddle Aeronautical University is divided into two teams, ERAU Blue and ERAU Gold. Each of these teams is further divided into programming and building sub-teams. This gives students the opportunity to gain experience working on multifaceted teams and communicating with peers to combine distinct projects to create a larger whole.

EAGLE PRIZE AWARD

A UX PARTICIPATORY DESIGN STUDY: UNDERSTANDING THE LOCAL SCENE OF WRITING/DESIGNING AT ERAU-PRESCOTT

Clarissa Winks, Human Factors Psychology
Marcos Osuna, Industrial/Organizational Psychology

MENTOR

Erin Cromer Twal, Humanities and Communications
Heather Lum, Behavioral and Social Sciences

The purpose of this study is to gather student and faculty opinions about current and desired university resources needed to provide writing support across all disciplines on the ERAU Prescott campus. Data has been gathered through a campus wide online survey, user experience (UX) design sprints with students, and faculty interviews. So far, it has been found that there is a desire for a writing center on campus as a digital (website), which is how the center will start out, and a physical space later. As a digital space, students and faculty participants have stated that they want the writing center to be a place for students to submit and receive feedback for their work with 24/7 assistance. Other suggestions have been to have writing resources such as templates, presentation assistance, how to properly sight sources, disability services, and help for international students.

IGNITE AWARD

OD LASER

Olivia Womack, Aerospace Engineering
Ethan Carlson, Aerospace Engineering

MENTOR

Daniel White, Mechanical Engineering

The mitigation of orbital debris, commonly referred to as "space junk" is imperative to the health and safety of our astronauts, the success of our satellites, and the progression of space travel as it becomes commercialized. Efforts to find and track this debris are being made all over the globe. Team OD Laser plans to expand upon current proposed methods for debris remediation, most notably the use of laser technology. The principal idea of this project is to create a system that can autonomously refine its targeting frame and track debris in orbit to be operated onboard a satellite with a laser. Our developed targeting system will supply necessary information to a laser module so that it will hit a piece of debris, causing it to change direction and deorbit, entering the atmosphere and burning up. For the scope of our AE 427 Preliminary Design course, we will be building a testbed to use infrared technology to locate an object, with zero feedback, autonomously refine its target frame and confirm a "hit" using information gathered from light reflections caused by a simple laser pointer.

IGNITE AWARD

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