
UNDERGRADUATE RESEARCH ABSTRACTS

# EMBRY-RIDDLE DISCOVERY DAY 2017

*Prescott, Arizona*

## Discovery Day Schedule of Events

### Friday, 31 March 2017

**Poster Display**
AC1-Atrium | 11:00 AM-3:00 PM

**Poster Presentations & Demonstrations**
AC1-Atrium | 1:00-3:00 PM

**Parents' Reception**
Eagle Gym | 7:00-9:00 PM

### Saturday, 01 April 2017

**URI Oral Presentations**

**Preview Day Welcome**
Activity Center | 9:00-9:30 AM

**Academic Program Meetings**

**College of Engineering**
Activity Center | 9:45-11:00 AM

**College of Aviation**
Davis Learning Center | 9:45-11:00 AM

**College of Arts and Sciences**
AC1-Rm 104 | 9:45-11:00 AM

**College of Security and Intelligence**
The Hangar | 9:45-11:00 AM

**DR. FRANK AYERS**
*Chancellor, Embry-Riddle*
*Aeronautical University – Prescott*

## Welcome to Discovery Day 2017

Thanks to all of you who are making this, our fifth annual Discovery Day, a great success. It is our privilege to support the efforts of our students through our Ignite and Eagle Prize initiatives, as well as through their classwork and special projects. We take time to celebrate their work every spring during Discovery Day. Today you will see the best work of our students, faculty, and staff on display and will have an insight into what makes them such a special group. Take the time to ask each of our project teams to explain the what, why, and how of their projects and be prepared to understand how the leaders of tomorrow are preparing today. To our students, we realize that these projects are how you express yourselves through imagination and creativity. To our faculty and staff, thanks for taking the time to work together with these amazing young scholars. My wife Debbie and I look forward to wandering around all day and hope to see you at each of the Discovery Day venues.

Warm Regards,

**Dr. Frank Ayers**
*Chancellor, Embry-Riddle Aeronautical University*
*Prescott, Arizona*

**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 5th Annual Discovery Day. During the 2016-2017 Academic Year, the Undergraduate Research Institute awarded a total of 18 Ignite, 9 Eagle Prize, and 10 travel grants. Ignite Projects range from one focused on hypoxia impacts in general aviation to one examining the design of unmanned aerial vehicle use for wildfire support. We have Eagle Prize teams competing in Intercollegiate Rocketry, RoboGames, AIAA Design-Build-Fly, and NASA's Micro-g Next Challenge. Embry-Riddle Prescott was the host site and primary organizer to the VEX Robotics Arizona State Championship. In addition, our students have 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 elementary, 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*
*Embry-Riddle Aeronautical University,*
*Prescott, Arizona*

## Undergraduate Research Institute Advisory Board

Akhan Almagambetov, Electrical, Computer & Software Engineering; Elliott Bryner, Mechanical Engineering; Elizabeth Davis, Humanities and Communication; Tyrone Groh, Intelligence Studies and Global Affairs; Timothy Holt, Applied Aviation Sciences; Brennan Hughey, Physics; Mary Alys Lillard, Honors Program; Jennah Perry, Applied Aviation Sciences; Patricia Watkins, Hazy Library and Learning Center; and Gary Yale, Aerospace Engineering

## Undergraduate Research Institute

Anne Boettcher, Director; Ginger MacGowan, Administrative Assistant; and Geoffrey Winship, Outreach Coordinator

## A special note of thanks to all of our mentors!

## Invited Oral Presentations

*URI Oral Presentations*

Preview Day Welcome
**Kevin Horn, Mechanical Engineering-Robotics, Senior**
Activity Center | 9:00-9:30 AM

Academic Program Meetings

College of Engineering
**Sarah Pearson, Electrical Engineering, Senior**
Activity Center | 9:45-11:00 AM

College of Aviation
**Camden Plunkett, Applied Meteorology, Senior**
Davis Learning Center | 9:45-11:00 AM

College of Arts and Sciences
**Hunter McCraw, Space Physics, Junior**
AC1-Rm. 104 | 9:45-11:00 AM

College of Security and Intelligence
**Erica Nieves, Global Security and Intelligence Studies, Senior**
The Hangar | 9:45-11:00 AM

## Posters and Demonstrations Presentations

*(Number Corresponds to Poster/ Demonstration Number)*

**Friday, 31 March 2017**
AC1-Atrium, 11:00 AM-3:00 PM
Eagle Gym, 7:00-9:00 PM

1. **Alternate Composite Team: Feasibility Study of Graphene for Structural Component Applications (Poster & Demonstration)**
   Trupti Mahendrakar, Alexandria Brown, Drew Takeda, Gavin Hofer, Ghonhee Lee, Miguel Recabarren, and Trishen Patel
   *Mentor: Wahyu Lestari*

2. **Hybrid Hydrogen / Gasoline Internal Combustion Engine**
   Ryan Arnold, Daniel Reynolds and Monty Bruckman II
   *Mentor: William Crisler*

3. **ERAU's AzLoop Hyperloop Competition Team**
   Amy Walker, Victor Ordaz, Meaghan Moeller, Maciek Czyz, and Garrett Ottmers
   *Mentor: Samuel Siewart*

4. **Developing Communication Link Analysis Tools**
   Sarah Pearson and Ashley Villa
   *Mentor: John M. Pavlina*

5. **Extra-Terrestrial Subsurface Sampling Device**
   Farjam Ashrafzadeh, Richard Murray, Zachary Davis, Benjamin Treece, William Hosea and Baxter Elwood
   *Mentors: Richard Mangum and Iacopo Gentilini*

6. **VEX Robotics Team**
   Adam Scott, Jesse Ives, Ferrin Katz, Lucas Widner, Kyle Lutterman, Braxton Kendall, Jeffrey Ryan, Maciek Czyz, Michael Buck, Connor Rockwell, Geoffrey Winship, Jonathan Buchholz, Jared Delinger, Xander Pickard, Edward Pierce, Murtuza Lemonwala, Christopher Allyas, Christopher Telles, Gregory Klatchko, and Ben Mohorc
   *Mentor: Joel Schipper*

7. **Development of a Walking Robotic Hexapod Platform (Poster & Demonstration)**
   Magnus Bergman, Davis Fischer, Kevin Horn, Evan Kline, Trentin Post, Steven Rudrich, Mariah Sampson, Kristin Sandager, David Olson, and Sarah Pearson
   *Mentors: Iacopo Gentilini and Rick Mangum*

8. **Scorpius Robotics Robotic Arm**
   Austin Wild, Robert Noble, Andrew Dittrich, Hilary Nelson, Jennifer Stiles, and Nicholas Harris
   *Mentors: Iacopo Gentilini and Rick Mangum*

9. **Eagle Robotics Autonomous Fire-Fighting Robot**
   Kevin Horn, Emma Hutchison, Ryan Burns, Zachary Parish, David Sanders, Blake Games, Tristan Minkoff, and Alex Young
   *Mentor: Stephen Bruder*

10. **Team Eagle Wingsuits: Sewing Seeds of Greatness**
    Glenn Borland, Brian Cowley, Connor McNicholas and Benjamin Salisbury
    *Mentor: Timothy Sestak*

11. **Human-Powered Aircraft Technologies (Poster & Demonstration)**
    Mark Van Bergen, Ryan Burns, Chris Jacobs, Duke Millett, Zachary Parrish, Laura Rudnik, Gillian Blumer, Kevin Horn and Michael Chastain
    *Mentor: Gary Yale*

12. **Eagle Aero Sport: Student-Built Aircraft**
Rachael Bradshaw, Kalynn Huebner, and Kyle Wimmer
*Mentors: Brian Davis and Wallace Morris*

13. **Novel n × n Bit-Serial Multiplier Architecture Optimized for Field Programmable Gate Arrays**
Rachael Bradshaw and Holly Ross
*Mentor: Akhan Almagambetov*

14. **AIAA Design Build Fly**
Evan Estep, Andres Sandoval, Brian Study, Cody Johnson, Jacob Adams, Adam Bergamini, Alexander Harvey, Trevor Lau, Anthony Lu, Mark Miller, Nathan Mills, Kyle Noland, Tyler Noland, Kevin Pereira, Elkanah Riley, Marcus Ross, Paul Sanders, Tharun Sankar, Bryan Schaefer, Travis Walker, and Mehdi Zoroufchian
*Mentors: William Crisler, David Lanning, and Bill Zwick*

15. **Implementation of an Unmanned Aerial Vehicle to Provide Close-Air Support to Wildland Firefighters as they Battle the Blaze Directly**
Nathan Montoya
*Mentor: Bill Zwick*

16. **Parawing's Application for UAVs**
Sho Okayama
*Mentor: Lance Traub*

17. **Micro Air Vehicle Platform Design (Poster & Demonstration)**
Nitin Susendran, Nathan Mills, Adam Bergamini, Jacob Schneider, Robin Loch, and Zachary Davis
*Mentors: Akhan Almagambetov and William Crisler*

18. **Integrating Unmanned Aircraft Operations into the National Airspace System**
Benjamin Cook, Holley Hughes, Kyle Wilkerson, and Allison Little
*Mentors: Jennah Perry, Johnny L. Young, and Jacqueline Luedtke*

19. **Utilizing Guided Simulation in Conjunction with Digital Learning Tools in Air Traffic Control Training to Enhance Learning at the Collegiate Level**
Allison M. Little, Benjamin D. Cook, Holly J. Hughes, and Kyle C. Wilkerson
*Mentors: Jennah Perry and Jacqueline Luedtke*

20. **Undergraduate Research on General Aviation Hypoxia: A Student's Perspective**
Claire Schindler
*Mentors: Timothy Holt and Jackie Luedtke*

21. **Airline Quality Research: A Student's Perspective**
Madeline S. Kuhn
*Mentors: Brent D. Bowen, Erin E. Bowen, Mary M. Fink, and Dean E. Headley*

22. **Tale of Two Stans: Afghan Motivations and Modalities in the Tajikistan Civil War**
Jake Delinger
*Mentor: Thomas Field*

23. **Mitigation of Online Violence and Sextortion through Social Media**
Aaron Quinones, Austin Musgrove, Erica Nieves, Steven Sensmeier, Ray Casillas, Trey Turley, Kaitlyn Masterson, Karolina Bergman, Kathryn Bowling, Duran Delgadillo, Louis Heaulme, Lauren Holdaway, Brett Hughett, Christopher Kunkle, Kolby Mays, Nicholas McGlynn-Moore, Giselle Tull, and Sean Yeoh
*Mentor: Tyrone Groh*

24. **Students Perspective on the Utilization of Social Media for Scholarly Research**
Hunter Watson
*Mentor: Brent D. Bowen, Timothy B. Holt, Jacqueline R. Luedtke, and David A. Ehrensperger*

25. **Unsafe Pedestrian Behaviors: A Comparative Analysis Between Elementary and Middle School Students**
Emilio Navarrete
*Mentor: Jonathan M. Gallimore*

26. **Simulations of Convective Flash Flood Events in Southern Switzerland**
Camden Plunkett
*Mentor: Curtis James*

27. **Variability of the North American Monsoon**
Madelyn Powell
*Mentor: Mark Sinclair*

28. **Eagle Aerospace: Solid Propellant Driven Competition Rocket (Poster & Demonstration)**
Reece Cabanas, Jason Aronson, Matthew Boban, Bryce Chanes, Jeffrey Chen, Thorin Compy, Maciek Czyz, Eric Fain, Andrew Gifford, Kevin Gray, Luke Hein, Michelle Luna, Joseph Scrivens, Nicole Shriver, Ashley Sims, Barik Smith, Bryce Smoldon, Paul Spencer, Dhruv Vasant, Steven Duhamel, and Shelby Lardner
*Mentor: Elliot Bryner*

29. **Development of a Hybrid Rocket to Achieve Precise Altitudes (Poster & Demonstration)**
Daniel Dyck, William Carpenter, Cameron Kurtz, Reece Cabanas, Bryce Chanes, Bea Johnson, Emily Keeland, Reece Krantz, Dillon Mcgrath, Steven Morales, Lee Morris, Bryan Schaefer, and Bryce Smolden
*Mentor: Elliot Bryner*

30. **KNSU Propellant Grain Geometries**
Cameron Kurtz, Robert Myers and Bryan Schaefer
*Mentor: Elliot Bryner*

31. **Impact of Red Iron-Oxide and Grain Geometry on Solid Rocket Motors for Amateur Rockets Reaching Mach 3**
Chad Reinart, Daniel Dyck, Cameron Kurtz, and Julia Levitt
*Mentor: John M. Pavlina*

32. **MP-1: Liquid Oxygen & Ethanol Rocket Engine by Mercury Propulsion**
William Carpenter, Seerat Sangha, Nicholas Wright, Tobias Fauser, Shawn Thompson, and Pedro Peña
*Mentors: Brenda Haven and Michael Fabian*

33. **CFD Study in Compound-Compressible Flow Nozzles for Rocket Thrust Augmentation**
Nicholas Wright
*Mentor: Shigeo Hayashibara*

34. **Computing and Detecting Gravitational Waves from Core Collapse Supernovae**
Travis Hansen
*Mentors: Michele Zanolin and Marek Szczepanczyk*

35. **Scattering from Optical Coating Defects in Prototype Optical Coatings for LIGO Test Masses**
Calley Tinsman
*Mentor: Andri Gretarsson*

36. **Arcjet Thruster Project**
Hunter McCraw, Stephen McMillan, and Richard Reksoatmodjo
*Mentor: Darrel Smith*

37. **What is Light? (Poster & Demonstration)**
Rob Mullins
*Mentor: Andri Gretarsson*

**Ryan Arnold**
*Mechanical Engineering Department, College of Engineering*

**Daniel Reynolds and Monty Bruckman II**
*Aerospace Engineering Department, College of Engineering*

***MENTOR:***
***William Crisler***
*Aerospace Engineering Department, College of Engineering*

## Hybrid Hydrogen / Gasoline Internal Combustion Engine

**IGNITE Grant Award**

Conventional gasoline-fueled internal combustion motors only use a small fraction of the energy in the fuel. This results in significant efficiency losses, harmful and unnecessary emissions, and deposits that cause engine wear. Hydrogen gas (H2) is highly combustible in the presence of the excess oxygen present in the combustion cycle of a conventional 4-stroke gasoline engine. The goal of this project is to retrofit a small internal combustion engine with innovative hydrogen induction technology to enhance combustion, improve efficiency to reduce fuel consumption, reduce emissions, and reduce deposits to improve reliability and extend engine life.

**Poster Presentation**


## Extra-Terrestrial Subsurface Sampling Device

**EAGLE PRIZE AWARD**

At the beginning of the Fall-2016 semester, NASA issued an invitation for engineering teams to participate in the 2017-Micro-g NExT challenge, an undergraduate research and development opportunity that focuses on future asteroid sample collection technology. The Embry-Riddle Aeronautical University Prescott team, Massive Aerospace Dynamics, elected to create a subsurface sampling device for the challenge. Massive Aerospace Dynamics will be constructing an Extra-Terrestrial Subsurface Sampling Device; a device that is intended to engage future space crews in the methodology of prospecting an asteroid/celestial body. The purpose of the device is to allow the space crew members to view the body's composition, the body's physical characteristics, and develop a greater understanding of the structure of the universe. Due to the unique environment of drilling in space, the challenge is hosted at NASA's Neutral Buoyancy Laboratory, an aquatic simulated micro gravity environment, in Houston, Texas. Massive Aerospace Dynamics is expected to be able to obtain a one-inch diameter, eight-inch cylindrical sample from three different bins containing various rocks and regolith. The Extra-Terrestrial Subsurface Sampling Device shall also allow the user to view the stratigraphy collected upon drilling into the bins, as well as allow the user to minimize any possibility of cross contaminating the samples extracted from the bins. Some of the build parameters of the Extra-Terrestrial Subsurface Sampling Device include a dry weight limit of 15 pounds, an ambidextrous design, chlorine water tolerance, and a size/volume constraint of 8" x 8" x 18".

**Poster Presentation**

**Farjam Ashrafzadeh**
*Aeronautical Science Department, College of Aviation and Mechanical Engineering Department, College of Engineering*

**Richard Murray**
*Aeronautical Science Department, College of Aviation*

**Zachary Davis**
*Computer, Electrical, & Software Engineering Department, College of Engineering*

**Benjamin Treece**
*Aerospace Engineering Department, College of Engineering*

**William Hosea and Baxter Elwood**
*Physics and Astronomy Department, College of Arts and Sciences*

***MENTORS:***
***Richard Mangum***
*Humanities and Communication Department, College of Arts and Sciences*

***Iacopo Gentilini***
*Mechanical Engineering Department, College of Engineering*

**Magnus Bergman, Davis Fischer, Kevin Horn, Evan Kline, Trentin Post, Steven Rudrich, Mariah Sampson, and Kristin Sandager**
*Mechanical Engineering Department, College of Engineering*

**David Olson and Sarah Pearson**
*Computer, Electrical, & Software Engineering Department, College of Engineering*

***MENTORS:***
***Iacopo Gentilini***
*Mechanical Engineering Department, College of Engineering*

***Rick Mangum***
*Humanities and Communication Department, College of Arts and Sciences*

# Development of a Walking Robotic Hexapod Platform

**EAGLE PRIZE AWARD**

The purpose of this project was to design and build a robot capable of competing in the 2017 RoboGames Walker Challenge and interfacing with the optionally attached manipulator. The competition consists of a 3-meter-long course covered with various objects to create an unstable surface, which the hexapod must be capable of traversing quickly. The hexapod must also be capable of interfacing with the attachable manipulator, mechanically and electrically, and communicating via software. While this robotic hexapod has been designed to complete a specific task, the long term intent is for this project to become a prototype for future projects. There are several applications in which a walking mobile robot would be more useful than a wheeled one. Walking robots are capable of navigating more treacherous terrain, such as stairs or rubble in a condemned or burning building. Additionally, hexapods can utilize a variety of gaits which allows them to optimize their movement. A wave gait offers the most amount of stability and least amount of speed with five legs always in contact with the ground, a tripedal gait offers a moderate amount of stability and speed with three legs always in contact with the ground, and a bipedal gait offers the least amount of stability and most speed with two legs in contact with the ground. This project implements a tripedal gait to allow for quick completion of the Walker Challenge while also maintaining mechanical stability.

**Poster Presentation and Demonstration**

## Team Eagle Wingsuits: Sewing Seeds of Greatness

**EAGLE PRIZE AWARD**

Team Eagle Wingsuit, an ongoing multi-disciplinary project, has been producing unique insights in wingsuit aerodynamics for the last nine semesters. As wingsuits grow in popularity, the demand for performance and safety has increased. The team goal is to increase performance and reduce the risk of wingsuit flight accidents. The primary hypothesis was, current wingsuit fabrics are not aerodynamically sound. To test this hypothesis, the team successfully built a test apparatus to research current wingsuit construction fabrics in the wind tunnel. This effort has produced unique information and unexpected results that are important to the entire wingsuit industry. Test results of combinations of materials, in the patterns and shapes (morphologies) used in wingsuit design will aid in the selection of alternate materials for wingsuit design. Graphical comparison of the performance of the tested materials shows a clear difference and reveals a potential factor involved in the number of fatal accidents involving elite world class wingsuit pilots. The current research phase involves using our apparatus to test ram-air inflated airfoils. Current ram-air inflated wingsuit designs deform in flight due to the dynamic air pressure. This deformation is hypothesized to reduce lift and controllability. In addition, the team will conduct CFD analysis on potential wingsuit designs to optimize performance and reduce production costs. After completing preliminary tests, the team intends to improve upon existing wingsuit designs and produce a next generation wingsuit to fly in the 2017 Wingsuit World Cup competition.

**Poster Presentation**

**Glenn Borland**
*Applied Aviation Sciences Department, College of Aviation*

**Brian Cowley**
*Aerospace Engineering Department, College of Engineering*

**Connor McNicholas and Benjamin Salisbury**
*Aeronautical Science Department, College of Aviation*

***MENTOR:***
***Timothy Sestak***
*Aeronautical Science Department, College of Aviation*

**Rachael Bradshaw, Kalynn Huebner, and Kyle Wimmer**
*Aerospace Engineering Department, College of Engineering*

***MENTORS:***
***Brian Davis***
*Computer, Electrical, & Software Engineering Department, College of Engineering*

***Wallace Morris***
*Aerospace Engineering Department, College of Engineering*

## Eagle Aero Sport: Student-Built Aircraft

**EAGLE PRIZE AWARD**

Eagle Aero Sport (EAS) is the first student operated aircraft build team at Embry-Riddle Aeronautical University. Our team allows students to gain hands-on experience in all aspects of aircraft production including: aircraft assembly, design engineering, management of production operations, finance, marketing, and team building skills. Through research, and consultation with the Experimental Aircraft Association, our airplane of choice is the Van's RV-12. EAS is modifying the airplane to add real time flight test instrumentation for research. These instruments will gather data for aerodynamic and structural, as well as aircraft performance experiments. Presently, EAS is progressing with the Build Team 45% complete and the Engineering Team 30% complete. EAS has received the power-plant and has installed the landing gear, which is the first step in power-plant installation. The team implements OSHA standards and mandates that all build teams are led by an FAA certificated Airframe and Power-plant Mechanic. Once complete, EAS will have the opportunity to conduct novel research in regards to airframe structural analysis and fatigue, aerodynamic flow characteristics, and other flight test studies including meteorology. Some of these experiments have been specifically requested by Van's Aircraft, our industry partner. All of the research and knowledge gathered by Eagle Aero Sport represents a rare asset that, we hope, will become more common-place as it is incorporated into Embry-Riddle's curricula, enhancing the student and faculty experience.

**Poster Presentation**


## Novel n × n Bit-Serial Multiplier Architecture Optimized for Field Programmable Gate Arrays

**Rachael Bradshaw**
*Aerospace Engineering Department, College of Engineering*

**Holly Ross**
*Computer, Electrical, & Software Engineering Department, College of Engineering*

***MENTOR:***
***Akhan Almagambetov***
*Computer, Electrical, & Software Engineering Department, College of Engineering*

Bit-serial multipliers have a variety of applications, from the implementation of neural networks to cryptography. The advantage of a bit-serial multiplier is its relatively small footprint, when implemented on a Field Programmable Gate Array (FPGA) device. Despite their apparent advantages, however, traditional bit-serial multipliers typically require a substantial overhead, in terms of component usage, which directly translates to a large area of the chip being reserved while many other resources are unused. This research addresses the possibility of an efficient two's complement bit-serial multiplier (serial-serial multiplier) implementation that would minimize flip-flop and control set usage on an FPGA device, thereby potentially reducing the overall area of the circuit. Since the proposed architecture is modular, it functions as a "generic" definition that can be effortlessly implemented on an FPGA device for any number of bits.

**Poster Presentation**


**Reece Cabanas, Jason Aronson, Matthew Boban, Bryce Chanes, Jeffrey Chen, Thorin Compy, Maciek Czyz, Eric Fain, Andrew Gifford, Kevin Gray, Luke Hein, Michelle Luna, Joseph Scrivens, Nicole Shriver, Ashley Sims, Barik Smith, Bryce Smoldon, Paul Spencer, and Dhruv Vasant**
*Aerospace Engineering Department, College of Engineering*

**Steven Duhamel, Shelby Lardner**
*Mechanical Engineering Department, College of Engineering*

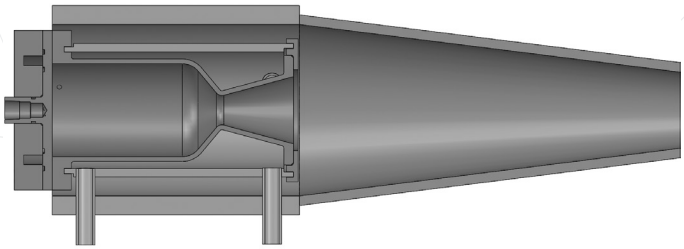
***MENTOR:***
***Elliot Bryner***
*Mechanical Engineering Department, College of Engineering*

# Eagle Aerospace: Solid Propellant Driven Competition Rocket

**EAGLE PRIZE AWARD**

The use of solid propellant motors has been around since the early days of rocketry, with applications in both aeronautics and astronautics. One outstanding example is the twin boosters used on the space shuttle flights, which would help boost the shuttle to a certain altitude before separating. What we strive to do as a team is create a student developed and manufactured rocket based on principles derived from high powered model rocketry. Our final rocket is expected to carry an 8.8-pound scientific payload as close to 10,000 feet as possible in order to meet the requirements stated in the Intercollegiate Rocketry Engineering Competition guidelines. This competition occurs annually with collegiate rocketry teams traveling from not only within the United States of America, but various nations around the world. This year's competition is located at Spaceport America in Las Cruces, New Mexico, the site of testing for aerospace companies such as Virgin Galactic. Our competition rocket will be comprised of a hand-made fiberglass airframe crafted by our team members, and a commercial off-the-shelf solid propellant rocket motor expected to output an average thrust of 1,148 newtons. Our payload section will consist of a 3D-printed housing which will carry vibration sensors, an accelerometer, a camera, and samples of various composites.

**Poster Presentation and Demonstration**



## MP-1: Liquid Oxygen & Ethanol Rocket Engine by Mercury Propulsion

**IGNITE GRANT AWARD**

Mercury Propulsion is an undergraduate engineering team whose members hold different majors as offered from the College of Engineering at Embry-Riddle Aeronautical University in Prescott, Arizona. The team is tasked to design, build, instrument, and test a liquid rocket engine utilizing an optional Ejector Thrust Augmentation System (ETAS). The engine will burn liquid oxygen and ethanol as its propellants and be designed to produce 200 lb of thrust without augmentation. The end goal of the project is to produce thrust data from two five-second hot-fire tests; one with and one without the ETAS installed.

**Poster Presentation**

**William Carpenter, Seerat Sangha, and Nicholas Wright**
*Mechanical Engineering Department, College of Engineering*

**Tobias Fauser and Shawn Thompson**
*Computer, Electrical, & Software Engineering Department, College of Engineering*

**Pedro Peña**
*Aerospace Engineering Department, College of Engineering*

***MENTORS:***
***Brenda Haven and Michael Fabian***
*Mechanical Engineering Department, College of Engineering*


**Benjamin Cook, Holley Hughes, Kyle Wilkerson, and Allison Little**
*Applied Aviation Sciences Department, College of Aviation*

***MENTORS:***
***Jennah Perry, Johnny L. Young, and Jacqueline Luedtke***
*Applied Aviation Sciences Department, College of Aviation*

## Integrating Unmanned Aircraft Operations into the National Airspace System

Unmanned Aircraft Systems (UAS) are expected to dominate the National Airspace System (NAS) in the near future. One particular barrier preventing the integration of unmanned aircraft into the NAS is the lack of standardized procedures for distinguishing and communicating with remote UAS operators. In preparation for adopting unmanned flight operations into a complex control system, it is important to identify solutions to effectively control UAS in the NAS. To achieve simultaneous safe manned and unmanned aircraft operations in the NAS, the Joint UAS and ATC Team (JUAT) at Embry-Riddle Aeronautical University (ERAU) are developing a system that could be used to control UAS. The JUAT group has designed several simulated ATC scenarios in order to determine effective solutions for UAS integration. A modified version of the Military Grid Reference System was developed and digitally overlaid onto the radar display. To incorporate this grid system, a customized flight plan database was created for the storage of operator submitted flight plans. Instead of verbal communication, a computer chat system was used for communication because of the low altitude operations in the field. The day when UAS fill the sky is rapidly approaching. The FAA has projected that the UAS market will reach 7 million systems by 2020. The FAA has made UAS integration a top priority and the JUAT will create a path for a positive solution.

**Poster Presentation**

## A Tale of Two Stans: Afghan Motivations and Modalities in the Tajikistan Civil War

**IGNITE GRANT AWARD**

Studies into the foreign policies of world powers acting in the Middle East are plentiful, but significantly less focus is placed on the foreign policies of these states being acted upon. What are their motivations, their means, their capabilities? Given the significance of historical relations in Asian and Middle Eastern societies to their present day relationships, it follows that a gap in understanding the conflicts of the past is a gap in understanding the conflicts of the present. This project documents and analyzes one such historically-focused conflict, the Tajikistan Civil War, which engulfed the Central-Asian country between 1992 and 1997. The political and economic motivations and modalities of intervention into the conflict by the Islamic State of Afghanistan and later the Taliban Emirate are examined, and comparisons of policies are made so as to provide a greater understanding and documentation of Afghan foreign policy towards Tajikistan in the first years of independence of the Central-Asian state. Using both interviews with subject matter experts in addition to first and second hand documentation and articles, a categorized, detailed breakdown of Afghan foreign policy in Tajikistan between the civil war of 1992-1997 will be created and published. The hope is to provide greater knowledge on a comparatively understudied conflict and region, with the ultimate aim of providing a broader understanding of the current conflicts occurring in these areas.

Image Source: Central Intelligence Agency

**Poster Presentation**


**Jake Delinger**
*Intelligence Studies and Global Affairs Department, College of Security and Intelligence*

***MENTOR:***
***Thomas Field***
*Intelligence Studies and Global Affairs Department, College of Security and Intelligence*


# Development of a Hybrid Rocket to Achieve Precise Altitudes

**EAGLE PRIZE AWARD**

**Daniel Dyck**
*Computer, Electrical, & Software Engineering Department, College of Engineering*

**William Carpenter and Cameron Kurtz**
*Mechanical Engineering Department, College of Engineering*

**Reece Cabanas, Bryce Chanes, Bea Johnson, Emily Keeland, Reece Krantz, Dillon Mcgrath, Steven Morales, Lee Morris, Bryan Schaefer, and Bryce Smolden**
*Aerospace Engineering Department, College of Engineering*

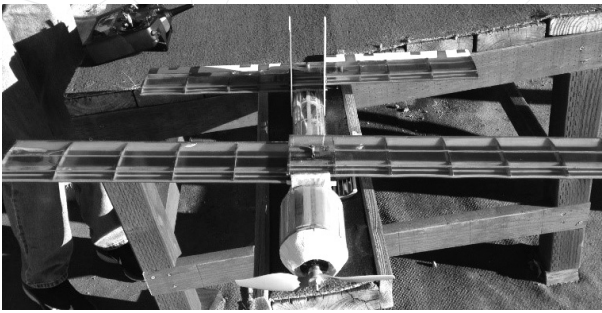
***MENTOR:***
***Elliot Bryner***
*Mechanical Engineering Department, College of Engineering*

Hybrid rockets, employed by companies like space tourism provider Virgin Galactic, use propellants that are in different phases. Most commonly used is a solid fuel, such as Hydroxyl Terminated Polybutadiene (HTPB), paraffin, or acrylic, and a liquid oxidizer, such as liquid oxygen or nitrous oxide. The oxidizer is injected into the combustion chamber in vapor form, to prevent droplets of oxidizer impacting the fuel, resulting in localized detonations. When compared to liquid rocket engines, hybrid rocket engines can be designed and manufactured at a lower cost. When compared to solid rocket motors, hybrid rocket engines usually have higher impulse, and the ability to be throttled.

The purpose of this project is to fly a rocket using a hybrid propulsion system to a target altitude of 10 thousand feet as accurately as possible. The hybrid engine will use nitrous oxide as the oxidizer and HTPB as the fuel, with injector orifices less than 0.1 inch in diameter for vaporization. A small-scale hybrid engine prototype is being designed for static testing, to provide preliminary data on the design and to act as a proof of concept.

The flight vehicle, will carry an altitude prediction system that actively determines when the rocket will reach 10 thousand feet, if combustion shutdown were to occur instantaneously. It will then close the valve that controls oxidizer flow, shutting down combustion, allowing the rocket to coast to its desired altitude.

**Poster Presentation and Demonstration**



## AIAA Design Build Fly

**EAGLE PRIZE AWARD**

Design-Build-Fly is an annual contest hosted by the American Institute for Aeronautics and Astronautics (AIAA), and sponsored by Cessna Aircraft Company and Raytheon Missile Systems. Design-Build-Fly challenges college students to create a small aircraft to meet a set of requirements. During the 2016-2017 academic year, more than 100 undergraduate student teams from around the world have been challenged to design, build, and flight test an aircraft which can carry a payload of hockey pucks and which can be folded to fit into a small storage tube. Eight months of designing and building will culminate in a 4-day fly-off in April in Tucson, AZ. This competition enables students to extend and demonstrate technical skills learned in the classroom, as well as develop practical teamwork skills.

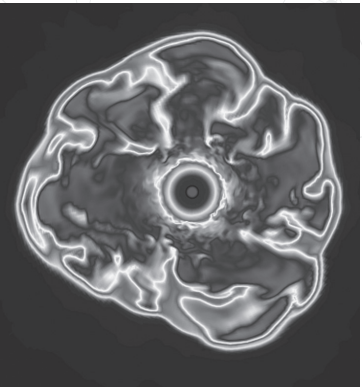
**Poster Presentation**

**Evan Estep, Andres Sandoval, Brian Study, Cody Johnson, Jacob Adams, Adam Bergamini, Alexander Harvey, Trevor Lau, Anthony Lu, Mark Miller, Nathan Mills, Kyle Noland, Tyler Noland, Kevin Pereira, Elkanah Riley, Marcus Ross, Paul Sanders, Tharun Sankar, Bryan Schaefer, and Travis Walker**
*Aerospace Engineering Department, College of Engineering*

**Mehdi Zoroufchian**
*Behavioral and Safety Science Department, College of Arts and Sciences*

***MENTORS:***
***William Crisler and David Lanning***
*Aerospace Engineering Department, College of Engineering*

***Bill Zwick***
*Mechanical Engineering Department, College of Engineering*



**Travis Hansen**
*Aerospace Engineering Department, College of Engineering*

***MENTORS:***
***Michele Zanolin***
*Physics and Astronomy Department, College of Arts and Sciences*

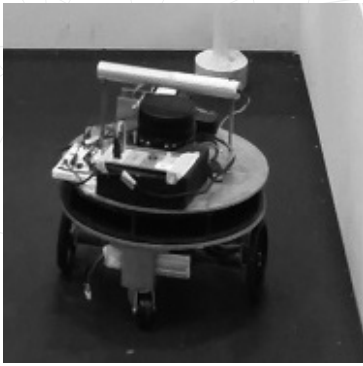
***Marek Szczepanczyk***
*Department of Physical Sciences, College of Arts and Sciences - Daytona*

# Computing and Detecting Gravitational Waves from Core Collapse Supernovae

**IGNITE GRANT AWARD**

The discovery of gravitational waves marked the beginning of a new era of astronomy. On Feb 11, 2016, LIGO reported the observation of the first signal from the merger of two black holes. Another black hole merger was reported later in May 2016, and even more detections are expected from this family of sources. The next family of sources that could revolutionize the field are Supernovae, the explosions that mark the end of large stars. This project will primarily focus on the numerical modeling of these sources and on optimizing the algorithms that search for these signals in the data collected by laser interferometers.

**Poster Presentation**



## Eagle Robotics Autonomous Fire-Fighting Robot

**EAGLE PRIZE AWARD**

**Kevin Horn and Emma Hutchison**
*Mechanical Engineering Department, College of Engineering*

**Ryan Burns, Zachary Parish, David Sanders, Blake Games, Tristan Minkoff, and Alex Young**
*Aerospace Engineering Department, College of Engineering*

***MENTOR:***
***Stephen Bruder***
*Computer, Electrical, & Software Engineering Department, College of Engineering*

The Eagle Robotics team is focused on the creation of an autonomous mobile robot platform capable of competing in the 2017 RoboGames firefighting robot competition. In order to fulfill the requirements of the challenge, the student led team must design a robot capable of navigating a small maze in search of a lit candle. Upon identifying the flame of the candle, the robot must extinguish the fire and then return to its starting location thus completing its mission. To address this challenge, the students on the Eagle Robotics team have implemented a variety of sensors to allow their robot to interpret the environment of the maze. For the purpose of navigation, the team has included a 360o laser distance scanner, an infrared line sensor, and an ultrasonic range sensor. In order to identify the flame of the candle the team has implemented an array of infrared light intensity sensors and a non-contact infrared thermometer. The information from all of these sensors is processed by an on-board microcontroller which allows the robot to analyze its environment and respond appropriately. Additionally, the navigation routine includes methods of path optimization to reduce the time of operation, which may improve the teams score during the competition. Beyond the scope of the competition, this robot demonstrates the properties of a self-controlled system that could aid in firefighting applications in industrial or residential environments, reducing the need for people to enter such a dangerous environment.

**Poster Presentation**
**Invited Oral Presentation**

**Madeline S. Kuhn**
*Department of Business, College of Arts and Sciences*

***MENTORS:***
***Brent D. Bowen***
*Aeronautical Sciences Department, College of Aviation*

***Erin E. Bowen***
*Behavioral and Safety Science Department, College of Arts and Sciences*

***Mary M. Fink***
*College of Aviation*

***Dean E. Headley***
*Department of Marketing, Frank Barton School of Business, Wichita State University*

## Airline Quality Research: A Student's Perspective

This study examines the relationship between the Airline Quality Rating (AQR) and the Airline Passenger Survey (APS) from an undergraduate student's perspective, as well as how conducting undergraduate research has influenced the student researcher. Operational performance of the U.S. airline industry has been monitored for the past 27 years by a quantitative model of metrics known as the Airline Quality Rating. These metrics include on-time flights, denied boarding, mishandled baggage, and customer complaints. As the nation's most comprehensive study of airline performance and quality, the National Airline Quality Rating (http://airlinequalityrating.com) sets the industry standard, providing consumers and aviation industry professionals a means to compare performance quality among U.S. airlines using objective, performance-based data. No other airline study in the country is based on performance measures. Criteria included in the Airline Quality Rating (AQR) report are screened to meet two basic elements: (1) they must be readily obtainable from published data sources for each airline, and (2) they must be important to consumers regarding airline quality. The APS was added as a new feature of the AQR in 2008 following increased interest in the relationship between consumer perceptions and objective airline industry performance. The student researcher has gained skills related to communication and collaboration with mentors; trend and data analysis within the aviation industry; as well as valuable research experience to apply in their graduate career. Results were retrieved from the April, 2016 Airline Quality Rating Report and the 2016 Airline Passenger Survey.

**Poster Presentation**

## KNSU Propellant Grain Geometries

**IGNITE GRANT AWARD**

**Cameron Kurtz**
*Mechanical Engineering Department, College of Engineering*

**Robert Myers and Bryan Schaefer**
*Aerospace Engineering Department, College of Engineering*

***MENTOR:***
***Elliott Bryner***
*Mechanical Engineering Department, College of Engineering*

There are two types of Solid Rocket Motors (SRMs): endburners and coreburners. The type of SRMs investigated in this project are coreburners, which burn from the inside of the propellant grain to the motor's inner wall. The cross-sectional area of the propellant grain is known as grain geometry, and the simplest shape is a circle. This means the burning surface area is the circle's circumference. As the circle burns outward, the circle's circumference expands, increasing the propellant's burning surface area. The thrust is therefore proportional to the propellant's exposed surface area. This exposed surface area dictates a SRM's performance and can be utilized to achieve the desired thrust curve. Historically, in order to change the thrust curve, the cross-sectional area is adjusted by changing the geometry. The purpose of this project is to compare the thrust and pressure curves of different propellant grain geometries with a sucrose fuel and potassium nitrate oxidizer (KNSU). Due to manufacturing considerations, the initial tests will be conducted with circular grains. All circle grains burn progressively, since the surface area increases during the burn. However, if a grain's geometry is designed without increasing surface area, then the SRM's thrust and pressure curves will be more uniform. In order to examine this, a star shaped cross-sectional grain geometry with an equal volume to the circular grain will be tested. This comparison will demonstrate the regression, thrust, and pressure properties of KNSU propellant, and provide data to be used for comparison of different propellant grain geometries.

**Poster Presentation**


**Allison M. Little,**
**Benjamin D. Cook,**
**Holly J. Hughes, and**
**Kyle C. Wilkerson**
*Applied Aviation Sciences Department, College of Aviation*

***MENTORS:***
***Jennah Perry and***
***Jacqueline Luedtke***
*Applied Aviation Sciences Department, College of Aviation*

## Utilizing Guided Simulation in Conjunction with Digital Learning Tools in Air Traffic Control Training to Enhance Learning at the Collegiate Level

Students in an air traffic control program are required to learn and apply advance knowledge and skills in a limited time frame. All students learn at different rates as well as through different learning styles. Swivl is a video capture tool designed to enhance student learning by allowing students to refer back to their individual classroom lab training session videos via an online portal. Swivl is being utilized in two ATC lab courses. During this research, two technological shortcomings were discovered: (1) Swivl lacks the ability to capture audio from the COA's existing communication software and (2) Swivl cannot focus on the radar display. As a result, the videos have lacked visual clarity when reviewing the session. Consequently Swivl has been shown to be an ineffective digital learning tool for this situation. Swivl, used in conjunction with a simulated ATC tower, has proven to be effective in enhancing overall learning due to the visual nature of the tower learning environment. The nature of the tower simulator allows for better visual acuity and effective communication exchange within the Swivl videos. Once these two issues are resolved, Swivl will have the potential to be an effective tool in ATC training, and may enhance learning by allowing students to sharpen those skills necessary for advancement in the field of air traffic control.

**Poster Presentation**

# Alternate Composite Team: Feasibility Study of Graphene for Structural Component Applications

**IGNITE GRANT AWARD**

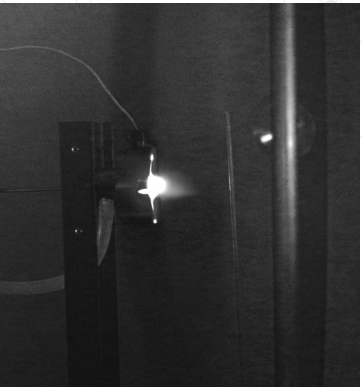

**Trupti Mahendrakar, Alexandria Brown, Drew Takeda, Gavin Hofer, Ghonhee Lee, and Miguel Recabarren**
*Aerospace Engineering Department, College of Engineering*

**Trishen Patel**
*Engineering Technology, El-Camino College*

***MENTOR:***
***Wahyu Lestari***
*Aerospace Engineering Department, College of Engineering*

Graphene is a newly discovered material with a variety of industrial applications from composites to electrical systems. Due to its high Young's modulus (2.0 ± 0.5 TPa) and electrical conductivity (106 S/cm), graphene-infused composites can serve as an alternative for several mainstream materials. Graphene infused composites could decrease aircraft weight, reduce lightning strike damage, increase the sensitivity of sensors, and improve the response time of electronics. In this study, graphene in the form of graphene oxide was used to fabricate the epoxy and fiber reinforced composites. The epoxy and fiberglass composites were made with and without graphene, and analyzed for their material properties. The results of the fiberglass tensile tests showed an improvement of 8.72 % in Young's modulus due to the presence of the graphene. The composites were then examined under both an optical microscope and a Scanning Electron Microscope (SEM ) to study the bonding of graphene within the epoxy and fibers. Additionally, electrical conductivity enhancement by graphene on carbon fiber composites was studied and analyzed. The overall goal is to conduct material tests to confirm that graphene can enhance the properties of conventional materials and composites. These properties will then be compared to industry standard materials to show the benefit of these graphene-infused composites.

**Poster Presentation and Demonstration**



**Hunter McCraw,**
**Stephen McMillan, and**
**Richard Reksoatmodjo**
*Physics and Astronomy Department,*
*College of Arts and Sciences*

***MENTOR:***
***Darrel Smith***
*Physics and Astronomy Department,*
*College of Arts and Sciences*

## Arcjet Thruster Project

**IGNITE GRANT AWARD**

Electric propulsion systems are critical to extending the lifetimes of satellites and other spacecraft. They are an increasingly important area of research for space industry companies looking to offer the longest lifetimes for commercial satellites. Electrothermal thrusters are Electric Propulsion (EP) devices that use electric power (electro) to generate heat (thermal) which is applied to a propellant, driving up pressure and enthalpy, which (in short) increases thrust output. Electric propulsion systems, compared with conventional chemical propulsion methods, have higher impulse ratings, higher thrust efficiency, better controllability, and longer operational lifetimes. The team has presented an electric propulsion project focused on designing, constructing, testing, and ultimately optimizing a simple electrothermal propulsion system. Through optimization of design parameters such as propellant mass flow rate, nozzle shape/length, cathode placement, and tangentially injected propellant, the hope is to optimize the thrust and specific impulse (Isp) performance levels of the propulsion system. The team has proposed that a simple arcjet can be constructed and operated to demonstrate feasibility of low-power electric propulsion systems, and allowing the investigation of the relevant properties such as thrust, specific impulse, and efficiency. The findings will contribute to the small body of knowledge regarding ultra-low-power arcjets of less than 1 kW in power, and their performance.

**Poster Presentation**
**Invited Oral Presentation**

**Nathan Montoya**
*Aerospace Engineering Department, College of Engineering*

***MENTOR:***
***Jacob Zwick***
*Mechanical Engineering Department, College of Engineering*

## Implementation of an Unmanned Aerial Vehicle to Provide Close-Air Support to Wildland Firefighters as they Battle the Blaze Directly

**IGNITE GRANT AWARD**

Wildfires are one of nature's most devastating forces, destroying anything in their path. Prescott, Arizona knows this all too well due to the horrific incident that occurred on June 30, 2013. The Granite Mountain Hotshots, based in Prescott, were fighting a wildfire in Yarnell when the unthinkable happened. The crew of twenty were battling the blaze when weather conditions shifted causing the wildfire to engulf the Hotshots. Nineteen Hotshots lost their lives that day. Brendan McDonough, the sole survivor, was the lookout that day and was far enough away to escape with his life. Currently, there are larger fixed wing unmanned aerial vehicles (UAVs) that aide with mapping of wildland fires, but they fly at high altitudes and can't provide immediate support if needed. The overarching goal of this project is to develop a UAV than can handle the harsh conditions of wildland fires in order to provide close air support to the Hotshots who are on the ground fighting the wildland fires directly. The UAV will have the capability to actively 3D map a larger site with the use of UV and IR cameras, actively track people and vehicles for increased situational awareness, and act as a communication relay to improve communication between ground crew and command elements. These capabilities will give the UAV the means to provide vital support to help prevent conditions that lead to the incident that occurred in June of 2013.

**Poster Presentation**

**Rob Mullins**
*Physics and Astronomy Department, College of Arts and Sciences*

***MENTOR:***
***Andri Gretarsson***
*Physics and Astronomy Department, College of Arts and Sciences*

## What is Light?

**IGNITE GRANT AWARD**

In general, light can be described as a wave or a particle. When looking at light as a wave, many different phenomena become apparent, such as spectroscopy, interferometry, and diffraction. When light is described as a particle, different areas of physics are unveiled such as particle collisions, photoelectric effects, and diffraction. This study will focus on how light behaves when described as a wave, specifically what the interference of light waves looks like, and how these waves are used in physics today. Looking at light through a spectrometer, will provide insight into how scientists discover what stars are made of and the compilation of gas and dust clouds in interstellar space. The study will also include the examination of a table top interferometer, a miniature, simplified version of the LIGO experiment which recently made the first direct detection of gravitational waves.

**Poster Presentation and Demonstration**

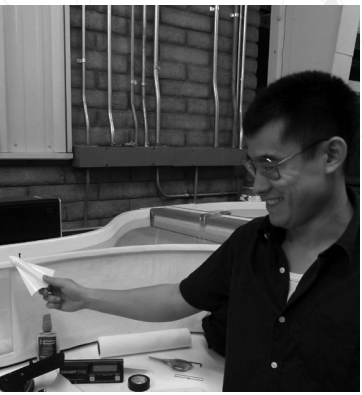
## Unsafe Pedestrian Behaviors: A Comparative Analysis Between Elementary and Middle School Students

**Emilio Navarrete**
*Behavioral and Safety Science*
*Department, College of Arts and Sciences*

***MENTOR:***
***Jonathan M. Gallimore***
*Behavioral and Safety Science*
*Department, College of Arts and Sciences*

In 2013 according to the National Highway Traffic Safety Administration, 21 % of children (individuals ≤ 14 years old) were killed in auto-pedestrian accidents. Children accounted for 5 % of pedestrian fatalities and approximately 15 % of pedestrian injuries. Children's unsafe pedestrian behaviors create concern about student safety among teachers and parents across the country. This study investigated whether children in elementary or middle school are more likely to commit unsafe pedestrian behaviors. It was anticipated that a child's developmental stage influenced the number and type of unsafe pedestrian behaviors. Two neighboring schools in Yavapai County, Arizona were observed over a three week period for 30 minutes before and after school. A modified version of the procedure developed by Suminski and Colleagues was used to collect data about the following unsafe pedestrian behaviors: talking to a friend, looking down, distractions due to inanimate objects, jay walking, horseplay, and running. A Chi-Square test of independence was conducted on the number and type of unsafe pedestrian behaviors between elementary and middle school students. The findings indicated that there was a relationship between a child's developmental stage and the amount and type of unsafe pedestrian behaviors. These results imply that administrators and parents should consider pedestrian education as well as adult oversight to increase safe pedestrian behaviors among school aged children. Through increasing safe pedestrian behaviors, fewer school aged children may become victims of auto-pedestrian injuries and fatalities.

**Poster Presentation**



**Sho Okayama**
*Aerospace Engineering Department, College of Engineering*

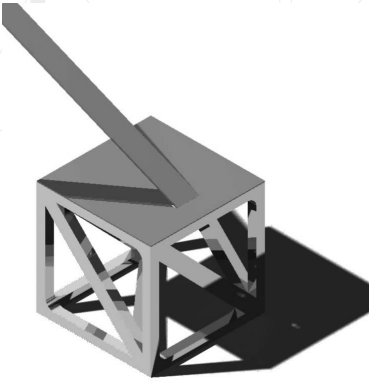
***MENTOR:***
***Lance Traub***
*Aerospace Engineering Department, College of Engineering*

## Parawing's Application for UAVs

**IGNITE GRANT AWARD**

To come up with a new configuration for a hand launched Unmanned Aerial Vehicle (UAV ), the application of the Rogallo wing design was considered as an idea for further research and development. The history of flight has always been inspired by the ways birds and bats fly efficiently, yet no aerial vehicle today mimics the drastic change in cross sections through the wing-span that those animals utilize. The Rogallo wing, also known as the para-wing or the para-glider, is a configuration with two conical parachutes made of flexible and inflatable material. This configuration was investigated because the vehicle can easily be controlled by simply changing the sweep angle of the wing. Focusing on research of the aerodynamic performance of this unique shape, mathematical and experimental approaches were undertaken. Unlike the conventional aircraft, there is a significant change in the cross sections through the wing-span. The aerodynamic analysis software known as Athena Vortex Lattice (AVL) uses the application of Thin Airfoil theory, and it was selected as the mathematical prediction tool. Validation of this method was done in low-speed wind tunnel testing using solid plastic models of the wing that simulate the fully inflated condition for each sweep angle. The experiments showed a non-linear relationship between the sweep angle and the lift performance, which suggests that this configuration does not require a large change in angle to control the vehicle.

**Poster Presentation**



## Developing Communication Link Analysis Tools

**IGNITE GRANT AWARD**

**Sarah Pearson and Ashley Villa**
*Computer, Electrical, & Software Engineering Department, College of Engineering*

***MENTOR:***
***John M. Pavlina***
*Computer, Electrical, & Software Engineering Department, College of Engineering*

What good is a satellite if we are not able to communicate with it? Over the last few years there has been an increase in the number of satellites being put into orbit. These satellites are typically CubeSats, which are ten centimeter cube satellites that are placed into low Earth orbit. These satellites offer a low-cost platform for universities to perform experiments in space. One key component of the satellite's design is the communication system. Without an adequate communication system, a communication link between the satellite and a ground station is nearly impossible. Through development of analysis methods that can be used during the design phase, investigation and refinement may be performed prior to building or launch. Two tools being utilized for analysis are ANSYS HFSS and STK. ANSYS FHSS allows for 3D modeling of the antenna's radiation pattern. The patterns can then be analyzed for directionality and strength based upon the location on the satellite. STK is used to model communications of the satellite once it is in orbit. The orbit and parameters such as tumble can be simulated to determine when the satellite has line of sight communication. From line of sight a full link budget can be calculated as well. The resultant tools and methods developed for performing communication link analysis will be able to be used for future projects as well. Future communication designs can be modeled and simulated in order to ensure performance and refine the design.

**Poster Presentation**
**Invited Oral Presentation**

**Camden Plunkett**
*Applied Aviation Sciences Department, College of Aviation*

***MENTOR:***
***Curtis James***
*Applied Aviation Sciences Department, College of Aviation*

## Simulations of Convective Flash Flood Events in Southern Switzerland

High-resolution Weather Research and Forecasting (WRF) model simulations were run for convective flash flood events with high peak discharges and flash flooding of the Maggia River in the Lago Maggiore region of southern Switzerland. The mesoscale mechanisms behind the observed convective training were studied to obtain insight into the atmospheric conditions that produce these events. Model verification was performed using radar-estimated rainfall totals (Panziera et al. 2015) and routine Radiosonde Observations from Milan, Italy. Mean atmospheric characteristics were analyzed using temporal averaging of the WRF output fields during the periods of heaviest precipitation over the Maggia catchment for each event as determined by the model composite reflectivity. Confluence of low-level southerly and easterly jets was observed in the cavity of the Alps surrounding the Lago Maggiore region. Furthermore, model omega and mixing ratio fields indicated significant downsloping and drying of the flow on the northern lee slope of the Apennines which led to deflection of the flow and the formation of the easterly barrier jet. The flow pattern was enhanced by a lee cyclone in the Piedmont region of northwest Italy, and the amount of the convective triggering over the region was related to the intensity of the convergence of the low-level flow. The confluence of these flow features and resultant orographic lifting of conditionally unstable air in the southerly LLJ are likely the mechanisms for the frequent convective triggering leading to intense flash floods in the Lago Maggiore region.

**Poster Presentation**
**Invited Oral Presentation**

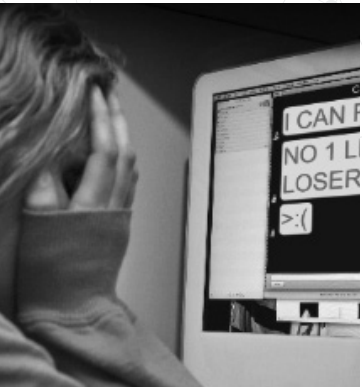
## Variability of the North American Monsoon

**Madelyn Powell**
*Applied Aviation Sciences Department, College of Aviation*

***MENTOR:***
***Mark Sinclair***
*Applied Aviation Sciences Department, College of Aviation*

Each summer, the North American Monsoon (NAM) causes a marked increase in thunderstorms and rainfall over the Southwestern United States. Monsoon precipitation occurs when there is a transition from westerlies to southwesterlies, and typically occurs when the high-pressure system moves north from its winter location and stalls near the Four Corners region. The Desert Southwest receives up to half of their annual precipitation from monsoon thunderstorms. These short lived, powerful storms can bring heavy rain, hail, flash flooding and frequent lightning. It is most predominant between the months of July and September. The NAM is not continuous, as its considerable variation relies on many factors, including the amount of moisture being advected into the region and the position of the high pressure/anticyclonic flow. If the high-pressure system is not in a favorable position to bring moisture into the Southwest region, a break in thunderstorm activity may occur. Understanding the variability of the NAM can help with regional flash flood and drought forecasting. This study will identify some of the sources of the variability in summer precipitation experienced over the last 65 years by analyzing El Nino's influence on the onset of summer precipitation, along with smaller scale influences such as local topography, movement of the high-pressure system and sea surface temperatures in the northern Gulf of California.

**Poster Presentation**




**Aaron Quinones, Austin Musgrove, Erica Nieves, Steven Sensmeier, Ray Casillas, Trey Turley, Kaitlyn Masterson, Karolina Bergman, Kathryn Bowling, Duran Delgadillo, Louis Heaulme, Lauren Holdaway, Brett Hughett, Christopher Kunkle, Kolby Mays, Nicholas McGlynn-Moore, Giselle Tull, and Sean Yeoh**
*Intelligence Studies and Global Affairs Department, College of Security and Intelligence*

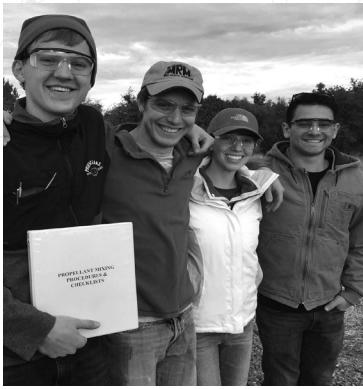
***MENTOR:***
***Tyrone Groh***
*Intelligence Studies and Global Affairs Department, College of Security and Intelligence*

## Mitigation of Online Violence and Sextortion through Social Media

**IGNITE GRANT AWARD**

The Global Security and Intelligence Studies Senior Capstone has been a three-semester long project with the objective to develop and finalize an intelligence program which will help the clients collect information on violence in social media. The first semester's goal was to identify the trends of violence in social media, and research was subsequently conducted that identified who is vulnerable to violence in social media. The second semester's primary goal was to create a preliminary intelligence collection method by working with Prescott Unified School District to establish times for initial collection and presentations for students in four target audiences: 5th to 6th graders, 6th through 8th graders, 9th and 10th graders, and 11th and 12th graders. The third semester's goal is to finalize this intelligence program and to make final recommendations for the clients as how to best conduct this type program in the future. The initial phase of the third semester was analyzing the research and findings of each of the previous semesters. The second phase was to revise the presentations established by the second semester and to conduct collection and presentations at middle schools and high schools in Prescott and Humboldt Unified School Districts. The final phase will be to analyze the information collected during the final presentations. The objective of this project to develop and finalize an intelligence program which will help the clients collect information on violence in social media will allow the clients to identify specific threats their audiences face, allowing them to create their own customized programs. The results will allow the team to provide recommendations for the clients to establish new policies defining how to deal with cyberbullying and sextortion.

**Poster Presentation**
**Invited Oral Presentation**




## Impact of Red Iron-Oxide and Grain Geometry on Solid Rocket Motors for Amateur Rockets Reaching Mach 3

**IGNITE GRANT AWARD**

Solid Rocket Motors (SRMs) are used across a variety of platforms from aircraft missiles to space shuttle boosters. Utilizing a solid propellant composed of both fuel and oxidizer, SRMs are capable of high thrust to weight ratios. The performance of a SRM is a function of its chamber pressure, which is determined by both the propellant and nozzle characteristics. Typically, higher chamber pressures are desirable as they lead to higher operational efficiencies. The primary design parameters that influence the chamber pressure are the propellant's exposed surface area, the propellant's chemistry, and nozzle throat area. This project seeks to use these parameters to develop an SRM capable of sending an amateur rocket to three times the speed of sound. The performance of the motor will be amplified through a pseudo-finocyl grain geometry and iron oxide. Motors with a diameter of 54mm will undergo static testing under different pressures to characterize the propellant. The data collected during testing will be used to scale the propellant to a 98mm diameter, allowing for the creation of a flight ready motor. Final static testing will be conducted to verify the scaling process before attempting to fly the motor on a rocket to Mach 3. Future research into these methods could yield a motor capable of much higher velocities.

**Poster Presentation**

**Chad Reinart**
*Computer, Electrical, & Software Engineering Department and Aerospace Engineering Department, College of Engineering*

**Daniel Dyck**
*Computer, Electrical, & Software Engineering Department, College of Engineering*

**Cameron Kurtz**
*Mechanical Engineering Department, College of Engineering*

**Julie Levitt**
*Aerospace Engineering Department, College of Engineering*

***MENTOR:***
***John M. Pavlina***
*Computer, Electrical, & Software Engineering Department, College of Engineering*

**Claire Schindler**
*Applied Aviation Sciences Department, College of Aviation*

***MENTORS:***
***Timothy Holt and Jackie Luedtke***
*Applied Aviation Sciences Department, College of Aviation*

# Undergraduate Research on General Aviation Hypoxia: A Student's Perspective

**IGNITE GRANT AWARD**

During the fall academic term of 2016, an opportunity arose through the College of Aviation to serve as an undergraduate research assistant. Through discussion with faculty mentors, it was decided that a severely overlooked aspect of the aviation industry was survivors of hypoxia, especially in the less regulated general aviation community. The problem this study addresses is the uncertainty of the common circumstances that general aviation pilots find themselves in that create a hypoxic state, as well as whether or not that pilot reported the occurrence to the proper establishments. The results of this study showed not only those that were impacted the greatest by hypoxia, but also a caring concern for reporting these events so that the general aviation community may learn from it and evolve their training as necessary. This study was significant in that a common topic, such as hypoxia, could be applied in a way that contributed to the general aviation community to such a tall degree. Beyond the study results, his experience has been educational about the applied process of launching a research project, the Institutional Review Board process, and aided in building confidence through presentations, and a sense of service through outreach events.

**Poster Presentation**

## VEX Robotics Team

**EAGLE PRIZE AWARD**

The VEX Robotics Team is a competition-based group of students at Embry-Riddle Aeronautical University, Prescott Campus. The team designs and constructs robots using standard VEX parts, and competes in university-level VEX Robotics competitions. This year, the organization separated into three teams: Blue, White, and Gold Teams. Each team built one robot and represented Embry-Riddle Aeronautical University at VEX competitions. The VEX game for the 2016-2017 season is named "Starstruck." In the game, each robot scores as many 6-pronged foam stars and 12 in cubes as possible over a 2ft high fence, which divides the field in half. Then, during the last 30 seconds of the 2-minute match, each robot has the opportunity to suspend itself off the ground using a 2 ft high pole located in one of the corners on its side of the field, either 4 inches for a low hang, or 12 inches for a high hang. The teams began the year with brainstorming ideas for robot designs, conducting research, and constructing prototypes. Then the teams constructed their final designs, programmed their robots using the RobotC programming language, and conducted final testing in preparation for the competition. The VEX Robotics Team successfully hosted its second VEX-U competition at Embry-Riddle Aeronautical University, Prescott Campus in November of 2016, and competed in the Southwest VEX-U Tournament on March 4th, 2017– also held at Embry-Riddle's Prescott Campus.

**Poster Presentation**

**Adam Scott, Jesse Ives, Ferrin Katz, Lucas Widner, Kyle Lutterman, Braxton Kendall, Jeffrey Ryan, and Maciek Czyz**
*Aerospace Engineering Department, College of Engineering*

**Michael Buck and Connor Rockwell**
*Computer, Electrical, & Software Engineering Department, College of Engineering*

**Geoffrey Winship**
*Business Department, College of Arts and Sciences*

**Jonathan Buchholz, Jared Delinger, Xander Pickard, Edward Pierce, Murtuza Lemonwala, Christopher Allyas, and Christopher Telles**
*Mechanical Engineering Department, College of Engineering*

**Gregory Klatchko and Ben Mohorc**
*Cyber Intelligence and Security Department, College of Security and Intelligence*

***MENTOR:***
***Joel Schipper***
*Computer, Electrical, & Software Engineering Department, College of Engineering*

**Nitin Susendran, Nathan Mills, Adam Bergamini, Jacob Schneider, and Robin Loch**
*Aerospace Engineering Department, College of Engineering*

**Zachary Davis**
*Computer, Electrical, & Software Engineering Department, College of Engineering*

***MENTORS:***
***Akhan Almagambetov***
*Computer, Electrical, & Software Engineering Department, College of Engineering*

***William Crisler***
*Aerospace Engineering Department, College of Engineering*

## Micro Air Vehicle Platform Design

**IGNITE GRANT AWARD**

The majority of small scale Unmanned Aerial Vehicles (UAV's) are made using very high performance, high cost materials, such as carbon fiber or other composite matter, typically shaped into very unconventional shapes and structures. While the use of these materials helps the airframe's structural stability and performance, the cost to buy, shape or machine such materials is extremely high. The focus of this project is to use consumer grade materials and technology to design and build an autonomous micro air vehicle that can functionally compete with military grade systems, while maintaining an under- budget status compared to the average budget of a typical military grade drone. The mission objectives include autonomous take-off and landing, waypoint navigation, collection and transmittal of data from IR & HD camera systems to the ground control module, perform minute stability control adjustments, basic flight maneuvers, and remaining in the air for at least 1 hour. The first phase of the project was testing different airframes and airfoils to get a feel for their flight characteristics. The most current prototype is a fixed flying airframe, remotely controlled by a UAS operator. This aircraft is made mostly out of EXPS foam, with an EPP foam nose to provide impact resistance. The leading edges of the aircraft were reinforced with drywall tape and epoxy to provide a ruggedized structure. In addition, the UAV gets approximately 45 minutes of flight time at half throttle. Steps are being taken to implement a Lisa/S autopilot system for phase two of the project.

**Poster Presentation and Demonstration**

**Calley Tinsman**
*Physics and Astronomy Department, College of Arts and Sciences*

***MENTOR:***
***Andri Gretarsson***
*Physics and Astronomy Department, College of Arts and Sciences*

## Scattering from Optical Coating Defects in Prototype Optical Coatings for LIGO Test Masses

**IGNITE GRANT AWARD**

This research will result in the development of a type of scattering microscope with a resolution limit that exceeds that of optical microscopy. The tradeoff is that only a limited amount of information is obtained about the sample morphology, which can still be valuable. The goal will be to learn to understand and catalog that limited information using Mie theory.

Mie theory describes the way light is scattered by homogeneous spherical particles with sizes comparable to the wavelength of light incident on the particle. Through directing a focused, Gaussian-profile laser beam onto a slide of fused silica microspheres, one can find the scattered light intensity as a function of scattering angle and compare this data to the Mie theory model. This approach provides a method of detecting and characterizing the morphology of point-defects in optical coatings, such as prototype optical coatings for Laser Interferometer Gravitational Wave Observatory (LIGO) test masses.

In the case of LIGO, a highly sensitive experiment whose performance depends on almost perfect optics, this scattering microscope could lead to an understanding of point-defects that affect the sensitivity of astrophysical observations. However, this method is of general applicability and is thus likely to find uses outside of LIGO as well.

**Poster Presentation**


**Mark Van Bergen, Ryan Burns, Chris Jacobs, Duke Millett, Zachary Parrish, Laura Rudnik, and Gillian Blumer**
*Aerospace Engineering Department, College of Engineering*

**Kevin Horn and Michael Chastain**
*Mechanical Engineering Department, College of Engineering*

***MENTOR:***
***Gary Yale***
*Aerospace Engineering Department, College of Engineering*

## Human-Powered Aircraft Technologies

**IGNITE GRANT AWARD**

The Human-Powered Aircraft Project is focused on the design and development of technologies to be used in the next generation of human-powered aircraft technologies. Human-powered aircraft are a specific and unique type of aircraft powered by only the physical input its pilot (or pilots) can provide. These aircraft require the use of the most current composite technologies combined with creative engineering solutions to create a strong, efficient, and extremely lightweight design. These engineering solutions involve making an aircraft with the wingspan of a commercial airliner (~120 ft) that weighs less than 80 pounds and achieves flight using only the 0.35 horsepower that its human pilot can provide. The Human-Powered Aircraft Project currently has two focuses. The first is to explore the effectiveness of contra-rotating propellers for improving the efficiency and flight qualities, and the second is to develop a flight simulator to be used in the testing and training of pilots. It is expected that the new propeller design will increase the efficiency of the propulsion system and aircraft stability while reducing the overall aircraft size. The team has already created a prototype of the contra-rotating gearbox and test stand and is in the process of fabricating the propellers. The team is also currently constructing a mock-up of the cockpit for use in a full cockpit simulator.

**Poster Presentation and Demonstration**

## ERAU's AzLoop Hyperloop Competition Team

**EAGLE PRIZE AWARD**

AzLoop is team of over 100 students from multiple schools in the state of Arizona from Embry-Riddle University, Northern Arizona University, Arizona State University, and Thunderbird University. The four schools have come together to revolutionize the future of transportation. The team is working on a system called the Hyperloop, which is a concept of a pod that travels through a vacuum tube at a speed of 760 mph for SpaceX Hyperloop Pod Design Competition which would be held at the SpaceX Headquarters at Hawthorne, California. The team broke the design down into multiple sub teams based on brakes, levitation, propulsion, electrical, and manufacturing. A business section was also included to look for sponsors, help write proposals, manage the budget, and prepare outreach programs. Most of the manufacturing will be completed at ASU facilities and then brought to ERAU for testing.

**Poster Presentation**

**Amy Walker**
*Behavioral and Safety Science Department, College of Arts and Sciences*

**Victor Ordaz**
*Aerospace Engineering Department and Mechanical Engineering Department, College of Engineering*

**Meaghan Moeller, Maciek Czyz, and Garrett Ottmers**
*Aerospace Engineering Department, College of Engineering*

***MENTOR:***
***Samuel Siewart***
*Computer, Electrical, & Software Engineering Department, College of Engineering*

**Hunter Watson**
*Business Department, College of Arts and Science*

***MENTORS:***
***Brent D. Bowen***
*Aeronautical Science Department, College of Aviation*

***Timothy B. Holt and Jacqueline R. Luedtke***
*Applied Aviation Sciences Department, College of Aviation*

***David A. Ehrensperger***
*Digital Learning Design-Research Librarian, Christine and Steven F. Udar-Hazy Library and Learning Center*

## A Students Perspective on the Utilization of Social Media for Scholarly Research

The research was conducted on the continuous advancements of the Airline Quality Rating (AQR) developed by Dr. Brent Bowen, and the benefactor of research from a student perspective. The general case study focus of this research is the AQR as it relates to the utilization of social media platforms, and thus having the ability to reach out to a broader worldwide presence. Media metrics consisting of social network platforms, and news releases, to assist in broadening the viewership and utilization of research in meeting individuals needs in gaining qualitative and quantified information about the AQR. The AQR research initiative has resulted in the student researcher's professional growth through the utilization of applied research methods. Additionally, writing towards a potential audience, enhanced the student's communication skills, as did presentations to members of the conferences attended.

**Poster Presentation**

## Scorpius Robotics Robotic Arm

**EAGLE PRIZE AWARD**

**Austin Wild, Robert Noble, and Andrew Dittrich**
*Computer, Electrical, & Software Engineering Department, College of Engineering*

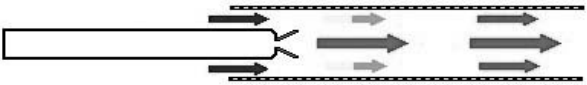
**Hilary Nelson, Jennifer Stiles, and Nicholas Harris**
*Mechanical Engineering Department, College of Engineering*

***MENTORS:***
***Iacopo Gentilini***
*Mechanical Engineering Department, College of Engineering*

***Rick Mangum***
*Humanities and Communication Department, College of Arts and Sciences*

Firefighters are tasked with dangerous search-and-rescue missions into hazardous situations that endanger their lives. Scorpius Robotics has recognized this problem and designed a robot that can help in search related efforts, possibly preventing firefighters an unnecessary trip into a burning building. Scorpius Robotics is a Mechanical Engineering Capstone team made up of six undergraduate engineering students. They have proposed a multi-jointed "tail" equipped with a FLIR Lepton thermal camera and thermal sensors that can identify hotspots. The tail will be mechanically connected to a hexapod body for transport through the hazardous areas. Images will then be transmitted to an external viewing station for technical observation by a firefighter. The tail has three joints with a total of seven degrees of freedom. The degrees of freedom allow for a manipulation redundancy which will be beneficial in the case of motor failure. The tail is also capable of grasping lightweight objects. In order to fully demonstrate the dexterity of the tail, Scorpius Robotics is taking the robot to a competition at the 2017 Robogames. The tail will be capable of drawing the Scorpius Robotics logo in a painting competition.

**Poster Presentation**



**Nicholas Wright**
*Mechanical Engineering Department, College of Engineering*

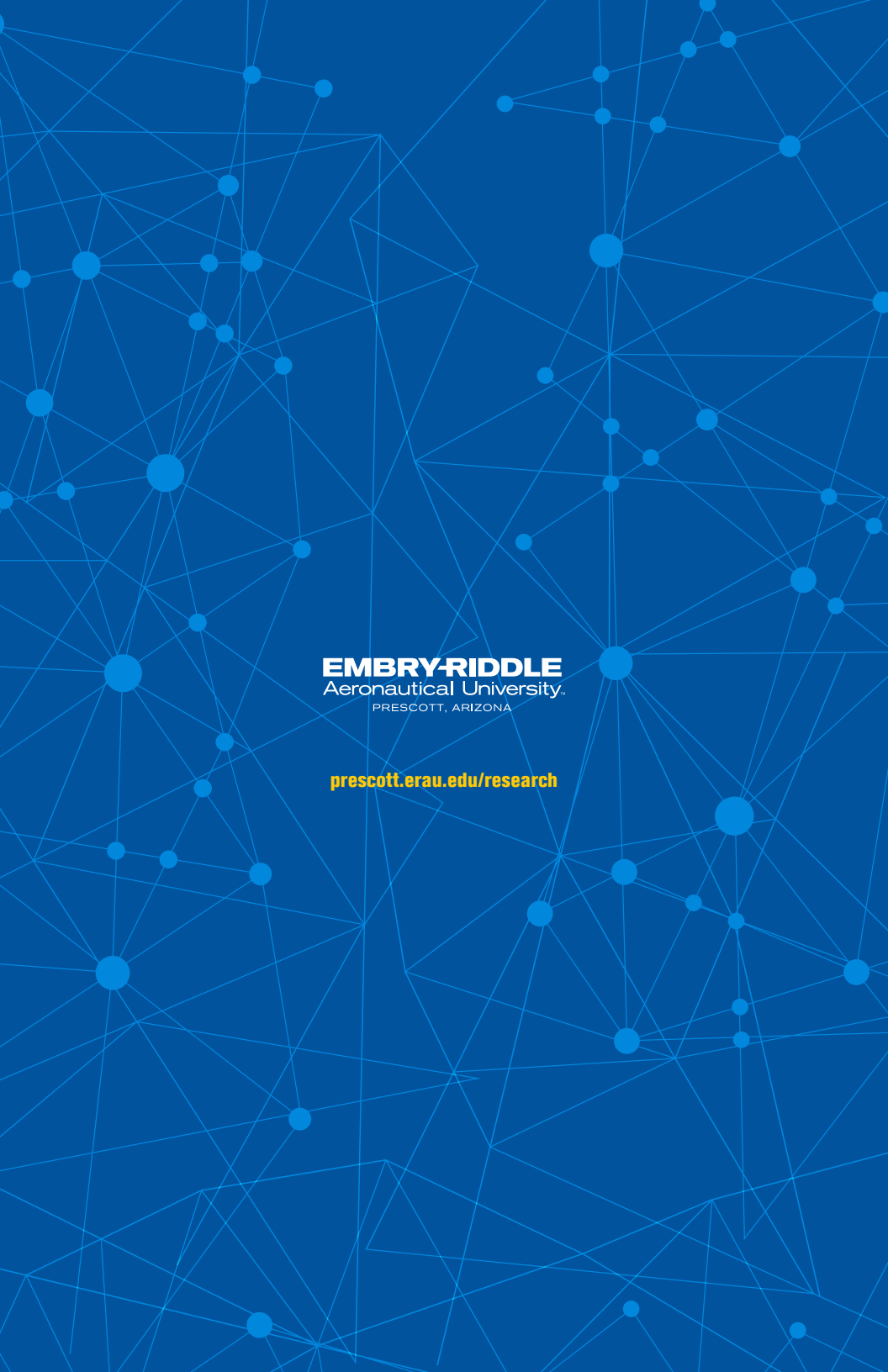
***MENTOR:***
***Shigeo Hayashibara***
*Aerospace Engineering Department, College of Engineering*

## CFD Study in Compound-Compressible Flow Nozzles for Rocket Thrust Augmentation

A compound-compressible flow nozzle can be used to augment the thrust generated by a rocket engine by using the rocket engine plume to entrain an air flow. The rocket engine plume and air flow mixes together within the nozzle to create an exhaust flow that generates additional thrust. The objective of this Computational Fluid Dynamics (CFD) study is to simulate the turbulent mixing of the rocket engine plume with the entrained air flow within a compound-compressible flow nozzle. Experimental data collected from tests of a rocket engine and compound-compressible flow nozzle system, which was designed and fabricated by the Ignite Mercury Propulsion Team, was used to create and validate a quasi-3D CFD simulation of the engine and nozzle system. The study provides insight on how a compound-compressible flow nozzle is used to augment the thrust generated by a rocket engine, and how the nozzle should be designed to minimize total pressure losses within the engine and nozzle system.

**Poster Presentation**

Undergraduate Research Institute (URI) promotes research, scholarly, and creative activities at the undergraduate level. By enhancing critical thinking, problem solving and communication skills, URI helps to prepare Embry-Riddle students to contribute as productive individuals, employees, and citizens. URI is university-wide and invites students and faculty from all disciplines to participate.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