UNDERGRADUATE RESEARCH ABSTRACTS

EMBRY-RIDDLE DISCOVERY DAY 2020

DISCOVERY DAY
SCHEDULE OF EVENTS

FRIDAY, MARCH 27, 2020

Poster Presentations & Demonstrations

AC1-Atrium | 1 - 3 p.m.

Air Force ROTC Undergraduate Research and Leadership Presentations

The Lower Hangar | 10am - noon, 1-3pm

Parents' and Family Reception and Poster Session

Eagle Gym | 7 - 9 p.m.

SATURDAY, MARCH 28, 2020

URI Oral Presentations

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

Academic Program Meetings

College of Engineering

Activity Center | 9:45 - 11 a.m.

College of Aviation

Davis Learning Center | 9:45 - 11 a.m.

College of Arts and Sciences

Eagle Gym | 9:45 - 11 a.m.

College of Security and Intelligence

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

ANETTE M. KARLSSON, PHD

Chancellor,

Embry-Riddle Aeronautical University – Prescott

WELCOME TO DISCOVERY DAY 2020

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. During Discovery Day, we showcase some of the students' best work and celebrate their success, their creativity, and their talent.

Discovery Day is one of the highlights of the year for our campus, and 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 Discovery Day as much as I do!

Warm Regards,

Anette M. Karlsson, PhD

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 8th Annual Discovery Day. During the 2019-2020 Academic Year, the Undergraduate Research Institute was able to award a total of 22 Ignite research/scholarship grants and 13 Eagle Prize competition grants, with an additional 10 projects funded through the Arizona Space Grant program. Ignite and Arizona Space Grant projects range from one on the development of a tip-driven rotor system for helicopters to one examining American and Chinese cultural differences. Eagle Prize teams will compete or have already competed in regional and national competitions including the VEX U, Model NATO, and AIAA Design-Build-Fly. In addition, a team of students from our Cyber Intelligence and Security Department developed and implemented an aviation-themed cyber challenge for regional high school students. Our students have also been conducting independent and team research projects through course-based and student organization opportunities. Linked to their research and scholarship, these students have been active in numerous outreach efforts with regional middle and high schools, as well as the Prescott community as a whole.

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

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

Anne Boettcher
Director, Undergraduate Research Institute and Honors Program
Embry-Riddle Aeronautical University
Prescott, Arizona

UNDERGRADUATE RESEARCH INSTITUTE ADVISORY BOARD

Akhan Almagambetov, Electrical, Computer & Software Engineering; Daniel Dannelley, Mechanical Engineering; Darrel Smith, Physics and Astronomy; Tyrone Groh, Intelligence Studies and Global Affairs; Michelle Hight, Aeronautical Sciences; Liza Kiesell, Humanities and Communication; Ronny Schroeder, Applied Aviation Sciences; Wahyu Lestari, Aeropace Engineering; Patricia Watkins, Hazy Library and Learning Center

Alumni Members: Karolina Bergman (17) Embry-Riddle Aeronautical University, Security and Intelligence MS Program; Daniel Dyck (19) Blue Origin, Propulsion Test Engineer; Lucas Mackey (16), Harvard Business School, MBA Candidate

UNDERGRADUATE RESEARCH INSTITUTE

Anne Boettcher, Director; Ginger MacGowan, Administrative Assistant; and Alexandria Taylor, Paul Ballard, and Rebekah Francis, Student Research and Outreach Coordinators

A special note of thanks to all of our mentors!

INVITED ORAL PRESENTATIONS

TOP AIR FORCE ROTC BRIEFING, MARCH 28

Chad T. Irick
Global Security and Intelligence Studies Department, College of Security and Intelligence

Daniel J. Mahan and Bryce A. Hughes
Aerospace Engineering Department, College of Engineering

Davis Leaning Center (DLC) | 11:15am-12:00pm

URI ORAL PRESENTATIONS, MARCH 28

Preview Day Welcome
Forrest Mobley
Aerospace Engineering Department, College of Engineering

Activity Center | 9 - 9:30 a.m.

Academic Program Meetings

College of Engineering
Matthew Boban
Aerospace Engineering Department, College of Engineering

Activity Center | 9:45 - 11 a.m.

College of Aviation
Paige Swenson
Applied Aviation Sciences Department, College of Aviation

Davis Learning Center | 9:45 - 11 a.m.

College of Arts and Sciences
Ashley Elliott
Physics and Astronomy Department, College of Arts and Sciences

Eagle Gym | 9:45 - 11 a.m.

College of Security and Intelligence
Kevin Dorland
Cyber Intelligence and Security Department, College of Security and Intelligence

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

POSTERS AND DEMONSTRATIONS PRESENTATIONS

(Number Corresponds to Poster/Demonstration Number)

FRIDAY, MARCH 27, 2020

AC1-Atrium, 1 p.m. - 3 p.m. | Eagle Gym, 7 - 9 p.m.

1. **Termination and Altitude Control Testing of a Standard Latex Weather Balloon**
   Xander Pickard
   Mentor: *Douglas Isenberg*

2. **Memory Degradation Experiment on EagleSat 2**
   Brennan Gray
   Mentor: *Daniel White*

3. **EagleSat 2: Cosmic Ray Payload**
   Trevor Butcher
   Mentor: *Daniel White*

4. **Preliminary Design of a Cube Satellite Compliant Hall Thruster**
   Alexis Hepburn
   Mentor: *Daniel White*

5. **Design and Construction of a Thrust Stand for Low Power Electric Propulsion**
   John Norton, Ryder Moreno, Austin Luttrell, Caitlyn Ooms, Tyler Hoover Parker Ayars and Kimiya Ghobadi
   Mentor: *Darrel Smith*

6. **Embry-Riddle Suborbital Reusable Vehicle Project: Go to Space Cheaper and Often**
   Gaurav Nene and Cooper Eastwood
   Mentor: *Michael Fabian*

7. **Self-Contained Microwave Thermal Rocket Engine**
   William (Hojin) Surh and Zachary Sadaghiani
   Mentor: *Daniel White*

8. **Augmented Spark Impinging Igniter for Liquid Rocket Engines**
   Anthony Bernard and Collin Mickels
   Mentor: *Michael Fabian*

9. **FAR 1030-5R Rocketry Competition**
   George Klett, Cooper Drain, Manuel A. Moreno, Hannah Willer, Mac Boyle, Justin Lord, Jason Johnson, and Victor Mandala,
   Mentors: *Brenda Haven and Ahmed Sulyman*

10. **Launch Vehicle Design for the FAR-Mars Competition**
    Matt Boban, Bryce Smoldon, Jonathan Noble, Stefan Johnson, Maxwell Kauker, Nicholas Wright, and Andrew Lucka
    Mentor: *Daniel Dannelley*

11. **Silica Ablative Composites and Construction**
    Zoe Brand, Ben Black, Douglas McPeak, Christopher Finnegan, and Ashton Uttke
    Mentor: *Andy Gerrick*

12. **Ethical Dilemma of Space Colonization**
    Justin Evans, Chris Parga, and Morgan Schaffer
    Mentor: *Daniel White*

13. **Effects of Leadership in Small Groups and Confined Workspaces in Extraterrestrial Environments**
    James Conner and Brennan Butcher
    Mentor: *Brian Zeltins*

14. **Lightweight Initial Sample Apparatus (LISA): A Compact Lunar Sample Collector**
    Faizan Janjua, Logan Huber, Colby Larson, Bea Johnson, Emily Keeland, and Seth Partyka
    Mentors: *Kaela Martin and Richard Mangum*

15. **E.R.E.B.U.S (prototype)**
    Bryan Kitsu, Maverick Thigpen, Brian Wahlstrom, Aimar Negrete, Sierra Wong, Cody Warren, Chaya Sherman, Carlos Rodriguez, Chris Bowers, John Roberts, Richard Manacas, Nadia Morando-Hernandez and Antony Iordanov
    Mentor: *Daniel White*

16. **Martian EAGLE Mission Proposal for a Short Surface Stay on Mars for the 2020 NASA Revolutionary Aerospace Systems Concepts – Academic Linkage Competition**
    Amber Adkins, Alise Arnold, Monica Choiniere, Kayla Gamble, Duran Heath, Payce Hooker, Paul Imler, Moriah Lewis, Trajan Maxon, Naci Ozgur, Noah Plaza, Hojin Surh, Peter Theune, Carly VeNard, Joseph Wong, Aquib Nazrul Toha, Maelee Devries, Alvaro Flores, Shay Bhardwaj, Christian Junio, Frederick Missell, Zane McCraw, James Rainey, Luke Overfelt, Jayla Thirtyacre, Amber Scarbrough, Sydney Smith, Ian Young, Samridh Sood, and Dakotah Stirnweis
    Mentors: *Davide Conte, Ryan Kobrick, and Claudia Ehringer Lucas*

17. **Supercritical Carbon Dioxide Based Heat Exchanger on the Martian Surface**
    Sarah Guinn
    Mentor: *Daniel Dannelley*

18. **Eagle Robotics**
    Robbie Shaw, Hunter Smatla, and Emmanuel Jefferson
    Mentor: *Douglas Isenberg*

19. **Chiroptera: Experiments in Biomimetic Flight**
    Collin Mickels
    Mentor: *Douglas Isenberg*

20. **VEX U Robotics**
    Kyle Lutterman, Jeffrey Ryan, Sierra Wong, and Elizabeth Geiger
    Mentor: *Joel Schipper*

21. **PhLoid Project: Binary Robotic Inertially Controlled BricK**
    Jadyn Acker, Salma Benitez, Chloe Childers, Riley Espinosa, Jace Franco, Amanda Smith, Archer Bazaure-Dilts, Crystal Boggio, Liliana Boice, Catherine Lopez, Ariella Salas, Parker Landon, and Peter Partoza
    Mentor: *Mehran Andalibi*

22. **Technical Communication Eagle Eye Optics Project**
    Gabby Lail, Robert Shaw, and Hunter Smatla
    Mentor: *Matt Haslam and Shirley Johnson*

23. **Longitudinal Applications of Stepladder Technique for Enhancing Group Performance|**
    Conner Lutterman
    Mentor: *Erin Bowen*

24. **Training Cybersecurity Through Gamification**
    Kevin Hood, Michaela Adams, Michael Mcadam, Maxime Dowla, Jacob Henry (ERAU alum) and Jessica Wilson (ERAU alum)
    Mentors: *Krishna Sampigethaya and Farid Dowla*

25. **Artificial Intelligence and Swarm-Enabled Tactics - Is the US Ready?**
Chad T. Irick, Daniel J. Mahan, and Bryce A. Hughes
Mentors: *Marella T. Big Mountain and Krishna G. Sampigethaya*

26. **Air Force Web Builder Using AI for Security and Organization**
Justin Holmes-Smith and Cole Marbach
Mentor: *Brian Zeltins*

27. **Effects of Artificial Intelligence on Pilots and the Future of the Piloting Career Field**
Rhett Wilkins, Joseph Revell, Tyler Jablonski, and Joshua Perrino
Mentor: *Brian Zeltins*

28. **Ethical Responsibility of Artificial Intelligence in Building Entry Security: The Productivity Lost and Responsible Parties**
Adalia Canfield, Garreth Gibson, Niki H. Powell, and William T. Wowor
Mentor: *Susan Rauch*

29. **Virtual Reality Simulations for Primary Flight Training**
Martin Kurkchubasche, Daniel Mills-Thysen, and Jacob Vlatkovich
Mentors: *Michelle P. Hight and Dawn Groh*

30. **Eagle Aero Sport - Student Built Aircraft**
Nick Bartholet
Mentor: *Wallace Morris II*

31. **Magonus Innovation: Tip Driven Rotor System**
Jeffrey Ryan, Dominic Domingo, Nathaniel Larson, Amandeep Singh, and Patrick Wentz
Mentor: *William Crisler*

32. **Urban Air Mobility (UAM) Flight Management System (FMS) Performance Study (UFPS)**
Brooklyn Cross, Henrik Hoffman, Ryan Maslowas, Drew Grobmeier, Evan Stuart, and Drew Yockey
Mentor: *Johann Dorfling*

33. **Aircraft Leading Edge Strakes on Conventional NACA Wings**
Anthony Pirone
Mentor: Shigeo Hayashibara

34. **Reducing the Cost of Uncertainty Quantification at Hypersonic Speeds**
Forrest Mobley
Mentors: *Shigeo Hayashibara*

35. **Continual Analysis of the Relationship Between Stall Hysteresis and Circulation Parameter**
Thorne Wolfenbarger and Gavin McDaniel
Mentor: *Wallace Morris*

36. **AIAA Design-Build-Fly (DBF)**
Elizabeth Mitchell
Mentors: *Jacob Zwick, William Crisler, and Johann Dorfling*

37. **Realistic Design, Build, and Fly Applications – Heavy-Lift Aircraft**
Jessica Millard, Anthony Pirone, Nathaniel Scott, Jeffrey Chen, and Evan Stuart
Mentor: *Shigeo Hayashibara*

38. **Arizona Hyperloop: The Fifth Mode of Transportation**
Eleanor Pahl and Matthieu Rada
Mentor: *Andy Gerrick*

39. **Title IX Effectiveness at American Universities**
Corrine Girard
Mentor: *Suzie Roth*

40. **Female Retention Rates in Air Force ROTC**
Rita Sorensen and Brittany Salazar
Mentor: *Brian Zeltins*

41. **Is it Ethical to Quantify a Person's Worth in Military Operations?**
Jonas Orrahood, Cole Alley, and Ryan Mahoney
Mentor: *Brian Zeltins*

42. **Second Order Asymptotic Expansion of the Fisher Information Matrix**
Jonathan Westhouse
Mentor: *Michele Zanolin*

43. **Gravitational Wave Memory: Supernova**
Colter Richardson
Mentor: *Michele Zanolin*

44. **Gravitational Wave Calibration Error for Supernovae Core Collapse**
Brad Ratto
Mentor: *Michele Zanolin*

45. **Short-Range Gravity Tests of Lorentz Invariance**
Jennifer James
Mentor: *Quentin Bailey*

46. **Coherent Captain Mills: The Search for Sterile Neutrinos**
Ashley Elliott, Jeramy Gordon, Jonah Greenwood, Rachel Lake, Ryder Moreno, Emily Strawn, and Kate Walker
Mentor: *Darrel Smith*

47. **Spectroscopy of HD6226, a Be Star Observed with TESS**
Andrea Daly and Alexis Lane
Mentor: *Noel Richardson*

48. **Julia Language 1.1 Ephemeris Reader and Gravitational Modeling Program for Solar System Bodies**
Parker D. Landon
Mentor: *Kaela Martin*

49. **Astrodynamic Software: Polyhedron Gravitational Modeling and Geometric Albedo**
Marcus Kaiser and Evelia Zapién Ramos
Mentor: *Kaela Martin*

50. **Bringing Awareness to American and Chinese Cultural Differences**
Jessica Rader, Tyler Smith, Ethan Muntz, Kaya Learned and Tatiana Chacon
Mentor: *Hong Zhan*

51. **Washington DC Model North Atlantic Treaty Organization**
Mackenzie Creighton, Kaylee Coffman, Kevin Lundquist, Cameron Zarnich, Colin Molitor, Marc Rego, Stefan Johnson, Robert Belz-Templeman, Takashi Quinlan, and Niklas Becker-Brown
Mentor: *Brooke Shannon*

52. **Developing a Plan for Improved Natural Disaster Response to U.S. Territories in the Atlantic**
Oisin Doyle, Garrett Foster, Caroline Keith, Jacob Ledesma and Nicholas Williams-Shupp
Mentor: *Brian Zeltins*

53. **Environmental DNA Metabarcoding Detects Mammal use of Stock Tanks and Natural Springs on the Prescott National Forest**
Berenice Carreras Mendiolea and Bethany Davis
Mentors: *Hillary Eaton and Matthew Valente*

54. **Global Political, Economic, Socioeconomic and Environmental Impacts of Whaling in Japan, Norway and Iceland**
Riley Coder, Paris Lorts, Parker Labine, Samuel DeKemper, Haidee Wesala, Erika McSheehy, Joshua Ockey, Christian Roderick, Kaylee Coffman, Allison McIntyre
Mentor: *Bryce Dickey*

55. **Statistical Analysis of the Northern Arizona Tornado Outbreak**
Paige Swenson
Mentors: *Curtis James and Ronny Schroeder*

56. **Leadership in the Eyes of a WC-130**
Dominick Uzzardo, Zachary MacAllister, Zane Warden
Mentor: *Kenneth E. Parsons*

57. **Provably Secure SCADA Architectures**
Luke Baird
Mentor*: Akhan Almagambetov*

58. **Experimental Study on Compression and Shear Strength of CFRP**
Joseph Gentile and Ethan Garber
Mentor: *Wahyu Lestari*

59. **Stator Fins and Stator Skirts of Vertical Axis Wind Turbines**
Jacob Wolf
Mentor: *Murat Okcay*

60. **Studies of Oval Tube and Fin Heat Exchangers**
Phillip Nielsen
Mentor: *Shigeo Hayashibara*

61. **Restructuring Cadet Organization, Instruction, and Leadership (ReCOIL)**
Joshua Morisawa, Tyler Bigham, Haley Rasmussen, Austin Blair, Carlos Easterbrook, William Kau, Trevor McDowell, Connor Murphy, Joselyn Rabbitt, Jacob Hawkins, Ashton Serratos and Isaiah Taylor
Mentor: *Brian Zeltins*

62. **What Does the Effect of Geographical Positioning have on Fitness Assessment Scores at Detachments Located in the Southwest Region?**
Tyler Reid, Danielle Mangila, Emerson Pereira, and James Embro
Mentors: *Nickolas Mondragon and Brian Zeltins*

63. **Combat Command and Control lessons: We Can Learn from the Battle of Britain and Apply to Modern Air Combat**
Timothy Wetzel and Corey Washburn
Mentor: *Brian Zeltins*

64. **Leadership Reaction Course Improvement Plan**
Anton Allen, Jeremy Carballido, and Bennett Harnish
Mentors: *Brian Zeltins and Scott McCloud*

65. **The Effects of MOUT tactics on Leadership Ability**
Tyler R. Smith, Angelo D. Velasquez, Matthew N. Clark, and Sara T. Borjeily
Mentor: *Scott M. McCloud*

PHLOID PROJECT: BINARY ROBOTIC INERTIALLY CONTROLLED BRICK

The PhLoid Project seeks to reconstruct Walt Disney Imagineering's BricK (Binary Robotic Inertially Controlled) robot that achieves a chosen orientation goal after falling from at an arbitrary height, angle, and angular speed. The device will be autonomously controlled by autonomous releasing weights and using on-board sensors. The project will require creating a symmetrical frame with internal components that are capable of changing their moment of inertia to control its spin to fall through or land in a precise orientation. This project is being conducted by the Society of Women Engineers (SWE) Research Committee.

POSTER PRESENTATION

Jadyn Acker, Salma Benitez, Chloe Childers, Riley Espinosa, Jace Franco, and Amanda Smith

Aerospace Engineering Department, College of Engineering

Archer Bazaure-Dilts

School of Business, College of Arts and Sciences

Crystal Boggio, Liliana Boice, Catherine Lopez, and Ariella Salas

Mechanical Engineering Department, College of Engineering

Peter Partoza

Electrical, Computer, and Software Engineering Department, College of Engineering

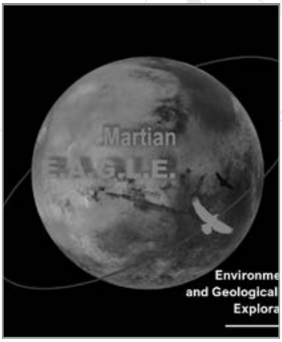
Parker D. Landon

Electrical, Computer, and Software Engineering Department, College of Engineering and Physics and Astronomy Department, College of Arts and Sciences

Mentor:

Mehran Andalibi

Mechanical Engineering Department, College of Engineering



MARTIAN EAGLE MISSION PROPOSAL FOR A SHORT SURFACE STAY ON MARS FOR THE 2020 NASA REVOLUTIONARY AEROSPACE SYSTEMS CONCEPTS – ACADEMIC LINKAGE COMPETITION

Martian EAGLE is the Embry-Riddle multi-campus (Arizona, Florida, and Worldwide) team participating in the 2020 NASA Revolutionary Aerospace Systems Concepts (RASC-AL) competition to develop a space mission design for a short duration surface stay on Mars. Martian EAGLE consists of seven sub-teams which explore the possible mission architecture and objectives for interplanetary human exploration. The mission will consist of four crew members, two of which will remain in orbit around Mars to support the other two, who will remain on the surface. The surface mission will last approximately 30 days to allow the surface crew to complete scientific experiments and data collection. The surface crew will have access to pressurized rovers for mobile exploration and various scientific instruments. To mitigate risks, a satellite constellation will be established in Martian orbit to provide uninterrupted communications between the surface and the astronauts that remained in orbit, as well as contribute to establishing initial communications infrastructure for future Mars missions.

POSTER PRESENTATION

Prescott
Amber Adkins, Alise Arnold, Monica Choiniere, Kayla Gamble, Duran Heath, Payce Hooker, Paul Imler, Moriah Lewis, Trajan Maxon, Naci Ozgur, Noah Plaza, Hojin Surh, Peter Theune, Carly VeNard, Joseph Wong, and Aquib Nazrul Toha, Maelee Devries, Alvaro Flores, Amber Scarbrough, Luke Overfelt and Jayla Thirtyacre, Samridh Sood

Daytona Beach
Sydney Smith, Ian Young, Dakotah Stirnweis, Shay Bhardwaj, Christian Junio and Frederick Missell

World Wide
Zane McCraw and James Rainey

Mentors:
Davide Conte
Aerospace Engineering Department, College of Engineering

Ryan Kobrick
Applied Aviation Sciences Department, College of Aviation, Daytona Beach

Claudia Ehringer Lucas
Engineering Fundamentals, College of Engineering, Daytona Beach

LEADERSHIP REACTION COURSE IMPROVEMENT PLAN
IGNITE GRANT AWARD

The leadership reaction course is made up of 11 different obstacles designed to test Air Force cadets in leadership as well as mental and physical fortitude. Cadets are evaluated in followership and leadership competencies some of which include critical thinking, initiative, and wingmanship as they attempt completing various scenarios on each obstacle. Of the 11 different obstacles, two are dysfunctional, one of which we have decided to prioritize and completely overhaul within the semester. After surveying the obstacle, a plan was devised in order to purchase and rebuild the obstacle so that it is structurally sound for cadets to use again and gain training value.

POSTER PRESENTATION
AIR FORCE ROTC UNDERGRADUATE RESEARCH AND LEADERSHIP PRESENTATION

Anton Allen and Jeremy Carballido

Global Security and Intelligence Studies Department, College of Security and Intelligence

Bennett Harnish

Aerospace Engineering Department, College of Engineering

Mentor:

Brian Zeltins and Scott McCloud

Air Force ROTC Cadre

PROVABLY SECURE SCADA ARCHITECTURES

Luke Baird

Electrical, Computer, and Software Engineering Department, College of Engineering

Mentor:
Akhan Almagambetov

Electrical, Computer, and Software Engineering Department, College of Engineering

IGNITE AWARD

Supervisory Control and Data Acquisition (SCADA) systems provide an architecture for autonomously monitoring and controlling devices in a large system. SCADA systems are used for many safety-critical applications including oil pipelines, water management systems, and the power grid. Over the past decade, SCADA systems have moved from landline or radio communications to internet communications. This, combined with the critical applications for SCADA systems, makes SCADA an increasingly lucrative target for cyber-attacks. Rather than preventing an attacker from penetrating a system, we propose an architecture that focuses on correct system operation, despite having one or more compromised nodes. If a remote terminal unit (RTU) is compromised, as detected by an off-the-shelf intrusion detection system (IDS), control of corresponding physical hardware is passed to another RTU within the network. Simultaneously, the attacked RTU severs its control logic from its physical hardware. The RTU then returns valid responses to the attacker, based on historical data, thus preventing the attacker from realizing that they have failed to compromise the security of the system. An alarm is triggered at the master terminal unit (MTU) to inform the operator that the RTU has been attacked and control has successfully been passed to another RTU in the system.

POSTER PRESENTATION

EAGLE AERO SPORT - STUDENT BUILT AIRCRAFT

Nick Bartholet

Aviation Sciences Department, College of Aviation

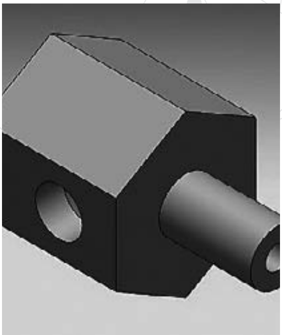
Mentor:
Wallace Morris II

Aerospace Engineering Department, College of Engineering

EAGLE PRIZE AWARD

Eagle Aero Sport (EAS) is a student run team comprised of undergraduate students from a variety of different majors at Embry-Riddle Aeronautical University. EAS is working to build and modify a Van's Aircraft "RV-12" airplane for the purpose of conducting research. Within EAS, students are divided up into four different sub-teams: build, engineering, business, and safety. The build team is responsible for the construction of the aircraft as it was designed by Vans Aircraft. Students on the build team have the opportunity to gain hands on experience in various aircraft construction methods such as riveting, plumbing, and wiring. The engineering team is responsible for the addition of flight test instrumentation and data recording. Engineering team, students are working to design, build, and test a plethora of instrumentation including accelerometers, wing spar strain gauges, airfoil pressure sensors, an angle of attack indicator, and slip/skid sensors. Data from these instruments will be available to view, real time, on a tablet while airborne, as well as recorded for analysis later on the ground. In addition to the pursuit of engineering research, other programs at Embry-Riddle Aeronautical University such as Meteorology have expressed interest in adding instruments for their own research. It is our hope that once our aircraft is operational, it will be a valuable asset to the university for years into the future.

POSTER PRESENTATION



AUGMENTED SPARK IMPINGING IGNITER FOR LIQUID ROCKET ENGINES

Anthony Bernard and Collin Mickels

Aerospace Engineering Department, College of Engineering

Mentor:
Michael Fabian

Mechanical Engineering Department, College of Engineering

IGNITE AWARD

The Augmented Spark Igniter (ASI) Project is a liquid propulsion study with the objective of providing a lasting and reliable way of igniting a liquid rocket engine. Spark igniters are used in the aerospace industry to start engines even in the vacuum of space. Current methods of ignition on campus have been a fire hazard and proven inconsistent. A spark igniter mainly involves mixing the main engine's propellant in a more volatile state with a spark. The ASI injects gaseous oxygen and jet fuel into a combustion chamber where a car spark plug ignites the two mixing propellants. As a result, the ASI becomes a small rocket engine with the main purpose of providing a flame temperature hot enough to light the main engine. The design incorporates interchangeable orifices so it can be installed on future engines with different parameters. Additionally, the igniter is accompanied by its own test bench to verify results before installing into an engine. The end goal of the ASI Project is to provide a safe and functioning igniter that can be adapted to any amateur rocket engine with a sizing spreadsheet and testing apparatus.

POSTER PRESENTATION

LAUNCH VEHICLE DESIGN FOR THE FAR-MARS COMPETITION

EAGLE PRIZE AWARD

Zenith Propulsion is constructing a launch vehicle, named Altair, to compete in a competition hosted by the Friends of Amateur Rocketry (FAR) and the Mars Society. The objective for Zenith Propulsion is to design, build and launch Altair to a qualifying altitude of 30,000 feet in the FAR-Mars competition. Altair will utilize a rocket engine that has been in development at Embry-Riddle Aeronautical University's Prescott campus since late 2018. This engine, named Janus, uses liquid oxygen and Jet-A and is designed to deliver 1000 lbf of thrust. Altair will be launched from the FAR launch site, in Mojave, CA, on April 18th, 2020.

POSTER PRESENTATION

Matt Boban, Bryce Smoldon, Jonathan Noble, and Stefan Johnson

Aerospace Engineering Department, College of Engineering

Maxwell Kauker, Nicholas Wright, and Andrew Lucka

Mechanical Engineering Department, College of Engineering

Mentor:
Daniel Dannelley

Mechanical Engineering Department, College of Engineering

SILICA ABLATIVE COMPOSITES AND CONSTRUCTION

Zoe Brand, Ben Black, and Douglas McPeak

Mechanical Engineering Department, College of Engineering

Christopher Finnegan, and Ashton Uttke

Aerospace Engineering Department, College of Engineering

Mentor:
Andy Gerrick

Mechanical Engineering Department, College of Engineering

IGNITE AWARD

This project's ablative combustion chamber is a low-cost chamber made of silica fiber and phenolic resin. It is designed to erode, drawing heat away from the structure of the chamber walls while the engine is firing. This project will conduct six experiments with a fifteen-degree difference in composite lay-up angles. The goal is to find the optimal angle of the silica fiber and drastically reduce the erosion rates, leading to a more consistent throat diameter of the chamber, improving overall performance. The research done will improve firing time for rockets on campus by creating a cost-efficient chamber that will be able to last longer than previous chambers.

POSTER PRESENTATION

EAGLESAT 2: COSMIC RAY PAYLOAD

Trevor Butcher

Electrical, Computer, and Software Engineering Department, College of Engineering

Mentor:
Daniel White

Mechanical Engineering Department, College of Engineering

ARIZONA SPACE GRANT AWARD

Cosmic rays are high-energy atomic nuclei found in space. It is challenging to observe them from Earth, since the Earth's atmosphere and magnetosphere causes air showering before they reach ground-based detectors. To remedy this, the Cosmic Ray Payload (CRP) is an experiment flying on EagleSat 2 that measures cosmic ray interactions while in low-Earth orbit, over a span of 8 to 12 months. The experiment will measure all types of cosmic rays, including solar, anomalous, and galactic cosmic rays. The primary goal of the experiment is to discover cosmic ray sources, along with providing supplemental data about particle energies to the Memory Degradation Experiment payload. It will focus on heavier particles with energies of 100 MeV to 3 GeV and will characterize both their initial energy and their source vector. This aligns with Objective 1.6 of NASA's Strategic Plan, which seeks to discover how the universe works. This project was also reviewed and approved by JPL. The payload functionally consists of an array of CMOS imaging sensors to capture particle interactions. The sensors will work in pairs, with two pairs dedicated to determining a particle vector, and two pairs determining particle energy.

POSTER PRESENTATION

ETHICAL RESPONSIBILITY OF ARTIFICIAL INTELLIGENCE IN BUILDING ENTRY SECURITY: THE PRODUCTIVITY LOST AND RESPONSIBLE PARTIES

As of 2018, the U.S. began developing "a shared understanding of the risk and benefits of this technology before deciding on a specific policy response. We remain convinced that it is premature to embark on negotiating any particular legal or political instrument in 2019." The DOD stated that "Human beings should exercise appropriate levels of judgment and remain responsible for the development, deployment, use and outcomes of DOD AI systems." With our investigation, we predict that accountability for AI that is predetermined will fall on the person who oversees the process, while deterministic AI will fall on whoever the AI is based off if there is no one to oversee. There is no current U.S. policy on the application of AI. The U.S. is starting to put a greater emphasis on the development of artificial intelligence but has yet to create policies on the application (Chambliss, 2019). Within the Armed Forces, AI has the means to kill people based on the given information it receives from human or automated input, and if the input is incorrect or there is other missing information, no one can be held liable, which is unethical and a cause for concern and lawsuits against the U.S. (Gregg, 2019). Due to a lack of U.S. policy regarding artificial intelligence, our research group looked to the policies of our allies towards development of a policy that would be beneficial for the U.S. and ethical for its citizens (Greguric, 2016).

POSTER PRESENTATION

Adalia Canfield and Garreth Gibson

Global Security and Intelligence Studies Department, College of Security and Intelligence

Niki H. Powell

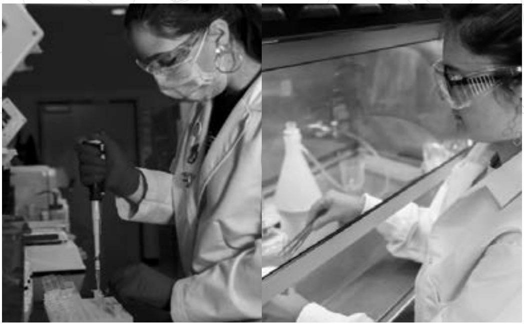
Electrical, Computer, and Software Engineering Department, College of Engineering

William T. Wowor

Mechanical Engineering Department, College of Engineering

Mentor:
Susan Rauch

Humanities and Communication Department, College of Arts and Sciences



ENVIRONMENTAL DNA METABARCODING DETECTS MAMMAL USE OF STOCK TANKS AND NATURAL SPRINGS ON THE PRESCOTT NATIONAL FOREST

Berenice Carreras Mendiolea and Bethany Davis

Biology and Chemistry Department, College of Arts and Sciences

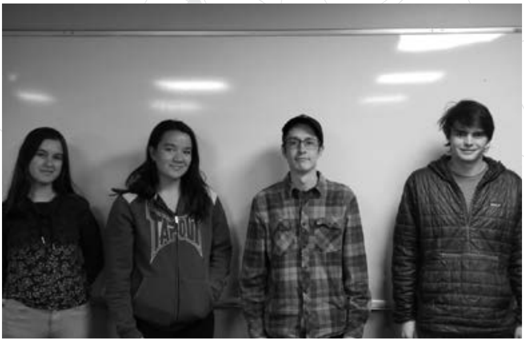
Mentor:
Hillary Eaton and Matthew Valente

Biology and Chemistry Department, College of Arts and Sciences

ARIZONA SPACE GRANT AWARD AND IGNITE AWARD

Recent research has shown the viability of environmental DNA (eDNA) analysis as a tool for identifying species presence in aquatic ecosystems. However, there is limited research indicating the feasibility of eDNA as a survey tool in water sources such as springs and stock tanks. Because of the scarcity of water in the high desert landscape of Arizona, natural springs and stock tanks are an important water resource. In this study, we examined whether 16S rRNA metabarcoding could detect mammal eDNA in springs and stock tanks in the Prescott National Forest. During summer 2019, we collected and analyzed water samples at eight sites, including five natural springs and three stock tanks. Across all sites, samples resulted in the detection of eight vertebrate species, including one amphibian, the American Bullfrog Lithobates catesbeiana, one bird, the Mallard Anas platyrhynchos, and seven mammal species, including the American Black Bear Ursus americanus, Mule Deer Odocoileus hemionus, and two squirrel species from the Genus Sciurus. However, of the 1.9 million sequences generated during sequencing, 1.85 million sequences belonged to invertebrate species. This suggests amplification of invertebrate eDNA associated with the 16S primers, which may interfere with the detection of vertebrate eDNA sequences in these systems.

POSTER PRESENTATION



GLOBAL POLITICAL, ECONOMIC, SOCIOECONOMIC AND ENVIRONMENTAL IMPACTS OF WHALING IN JAPAN, NORWAY AND ICELAND

URI RESEARCH AWARD

The researchers were presented with the challenge of discovering who is conducting whaling in Japan, Norway and Iceland. Moreover, the researchers were tasked with understanding why people continue to whale and how issues like economic pressures, cultural heritage and nationalism might affect whaling. Students researched these issues over the past three months and have discovered some fascinating facts about whaling; for example, most recorded whaling in Japan is a result of whale research at universities. The research further addressed the supply-chain for illegal whale parts, and its association with crime syndicates such as the Yakuza, and how corporations can wittingly, or unwittingly, become part of the supply-chain. Finally, the group addressed whether there are other problems confronting marine mammals, such as plastic pollution in the oceans. While the researchers did not want to suggest policy or express opinions, the researchers did explore methods to help address whaling and pollution.

POSTER PRESENTATION

Riley Coder, Paris Lorts, Parker Labine, Haidee Wesala, Christian Roderick, Kaylee Coffman, and Allison McIntyre

Global Security and Intelligence Studies Department, College of Security and Intelligence

Samuel DeKemper,

Cyber Intelligence and Security Department, College of Security and Intelligence

Erika McSheehy and Joshua Ockey

Aerospace Engineering Department, College of Engineering

Mentor:

Bryce Dickey

Global Security and Intelligence Studies Department, College of Security and Intelligence

EFFECTS OF LEADERSHIP IN SMALL GROUPS AND CONFINED WORKSPACES IN EXTRATERRESTRIAL ENVIRONMENTS

Leadership in small groups primarily on space exploration missions and possibly on other celestial bodies is the future. With the introduction of the United States Space Force (USSF) it is necessary to further examine the psychological effects that people have on each other in small operational spaces over long periods of time. Additionally, we study how small teams function normally on Earth, as well as current research the National Aeronautics and Space Administration (NASA) is conducting. This is an important topic to research because as the military is heading in the direction of space operations, we will need to know the best way to operate in this new environment on a tactical scale. Relatively speaking we have only scratched the surface of human occupation and interaction with space. This research project will explore the optimal solutions to better prevent military operators for hardships they will encounter on their missions.

POSTER PRESENTATION
AIR FORCE ROTC UNDERGRADUATE RESEARCH AND LEADERSHIP PRESENTATION

James Conner

Aerospace Engineering Department, College of Engineering

Brennan Butcher

Mechanical Engineering Department, College of Engineering

Mentor:
Brian Zeltins

Air Force ROTC Cadre

WASHINGTON DC MODEL NORTH ATLANTIC TREATY ORGANIZATION

EAGLE PRIZE AWARD

Model North Atlantic Treaty Organization (NATO) consists of several committees, each of whom draft policy relevant to their respective topics of discussion. The Committees debate for the course of the conference, drafting NATO policy to solve a multitude of issues. During this time, a simulated crisis also occurs, and each committee must respond to the updates from the crisis as well as focus on their original goals. After the final committee sessions of the conference, the final resolutions passed by each committee are sent to the North Atlantic Council (NAC), who works to approve all of them unanimously. The end result is a final communique, consisting of the unanimously approved policy from the body of the entire conference. This final communique is sent to NATO Headquarters, where it is used by actual NATO officials to guide potential policy directives in the future.

POSTER PRESENTATION

Mackenzie Creighton, Kaylee Coffman, Kevin Lundquist, Cameron Zarnich and Colin Molitor

Global Security and Intelligence Studies Department, College of Security and Intelligence

Marc Rego, Stefan Johnson, Robert Belz-Templeman, and Takashi Quinlan

Aerospace Engineering Department, College of Engineering

Niklas Becker-Brown

Applied Aviation Sciences Department, College of Aviation

Mentor:
Brooke Shannon

Global Security and Intelligence Studies Department, College of Security and Intelligence

URBAN AIR MOBILITY (UAM) FLIGHT MANAGEMENT SYSTEM (FMS) PERFORMANCE STUDY (UFPS)

Brooklyn Cross, Henrik Hoffman, and Ryan Maslowas

Mechanical Engineering Department, College of Engineering

Drew Grobmeier

Computer, Electrical, and Software Engineering Department, College of Engineering

Evan Stuart

Applied Aviation Sciences Department, College of Aviation

Drew Yockey

Aerospace Engineering Department, College of Engineering

Mentor:
Johann Dorfling

Aerospace Engineering Department, College of Engineering

URI RESEARCH AWARD

Urban Air Mobility (UAM) refers to urban transportation systems that move people or goods, through the air. UAM holds the promise of quick and efficient transportation within cities in a safe and environmentally friendly manner. These transportation systems include all electric vehicles that can transport up to six people at a time. Companies that are venturing into the UAM market include Boeing, Uber, Airbus, Bell Helicopters, Lilium, and Honeywell, to name a few. Research performed currently aims to obtain a baseline aircraft performance model that is scalable and may be used to develop flight management systems. Various flight profiles are also being studied to determine the optimum flight path in terms of energy usage and time. The research is focusing on a sub-scale aircraft to collect performance data that will be scaled to a full-scale aircraft. Wind tunnel testing of propellers and the airframe will be conducted in support of the performance model development.

POSTER PRESENTATION

SPECTROSCOPY OF HD6226, A BE STAR OBSERVED WITH TESS

Andrea Daly and Alexis Lane

Physics and Astronomy Department, College or Arts and Sciences

Mentor:
Noel Richardson

Physics and Astronomy Department, College or Arts and Sciences

IGNITE AWARD

Be stars are rapidly rotating hot stars, rotating at a speed just below the break-up velocity. Be stars are non-supergiant stars and have been found to have emission lines within their spectra, due to "circumstellar Keplerian disks". Our goal has been to analyze spectra of HD6226. We use spectroscopy and compare these data to the photometric data that TESS collected at the same time. The star was in the process of building a disk during the TESS observation timeframe. We find several pulsational periods in the TESS data, and compare the points in the light curve that do not match our pulsational model in order to examine how these stars build their disks, and the causes of their variations, which has eluded observers for a long time.

POSTER PRESENTATION

DEVELOPING A PLAN FOR IMPROVED NATURAL DISASTER RESPONSE TO U.S. TERRITORIES IN THE ATLANTIC

Current United States natural disaster relief plans are dependent on administration policies that change from one administration to another. This leads to a problem where one natural disaster receives rapid and well-coordinated relief while another does not, even when the capability to prevent damage and loss of life is present. This problem was well demonstrated in the aftermath of Hurricane Maria, where the U.S. overseas territories in the Atlantic Ocean were not the beneficiaries of a widespread or well-coordinated disaster relief effort. In order to provide the most coordinated response it is necessary for the U.S. to adopt one centralized plan that can be enacted effectively immediately after the occurrence of a natural disaster. This centralized plan needs to be developed specifically for the infrastructure and resources present in individual regions. By focusing only on the American territories in the Atlantic (i.e. Puerto Rico and the U.S. Virgin Islands), a specific timeline for the response to natural disasters in the region will be developed in order to mitigate losses and optimize the utilization of existing resources and infrastructure.

POSTER PRESENTATION
AIR FORCE ROTC UNDERGRADUATE RESEARCH AND LEADERSHIP PRESENTATION

Oisin Doyle

Global Security and Intelligence Studies Department, College of Security and Intelligence

Garrett Foster

Aerospace Engineering Department, College of Engineering

Caroline Keith, Jacob Ledesma and Nicholas Williams-Shupp

Applied Aviation Sciences Department, College of Aviation

Mentor:
Brian Zeltins

Air Force ROTC Cadre

COHERENT CAPTAIN MILLS: THE SEARCH FOR STERILE NEUTRINOS

Ashley Elliott, Jeramy Gordon, Jonah Greenwood, Rachel Lake, Ryder Moreno, Emily Strawn, and Kate Walker

Physics and Astronomy Department, College or Arts and Sciences

Mentor:
Darrel Smith

Physics and Astronomy Department, College or Arts and Sciences

IGNITE AWARD

The observation of neutrino oscillations confirms that the active neutrinos (νe, νμ, ντ) are comprised of three mass eigenstates with Δm2 values between 10-3 to 10-5 eV2 . However, a persistent phenomenon has been observed at LSND, MiniBooNE and other short-baseline experiments (SBE) where Δm2 ~ 1eV2 and is not compatible with the current mixing between mass eigenstates. However, a 4th neutrino, a sterile neutrino (νs) that doesn't participate in weak interactions could explain the phenomena observed as SBE's. An experiment has been constructed at TA-53 at Los Alamos National Laboratory to investigate this large Δm2 ~ 1eV2 and determine conclusively whether or not this large Δm2 is due to a "new" sterile neutrino.

POSTER PRESENTATION

ETHICAL DILEMMA OF SPACE COLONIZATION

Space colonization is the act of permanently achieving human habitation off planet Earth. This is an important consideration for Humanity's future, as we continue to run out of space and resources on Earth, with an ever-increasing population. Colonizing another planet would allow new places to live, as well as vast new resources available. A big consideration in attempting space colonization is the impact it would have on the colonists both their mental and physical health. This research project will test if it is ethically just to subject humans to the negative physical and psychological effects of space colonization. The end goal of the project is to determine if the benefits of colonizing space at this time out ways the many drawbacks and pitfalls.

POSTER PRESENTATION
AIR FORCE ROTC UNDERGRADUATE RESEARCH AND LEADERSHIP PRESENTATION

Justin Evans

Aerospace Engineering Department, College of Engineering

Chris Parga

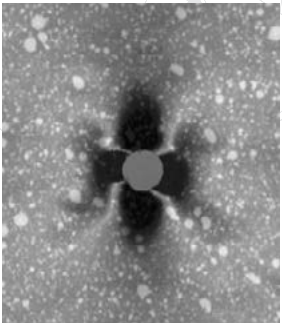
Global Security and Intelligence Studies Department, College of Security and Intelligence

Morgan Schaffer

Department of Behavioral & Social Sciences, College of Arts and Sciences

Mentor:
Daniel White

Mechanical Engineering Department, College of Engineering



EXPERIMENTAL STUDY ON COMPRESSION AND SHEAR STRENGTH OF CFRP

Joseph Gentile and Ethan Garber

Aerospace Engineering Department, College of Engineering

Mentor:
Wahyu Lestari

Aerospace Engineering Department, College of Engineering

ARIZONA SPACE GRANT AWARD

The increasing use of carbon fiber-reinforced polymer (CFRP) in the aerospace industry requires a better understanding of its damage properties. Many modern aircraft under high loads are utilizing this material for their primary structures due to its high strength to weight ratio. However, CFRPs are sensitive to out-of-plane loading such as low-velocity impact and indentation. These damages can reduce the compressive strength significantly without leaving a visible mark on the surface, which is known as Barely Visible Impact Damage (BVID). The behavior and residual strength of CFRPs after impact damage under compressive loading are still not fully understood. Studies of Compression After Impact (CAI) tests are still very few. The purpose of this research is to use Digital Image Correlation (DIC) to study the failure mechanism and better understand the shear properties of CFRP after impact. To account for variety of CFRP structures and to study the trend in the damages, a series of CAI and shear tests with different impact levels will be performed. The strain values from the DIC method will be validated by conventional measurement using strain gauges that will be collected concurrently. The DIC will capture damage propagation and local behavior of the material under compressive and shear loading. Based on the test results, damage sequence and damage mechanism of different composite layups and damaged will be analyzed.

POSTER PRESENTATION

TITLE IX EFFECTIVENESS AT AMERICAN UNIVERSITIES

Corrine Girard
Applied Aviation Sciences Department, College of Aviation

Mentor:
Suzie Roth
Hazy Library and Learning Center

IGNITE AWARD

The purpose of this research is to contribute to and improve existing university knowledge of the effectiveness of the University Title IX reporting process. After discussing experiences with Title IX with students at ERAU, it is apparent that there is a negative connotation among university students with this program. This research will build off of the research completed last year in which ERAU Title IX processes were compared to that of Occidental College and CalTech.

This research aims to provide clarity to Title IX offices at the University to aid in successfully adapting their program to the needs of the students reporting Title IX cases by using policies from other universities to identify best practices. This research will also make information about Title IX on the ERAU campus more accessible through programs aimed at the freshman and resident student communities through the Housing and Residence Life Department.

POSTER PRESENTATION

MEMORY DEGRADATION EXPERIMENT ON EAGLESAT 2

Brennan Gray

Aerospace Engineering Department, College of Engineering

Mentor:
Daniel White

Mechanical Engineering Department, College of Engineering

ARIZONA SPACE GRANT AWARD

The Memory Degradation Experiment (MDE) is a scientific payload for EagleSat 2 CubeSat. The space environment is hostile to computer technologies, particularly the memory technologies which enable computation and storage of scientific data. Memory technologies are susceptible to errors caused by space radiation, and thus have been the focus of much flight and on-ground testing. The MDE seeks to address the lack of highly comparable error-rate data from flight tests for various kinds of commercial-off-the-shelf (COTS) computer memories. The MDE is comprised of an array of five types of COTS memories. Some of these memories, such as Flash and SRAM, have been in use for many decades and thus have well-known error rates. Others, such as FRAM and MRAM are much more recent developments and thus do not have as well-known error rates. However, memory flight tests are conducted in a variety of different orbits, and by extension radiation environments. Thus, attempting to establish relative error rates between different COTS memories is difficult as datasets from different flight tests are not directly comparable. By creating a comparable flight test dataset for the most used types of COTS memories, the MDE will provide spacecraft engineers with actionable engineering data, usable in spacecraft design and mission assurance.

POSTER PRESENTATION

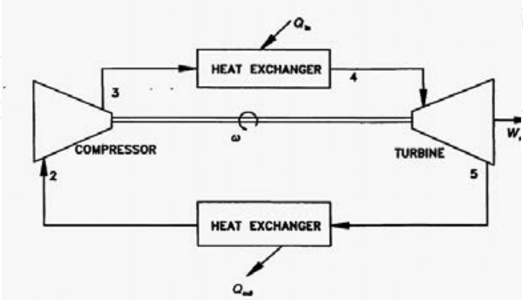


Figure 1.12 Geometry of closed Brayton cycle.

SUPERCRITICAL CARBON DIOXIDE BASED HEAT EXCHANGER ON THE MARTIAN SURFACE

Sarah Guinn

Mechanical Engineering Department, College of Engineering

Mentor:
Daniel Dannelley

Mechanical Engineering Department, College of Engineering

IGNITE AWARD

The use of supercritical carbon dioxide (sCO2) in power cycles has been fairly new in the last decade. Due to this, there is a lack in research for both terrestrial and extra-terrestrial applications. The purpose of this project is to utilize sCO2 as a working fluid and design and optimize a Brayton Cycle based heat exchanger on the Martian surface. Due to the lack of water on Mars, this research will provide a stronger analysis of planetary based dry-cooling processes in low atmospheric pressure and colder temperatures. We have been conducting an in-depth analysis of the heat exchanger by modeling and validating the changing variables and parameters of sCO2. These include how the density, critical temperature, and velocity of sCO2 will change due to pressure and temperature within the heat exchanger. We are also designing and conducting an analysis of the inside and outside geometries of the heat exchanger and which materials will be the most appropriate for transportation and efficiency. This research will provide an analysis of sCO2 as a working fluid as well as dry-cooling processes for space exploration applications.

POSTER PRESENTATION

Image Source: Flack, R., Fundamentals of Jet Propulsion with Applications, Cambridge University Press, New York, NY, 2005.

PRELIMINARY DESIGN OF A CUBE SATELLITE COMPLIANT HALL THRUSTER

Alexis Hepburn

Aerospace Engineering Department, College of Engineering

Mentor:
Daniel White

Mechanical Engineering Department, College of Engineering

ARIZONA SPACE GRANT AWARD AND PORTZ FELLOWSHIP

The purpose of this research is to conduct the preliminary design, manufacturing, and testing of a miniaturized, single-stage Stationary Plasma Thruster (SPT) type Hall thruster. Dimensionally, the thruster should be consistent with the requirements put forth in the most current CubeSat Design Specification document. The most restricting criterion is the size limitation, which confines the engine envelope to 100 mm in cross-sectional diameter. Considerate deliberation will be provided to the thermal specifications to be compliant with future integration into CubeSat module applications. The target input power for this engine will be approximately 100 W. Argon will be used for primary testing utilizing a direct feed system. The thruster will take advantage of a solid (LaB6) cathode as its electron source. The magnetic circuit will be powered independently via a stand-alone power supply. The exploratory design will focus exclusively on synthesizing a procurable and realizable plasma accelerator stage. Engine success, as based on the long-term mission objective, will be contingent upon having a firing time between 1 and 2 kh, corresponding to a propellant throughput of approximately 2 to 2.5 kg. Testing will need to be completed to demonstrate that the erosion rates observed on the thruster metallic structures, ceramic channel walls, and cathode are broadly consistent with these mission requirements.

POSTER PRESENTATION

AIR FORCE WEB BUILDER USING AI FOR SECURITY AND ORGANIZATION

Justin Holmes-Smith

Aerospace Engineering Department, College of Engineering

Cole Marbach

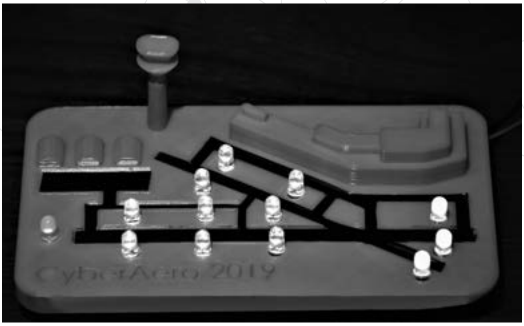
Cyber Intelligence and Security Department, College of Security and Intelligence

Mentor:
Brian Zeltins

Air Force ROTC Cadre

Government websites like Holm Center Wings are hard to navigate and not user-friendly. Despite being in an age of highly advanced technology, the Air Force and the government, in general, have very dated and inefficient web tools. Sites are often poorly designed, are redundant, and have limited capabilities. Sires have not been updated in several years, leading to incomplete and incorrect information or lack of access to important information. Sites are often difficult to navigate with unclear links and poorly designed navigation flow. This study will focus on one possible solution, which is an easy to use web builder that creates secure websites for Air Force programs like AFROTC, utilizing AI as an evolving security tool or an independent network. A web builder that can simplify and automate the process of creating and organizing information can eliminate the frequency of outdated information, improve the design aspect, and make a standardized user friendly system that anyone can very quickly learn to use. The use of an AI web builder will improve the efficiency of communication transmission and help keep relevant information at the fingertips of the service members that rely on fast and easy access to information. This fix to one of the most neglected problems in the Air Force will improve how websites are created and navigated in a way that everyone can understand and rely on.

POSTER PRESENTATION
AIR FORCE ROTC UNDERGRADUATE RESEARCH AND LEADERSHIP PRESENTATION



TRAINING CYBERSECURITY THROUGH GAMIFICATION

Kevin Hood, Michaela Adams, Michael Mcadam, and Maxime Dowla

Cyber Intelligence and Security Department, College of Security and Intelligence

Jacob Henry and Jessica Wilson (ERAU alumni)

Cyber Intelligence and Security Department, College of Security and Intelligence

Mentor:
Krishna Sampigethaya and Farid Dowla

Cyber Intelligence and Security Department, College of Security and Intelligence

EAGLE PRIZE AWARD

The major job shortage in the cybersecurity industry has led to organizations creating cybersecurity competitions. Embry-Riddle's focus in aviation allowed the team to develop and pursue aviation cybersecurity competitions which led to CyberAero. CyberAero was designed to introduce high school students to cybersecurity through aviation-themed challenges ranging from easy to very hard difficulty. Exposing students to cybersecurity competitions allows them to enhance their critical thinking, collaboration, and leadership skills while teaching them new content. Also, students competing had the opportunity to network with a representative from Lockheed Martin to learn about scholarship and internship opportunities. In turn, our own students attended the Department of Energy's CyberForce Competition at Sandia National Laboratory. This fast-paced environment prepares students for real-world scenarios by teaching them how to react during a cyber-attack. Participating in these gamified environments allows for more hands-on training while providing students with job opportunities, scholarships, and exposure to topics that may inspire students to go further with their education. The next goal for Embry-Riddle's cybersecurity competition is to build Aviation ISAC's Cyber Challenge to reach an international audience and discuss more advanced cyber threats in aviation.

POSTER PRESENTATION

ARTIFICIAL INTELLIGENCE AND SWARM-ENABLED TACTICS - IS THE US READY?

URI TRAVEL AND RESEARCH AWARD

One of the most important Artificial Intelligence (AI) projects for the United States military is Swarm-Enabled Tactics. The Defense Advanced Research Projects Agency (DARPA), is developing the OFFensive Swarm-Enabled Tactics program (OFFSET), which envisions future small-unit infantry forces using swarms comprising upwards of 250 small unmanned aircraft systems (UASs) and/or small unmanned ground systems (UGSs) for diverse missions in complex urban environments (Chung, 2016). It is imperative to the national security of the U.S. and its allies that the U.S. is leading the development of AI and Swarm-Enabled Tactics. World powers such as Russia and China are also working towards an established world of AI and Swarm-Enabled Tactics. Three years prior to the U.S. making this program a priority, China implemented a global initiative to be global leaders in AI by 2030 (Kallenborn, 2019). Russia and China are ahead of the U.S. in aspects such as maritime swarm warfare. Our project goals are to evaluate plans for the development of OFFSET, examine if the U.S. is leading the charge in AI, and if not produce a plan justifying why the U.S. needs to lead AI and Swarm-Enabled Tactics.

POSTER PRESENTATION
AIR FORCE ROTC UNDERGRADUATE RESEARCH AND LEADERSHIP PRESENTATION

Chad T. Irick

Global Security and Intelligence Studies Department, College of Security and Intelligence

Daniel J. Mahan and Bryce A. Hughes

Aerospace Engineering Department, College of Engineering

Mentor:
Marella T. Big Mountain

Air Force ROTC Cadre

Krishna G. Sampigethaya

Cyber Intelligence and Security Department, College of Security and Intelligence

SHORT-RANGE GRAVITY TESTS OF LORENTZ INVARIANCE

Jennifer James

Physics and Astronomy Department, College of Arts and Science

Mentor:
Quentin Bailey

Physics and Astronomy Department, College of Arts and Science

Newton's inverse square law of gravity explains many phenomena in the solar system and beyond. Physicists are interested in testing its validity at short distances where new physics may play a role. The goal of this project is to examine in detail corrections to Newtonian gravity coming from some underlying unified theory of physics that may break Lorentz invariance (the symmetry of Special Relativity). The Standard-Model Extension test framework is used to study these corrections. We study the properties of exact solutions to modifications of the Poisson equation valid at short distances. Approaches include experimenting with the standard equations for gravity and adding terms that modify it.

POSTER PRESENTATION

LIGHTWEIGHT INITIAL SAMPLE APPARATUS (LISA): A COMPACT LUNAR SAMPLE COLLECTOR

Faizan Janjua, Logan Huber, Colby Larson, Bea Johnson, Emily Keeland, and Seth Partyka

Aerospace Engineering Department, College of Engineering

Mentor:
Kaela Martin

Aerospace Engineering Department, College of Engineering

Richard Mangum

Humanities and Communication Department, College of Arts and Sciences

EAGLE PRIZE AWARD

Primus Gradus is designing a lightweight lunar sampling device for specimen collection on humaned missions to the moon. The team assessed requirements inspired by NASA's need for a lightweight and compact contingency sampler for lunar missions. NASA requires a sampling device that can be stored in an astronaut's EVA suit pocket, be quickly accessed and deployed, and collect at least one lunar rock sample. To meet these objectives, Primus Gradus designed LISA, or the Lightweight Initial Sample Apparatus. LISA is comprised of three subsystems, the handle, body, and collector, which are connected internally by steel cables. The handle allows astronauts to manipulate the tool comfortably in bulky EVA gloves and includes a telescoping feature in its interior that locks the body into place. The body is a tent-pole style design that includes three tubular sections, allowing for 28 inches of extension when assembled, but gives the tool the ability to fit within an astronaut's EVA suit pocket when collapsed. The collector features a set of tines to conform around an irregularly shaped rock sample. These tines are mechanically actuated by a pull tab on the handle which creates tension on an internal cable, opening the tines. Once the tool is positioned over a sample, the pull tab is released, and the tines close around the rock. With this design, LISA fulfils the objective of creating a compact and lightweight sample collection solution for future lunar mission applications, such as Artemis.

POSTER PRESENTATION AND DEMONSTRATION

ASTRODYNAMIC SOFTWARE: POLYHEDRON GRAVITATIONAL MODELING AND GEOMETRIC ALBEDO

Marcus Kaiser and Evelia Zapién Ramos

Aerospace Engineering Department, College of Engineering

Mentor:
Kaela Martin

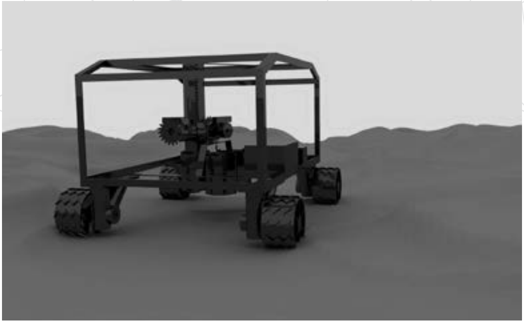
Aerospace Engineering Department, College of Engineering

IGNITE AWARD

This project aims to model the behavior of celestial objects through code written in MATLAB and Julia. The software developed by this project is intended to be used as a tool in the field of astrodynamics for use in mission planning and future research. Versions of the software are developed in both MATLAB and Julia to assess the accuracy and efficiency of the programs. The final goal is to develop a library of functions in Julia that are computationally faster than MATLAB.

Current research will implement Polyhedron Gravitational modeling and Geometric Albedo functions into the Julia and MATLAB programs. The Polyhedron Gravitational modeling is intended to provide an accurate analysis of the gravitational attraction of non-spherical bodies such as asteroids, comets, and small moons. The Geometric Albedo is the ratio of a body's brightness referenced at a zero phase angle to that of a perfectly reflective and ideally flat disk, and can be used to estimate of the size of a celestial body by analyzing its thermal history.

POSTER PRESENTATION



E.R.E.B.U.S (PROTOTYPE)

Bryan Kitsu, Maverick Thigpen, Brian Wahlstrom, Aimar Negrete, Sierra Wong, Cody Warren, Chaya Sherman, and Carlos Rodriguez

Aerospace Engineering Department, College of Engineering

Chris Bowers, John Roberts, and Richard Manacas

Electrical, Computer, and Software Engineering Department, College of Engineering

Nadia Morando-Hernandez and Antony Iordanov

Mechanical Engineering Department, College of Engineering

Mentor:
Daniel White

Mechanical Engineering Department, College of Engineering

EAGLE PRIZE AWARD

Intended to meet the requirements set by the NASA Big Ideas challenge, the E.R.E.B.U.S. rover was designed last semester by the Interplanetary Design and Research Team. This semester, a prototype of the designed rover is in development, with the goal of both preparing for potential selection by NASA, in addition to learning more about the design and fabrication of space systems for the improvement of next year's proposed system. Consisting of both 3D-printed materials and welded Aluminium, the physical rover prototype serves as a means of testing Guidance Navigation and Control systems more than an accurate physical model suitable for testing. Present development goals for the rover include:

1. a to-scale physical model of the rover
2. demonstration of propulsive systems
3. demonstration of object detection

By the development of these capabilities, future NASA Big Ideas designs may be refined to reflect lessons learned, and improve the quality of future proposals.

DEMONSTRATION

FAR 1030-5R ROCKETRY COMPETITION

George Klett and Cooper Drain

Mechanical Engineering Department, College of Engineering

Manuel A. Moreno, Hannah Willer, Mac Boyle, Justin Lord, and Jason Johnson

Aerospace Engineering Department, College of Engineering

Victor Mandala,

Electrical, Computer, and Software Engineering Department, College of Engineering

Mentor:
Brenda Haven

Mechanical Engineering Department, College of Engineering

Ahmed Sulyman

Electrical, Computer, and Software Engineering Department, College of Engineering

EAGLE PRIZE AWARD

Rocketry is a large part of student life here on campus. The idea for competing in the FAR 1030-5R competition is to help students in any field learn and gain experience with rocketry as a whole. Members gain firsthand experience with designing and building a rocket capable of flying a 5lb payload to 10,000 feet. Members also gain experience with designing a robust recovery system that allows the rocket to land safely. The second aspect to this project is the challenge of designing and building a reconnaissance payload that can perform a variety of tasks. There are 5 options to choose from, each being worth a specific amount of points based on difficulty. The team with the most points at the end of the competition wins. Our team decided on building a rover that can exit the rocket upon landing and drive 10 feet from the landing spot. This option is challenging for many reasons. The main reason being the rover must continuously communicate with the ground state. Rockets can drift for miles under parachutes, meaning the team has to develop a powerful communications system. The rover will transmit live video back to our ground station so we can see any obstacles in the way. This system is designed to communicate with the ground station that is, at worst case, three miles away. The Competition date is June 6th, 2020. The team will drive out to the Mojave Desert and compete against colleges across the country.

DEMONSTRATION

VIRTUAL REALITY SIMULATIONS FOR PRIMARY FLIGHT TRAINING

Martin Kurkchubasche, Daniel Mills-Thysen, and Jacob Vlatkovich

Aeronautical Science Department, College of Aviation

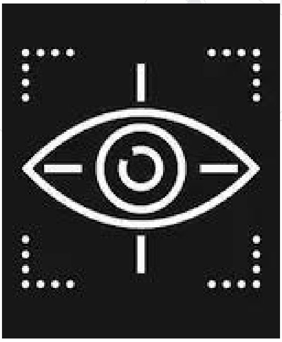
Mentor:
Michelle P. Hight and Dawn Groh

Aeronautical Science Department, College of Aviation

IGNITE AWARD

Flight training has been blamed for many different aspects of the pilot shortage. Whether it is the cost of flight training or the time and efficiency, there are many ways to improve it. For many years, the Federal Aviation Administration (FAA) has acknowledged this and approved simulators for use, ranging from simple home-built solutions to Level-D full motion simulators. While simulators offer many benefits, Virtual Reality can put a pilot candidate directly into any aircraft, where full interaction is available. Virtual Reality is cheaper to implement than a full-sized simulator and is easier to troubleshoot if problems arise. Utilizing virtual reality in primary flight training can not only decrease the time and costs of flight training but also increase the efficiency by utilizing computer-based training. Candidates can be placed in any scenario ranging from engine fire and failure, to a simulated mock checkride allowing them to interact with simulated systems in a given aircraft. The simulations are self-paced and the computer gives pre-recorded directions from a Certified Flight Instructor to walk the student through maneuvers, emergencies, and simulated check rides.

POSTER PRESENTATION AND DEMONSTRATION



TECHNICAL COMMUNICATION EAGLE EYE OPTICS PROJECT

IGNITE AWARD

Gabby Lail

Electrical, Computer, and Software Engineering Department, College of Engineering

Robert Shaw and Hunter Smatla

Mechanical Engineering Department, College of Engineering

Mentor:
Matt Haslam and Shirley Johnson

Humanities and Communication Department, College of Arts and Sciences

Mobile eye-tracking systems provide usability research support as well as access to a wide range of robotics and technical communication research opportunities. Optical tracking systems are often prohibitively expensive and do not provide the mobility or flexibility needed for a variety of research application possibilities. Our team proposes building a simple mobile eye-tracking system to be used in-house at ERAU for heat-mapping, robotics, control systems, and various technical communication applications in a structured research environment. The mobile eye-tracking system will become part of a larger research and hands-on technical communication usability lab and research center. The research team intends to publish the outcome of implementing an in-house eye-tracking system, as well as a training manual, possibly providing a new open-source instruction set for other ERAU students and other universities. The building of the Eagle Eye tracking system will provide numerous learning and research opportunities for the Prescott ERAU campus.

POSTER PRESENTATION

JULIA LANGUAGE 1.1 EPHEMERIS READER AND GRAVITATIONAL MODELING PROGRAM FOR SOLAR SYSTEM BODIES

Parker D. Landon

Electrical, Computer, and Software Engineering Department, College of Engineering and Physics and Astronomy Department, College of Arts and Sciences

Mentor:
Kaela Martin

Aerospace Engineering Department, College of Engineering

ARIZONA SPACE GRANT AWARD

Julia is a new programming language designed for numerical computing, combining simplicity and the ease of dynamic languages with the speed of compiled languages. Julia version 1.0 was released in August of 2018, marking the first stable version of the language. Julia's ability to handle large amounts of data provides the perfect language to create an ephemeris reader. Ephemeris readers are used in astrodynamics to access hundreds of years' worth of celestial body data. An ephemeris and constant reader, capable of retrieving data for major and small bodies, does not yet exist in Julia. Creating such a tool in Julia would provide later projects with a convenient and functional package to automate many tasks in astrodynamics. The most recent addition, gravitational field modeling, uses both polyhedral models and spherical harmonics to calculate the fields. Our team's newest version can now calculate additional sets of harmonics to more accurately represent the field. Using the Database of Asteroid Models from Inversion Techniques (DAMIT), the code can produce three-dimensional models of asteroids. DAMIT provides coordinates for the asteroid, the reader then utilizes DAMIT to provide an accurate gravitational model. The knowledge of celestial bodies and their gravitational models within one program will help reduce the cost and increase efficiency in astrodynamics and space trajectory optimization.

POSTER PRESENTATION

LONGITUDINAL APPLICATIONS OF STEPLADDER TECHNIQUE FOR ENHANCING GROUP PERFORMANCE

Conner Lutterman

Behavioral and Social Sciences Department, College of Arts and Sciences

Mentor:
Erin Bowen

Behavioral and Social Sciences Department, College of Arts and Sciences

EAGLE PRIZE AWARD

Stepladder technique is intended to improve decision-making in small groups by structuring the entry of group members, ensuring that each member contributes to the decision-making process. Previous research has employed the stepladder technique for intellective exercises of short duration. Here, we examined a more realistic application of the stepladder technique to a longitudinal project team engaged in a design/build/test engineering program. Application of stepladder technique beyond a laboratory/one-time setting is a unique addition to the team performance research. Preliminary data indicates that the stepladder technique is effective in a longitudinal project more aligned to typical organization applications; constraints, covariates and mitigating issues will also be presented.

POSTER PRESENTATION

VEX U ROBOTICS

EAGLE PRIZE AWARD

Kyle Lutterman, Jeffrey Ryan, Sierra Wong, and Elizabeth Geiger

Aerospace Engineering Department, College of Engineering

Mentor:
Joel Schipper

Electrical, Computer, and Software Engineering Department, College of Engineering

VEX U is a competition hosted by the REC Foundation for university students to get engaged in hands-on engineering. Each team produces two robots using the VEX provided parts to compete in the VEX U competition. The competition changes every year with the only constants being the size of the field, the tools and parts teams are able to use, and the size constraints of the robots. The teams compete in regional competitions in order to qualify for the World Championship Competition, which is the highest competition a team can compete in for VEX U. The VEX U teams at Embry-Riddle Aeronautical University are divided into two teams, ERAU Blue and ERAU Gold. Each of these teams are divided into a programming and build teams, in which students learn to communicate and cooperate between software and hardware and the importance of doing so. The leadership structure of the club includes the president, vice president/treasure, the gold and blue team leads, the programming leads, and the build team leads. Both teams compete at the competitions in order to gain engineering experience, networking opportunities, and the opportunity to compete in a rigorous competition.

POSTER PRESENTATION AND DEMONSTRATION

CHIROPTERA: EXPERIMENTS IN BIOMIMETIC FLIGHT

Collin Mickels

Aerospace Engineering Department, College of Engineering

Mentor:
Douglas Isenberg

Mechanical Engineering Department, College of Engineering

IGNITE AWARD

Developing flapping-winged MAVs necessitates the reverse engineering and replication of flight mechanisms found in nature, a process known as biomimetics. This provides a two-fold means to study the flight-specialization of various flying birds and mammals and apply learned methods towards optimizing highly maneuverable micro-air vehicles.

POSTER PRESENTATION

Image Source: https://commons.wikimedia.org/wiki/File:Mammalogy_and_Ornithology._Mammalogy._Plate_2.jpg

REALISTIC DESIGN, BUILD, AND FLY APPLICATIONS – HEAVY-LIFT AIRCRAFT

Jessica Millard, Anthony Pirone, Nathaniel Scott, and Jeffrey Chen

Aerospace Engineering Department, College of Engineering;

Evan Stuart

Applied Aviation Sciences Department, College of Aviation

Mentor:
Shigeo Hayashibara

Aerospace Engineering Department, College of Engineering

EAGLE PRIZE AWARD

ERAU's SAE Aero Design West Competition team encourages students of all majors who have an interest in the design of heavy-lift cargo and passenger aircraft to design, build, and fly a large RC aircraft to meet a new set of regulations each competition year. Since the team, Eaglenautics, was founded in 2017 it has successfully been to competition once in April 2019 in California. The team's aircraft flew 4 out of 5 flight rounds, passed all technical inspections, and is now on display in ERAU's Aero-Fab in the AXFAB. The 2020 competition requirements are unique in that the cargo's weight-to-volume ratio directly affect the team's overall flight score. The 2020 rules also dictate a maximum wingspan of 10 feet, maximum gross takeoff weight (GTOW) of 55 lbs, and a maximum power limitation of 1000 Watts. For Eaglenautics' competition class, fiber-reinforced plastics such as carbon fiber are prohibited. These regulations simulate similar design requirements for large passenger or cargo aircraft. The team utilizes modern engineering techniques like Computational Fluid Dynamics (CFD), aircraft optimization, and structural analysis to verify more traditional methods. This process gives students practical experience with aircraft design not found in coursework which can be applied at companies such as Boeing after graduation. The team's 2020 aircraft design has a wingspan of 5.5 ft, an estimated GTOW of 31 lbs, and will be manufactured by the team over the next month to compete in Texas in April 2020.

POSTER PRESENTATION

AIAA DESIGN-BUILD-FLY (DBF)

EAGLE PRIZE AWARD

The AIAA DBF team competes at the annual, international Design-Build-Fly competition issued by the American Institute of Aeronautics and Astronautics (AIAA). This team provides hands on engineering experience to all of its members through designing the aircraft from the ground up, manufacturing several prototypes and models, and flying at competition. The unmanned aircraft is designed and manufactured completely by undergraduate students. This year's team is designing, building, and flying a banner towing, passenger carrying bush plane. AIAA's challenge is comprised of three missions. Mission 1 is a proof of concept mission. Mission 2 will involve carrying as many passengers and luggage as possible. For this mission the students have designed a passenger and luggage restraint system. Mission 3 is a banner towing mission. Students designed and manufactured deployment and towline release systems as well as the banner itself. The end goal of this team is to compete and place in the top 15 worldwide at the DBF competition in April.

POSTER PRESENTATION

Elizabeth Mitchell

Mechanical Engineering Department, College of Engineering

Mentor:
Jacob Zwick

Mechanical Engineering Department, College of Engineering

William Crisler and Johann Dorfling

Aerospace Engineering Department, College of Engineering

REDUCING THE COST OF UNCERTAINTY QUANTIFICATION AT HYPERSONIC SPEEDS

ARIZONA SPACE GRANT AWARD

Engineers are lacking adequate tools to manage the ensemble of simulation and test data that is generated when applying verification, validation, and uncertainty quantification (UQ) standards and methods. This results in excessive time spent to decipher, utilize and manage the provenance of simulation-based workflows. Commercial industry needs a solution that bridges the gap between existing uncertainty quantification toolkits and advanced computer simulations with a foundation in strong data management. As part of an effort to develop Spectre, a new full-stack application developed by Intelligent Light through a Department of Energy (DOE) SBIR, the purpose of this project is to develop a series of computational fluid dynamics (CFD) simulations and perform preliminary UQ analysis. Due to the unique complexities associated with hypersonic flight, such as complex boundary layer profiles due to viscous layers and high temperature gas dynamics, hypersonic simulations are not only more time consuming but also more difficult to achieve and validate; thus, a hypersonic case was chosen. The target of UQ analysis was the boundary layer of an axisymmetric ogive cylinder at Mach 7. Discretization error was analyzed via Richardson extrapolation on a set of 5 grid refinement levels, and each grid was simulated as fully laminar, then fully turbulent using the Spalart-Allmaras turbulence model. Uncertainty in the parameter space was analyzed via polynomial chaos.

POSTER PRESENTATION

Forrest Mobley

Aerospace Engineering Department, College of Engineering

Mentor:
Shigeo Hayashibara

Aerospace Engineering Department, College of Engineering

Seth Lawrence

Research Engineer, Intelligent Light

RESTRUCTURING CADET ORGANIZATION, INSTRUCTION, AND LEADERSHIP (RECOIL)

AFROTC is a program designed to build leaders of character for tomorrow's Air Force. Our mission in ReCOIL is to improve upon the program by reintroducing supplemental values into the cadet programs. In order to do so, we plan to provide early leadership opportunities and empower cadets to take initiative of their learning while accurately replicating the rank progression of the active duty Air Force. The end goal of this project is to produce well-rounded, highly qualified officer candidates better prepared for their roles as leaders.

POSTER PRESENTATION
AIR FORCE ROTC UNDERGRADUATE RESEARCH AND LEADERSHIP PRESENTATION

Joshua Morisawa

Aeronautical Science Department, College of Aviation

Tyler Bigham and Haley Rasmussen

Global Security and Intelligence Department, College of Security and Intelligence

Austin Blair, Carlos Easterbrook, William Kau, Trevor McDowell, Connor Murphy, and Joselyn Rabbitt

Aerospace Engineering Department, College of Engineering

Jacob Hawkins

Applied Aviation Sciences Department, College of Aviation

Ashton Serratos and Isaiah Taylor

Electrical, Computer, and Software Engineering Department, College of Engineering

Mentor:
Brian Zeltins

Air Force ROTC Cadre

EMBRY-RIDDLE SUBORBITAL REUSABLE VEHICLE PROJECT: GO TO SPACE CHEAPER AND OFTEN

Gaurav Nene and Cooper Eastwood

Aerospace Engineering Department, College of Engineering

Mentor:
Michael Fabian

Mechanical Engineering Department, College of Engineering

IGNITE AWARD

The Embry-Riddle Suborbital Reusable Vehicle (SRV) Project is a student-driven initiative to develop a two-stage, unguided, reusable suborbital sounding rocket to gain experience in next-generation launch vehicle development. This research will combine low-cost rocket propulsion and commercial off the shelf flight systems to develop a vehicle that is cheaper to launch than comparable commercial and university developed SRVs in its altitude range. Our research objectives are to develop a reliable, inexpensive recovery system to operate at high altitudes and recover both stages. We will develop a solution to the commonly documented problem with the lack of reliable ignition of black powder ejection charges at high altitudes. We will also test an alternative staging mechanism to traditional piston and pyrotechnic systems, to ensure reliable stage separation at high supersonic speeds. Our research will also develop and test a method for high altitude ignition for an upper stage solid rocket motor. We will analytically determine the size of the upper stage ignition charge based on an empirical relationship between the solid motor propellant grain geometry and ignition energy. Our research will also develop a method to qualify this vehicle to launch from a FAA-licensed launch facility, and achieve standards of reliability, safety, and performance imposed by the FAA-AST, while keeping total cost to a fraction of larger university spaceshot projects.

POSTER PRESENTATION

STUDIES OF OVAL TUBE AND FIN HEAT EXCHANGERS

Phillip Nielsen

Mechanical Engineering Department, College of Engineering

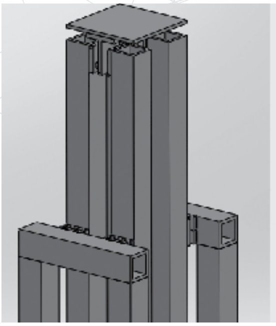
Mentor:
Shigeo Hayashibara

Aerospace Engineering Department, College of Engineering

IGNITE AWARD

Heating Ventilation and air-conditioning (HVAC) is a system which changes the temperature of the surroundings for the purposes of cooling or heating. This system requires energy to maintain a temperature difference from the outside temperature. This is important since minimized power is one of the requirements for the system to achieve a better efficiency. Optimizing the flow over the evaporator coils is one way to increase the cooling efficiency. This will reduce the power required to have a sustainable system. Optimizing the flow to increase the energy transfer between the fins and the incoming air could result in a greater Coefficient of Performance (COP). This will be achieved by changing the geometry of the tubes for greater interaction with the flow. For reduced recirculation, an oval design for the tube geometry was chosen. These studies will be simulated using Computational Fluid Dynamics (CFD) as the main comparison between the different models. The different models will be a standard oval shaped tube geometry with different angles of attack alternating through the rows. This method could, in theory, increase the overall heat transfer coefficient of the evaporator because of more mixing of the flow through the evaporator. In conclusion, this study will analyze the effects of changing the geometry and alternating the angle of attack of the evaporator tubes along rows, on the overall heat transfer coefficient and pressure drop across the model.

POSTER PRESENTATION



DESIGN AND CONSTRUCTION OF A THRUST STAND FOR LOW POWER ELECTRIC PROPULSION

John Norton, Ryder Moreno, Austin Luttrell, and Caitlyn Ooms

Physics and Astronomy Department, College of Arts and Sciences

Tyler Hoover and Parker Ayars

Aerospace Engineering Department, College of Engineering

Kimiya Ghobadi

Mechanical Engineering Department, College of Engineering

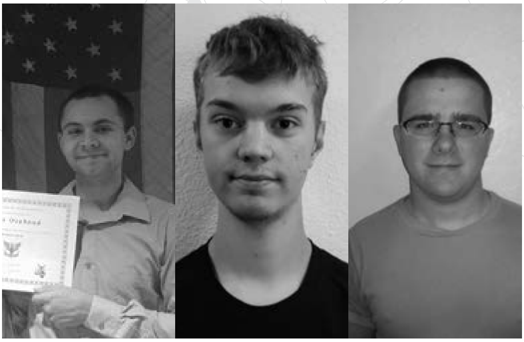
Mentor:
Darrel Smith

Physics and Astronomy Department, College of Arts and Sciences

IGNITE AWARD

Electric propulsion (EP) project focused on the design and optimization of a simple electrothermal propulsion system. Focusing on parameters such as propellant mass flow rate, power supplied, nozzle shape/length, and tangentially injected propellant, we hope to optimize the thrust and specific impulse performance levels of the propulsion system. Due to the nature of EP devices, they have very low thrust outputs, and we currently do not have any equipment on campus that is capable of making accurate thrust measurements in the range required for EP devices. 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. Our expected outcomes include enhancing student understanding of electrostatic propulsion systems, laying the groundwork continued growth of the various electric thruster projects on campus. With the capability to take thrust measurements, we will be able to correlate thrust improvements to design changes and compare our thrusters to those in current use. We will gain a more thorough understanding of electric thrusters, and the variables that contribute to a more effective thruster.

POSTER PRESENTATION



IS IT ETHICAL TO QUANTIFY A PERSON'S WORTH IN MILITARY OPERATIONS?

Jonas Orrahood

Applied Aviation Sciences Department, College of Aviation

Cole Alley

Mathematics Department, College of Arts and Sciences

Ryan Mahoney

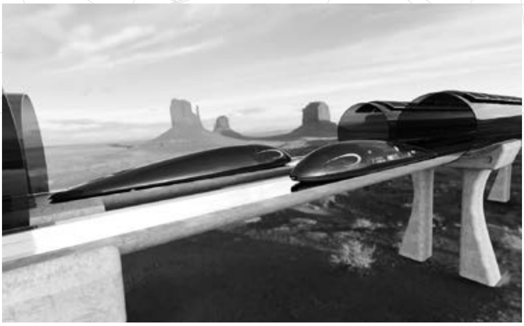
Global Security and Intelligence Studies Department, College of Security and Intelligence

Mentor:
Brian Zeltins

Air Force ROTC Cadre

Future of military operations are largely dependent on advancement of Artificial Intelligence (AI). Although, the concept of AI is simple, using complex computer systems to compile analytical data and make decisions based on outcome possibilities, it becomes more complex the more e automation is used make decisions. Currently, there is not a large representation of automation in critical decision making fields. Most uses are for tasks such as sorting and auto piloting. However, this does not mean we cannot seek to further the ability to automate. In order to make decisions, a computer has to understand data in a numerical way. Often times, any and all decisions made involving a military operation can have a direct impact on casualties or even lives lost. In every case, in every decision there must be a certain weight given to each individual's life compared to missions at stake and the task goals. Many surmise that using computer analysis to make such decisions or even to analyze possibilities may help to alleviate bias. In a 2012 study, researchers examined if simply changing the order in which odds of winning and losing were presented could affect people's betting practices. Changing that single aspect of the game allowed them to influence a 31% change in the average bet. These results and others lead us to the conclusion that it is not ethical to quantify the value of people's life for computer analytics based on the current available technology.

POSTER PRESENTATION
AIR FORCE ROTC UNDERGRADUATE RESEARCH AND LEADERSHIP PRESENTATION



ARIZONA HYPERLOOP: THE FIFTH MODE OF TRANSPORTATION

EAGLE PRIZE AWARD

Arizona Hyperloop is a coalition between Embry-Riddle Aeronautical University and Arizona State University students competing in Elon Musk's annual SpaceX Hyperloop Pod Competition. Hyperloop is the proposed "Fifth Mode of Transportation" - coined "a cross between a Concorde, a rail gun, and an air hockey table." A hyperloop pod levitates and travels at nearly the speed of sound inside a vacuum tube, which eliminates air resistance.

Musk hosts the annual competition to university students to encourage the evolution of urban transportation. The goal is to design, build, and race the fastest prototype pod at SpaceX's mile-long test track in Hawthorne, CA. In the absence of the SpaceX competition this year, Arizona Hyperloop is hosting an international competition in March 2020.

Arizona Hyperloop has been involved with the project for over four years and was selected to compete for three years in a row. The team demonstrates an aptitude for leadership and teamwork despite working split across the state with tight deadlines. Arizona Hyperloop is excited to be a pioneer in the future of transportation.

On Discovery Day, Arizona Hyperloop is presenting the hyperloop pod as an example of what engineering students can accomplish. This display may interest students in joining Embry-Riddle and hyperloop.

POSTER PRESENTATION AND STATIC DISPLAY

Eleanor Pahl

Aerospace Engineering Department, College of Engineering

Matthieu Rada

Mechanical Engineering Department, College of Engineering

Mentor:
Andy Gerrick

Mechanical Engineering Department, College of Engineering

TERMINATION AND ALTITUDE CONTROL TESTING OF A STANDARD LATEX WEATHER BALLOON

Xander Pickard

Mechanical Engineering Department, College of Engineering

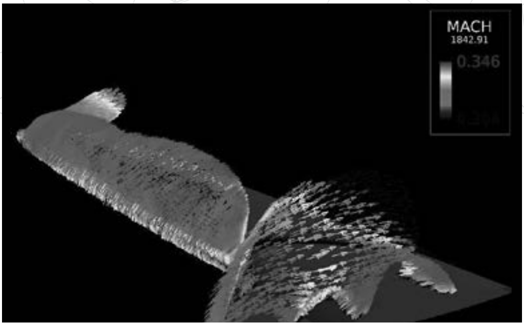
Mentor:
Douglas Isenberg

Mechanical Engineering Department, College of Engineering

IGNITE AWARD

The proposed High-Altitude Balloon Controlled Ascent System (HABCAS) is an innovative approach to near-space research using cost-effective latex weather balloons. Control of the altitude allows for extended duration flights above 95% of the Earth's atmosphere. A dynamical model was created and improved based on data from previous flights, which provides the governing equations required for the control system. The termination subsystem was successfully tested in November of 2019 and will be used on the April 2020 flight, testing the gas release subsystem, which causes the system to descend. A possible future flight would also include liquid ballast release, additionally permitting ascent capability.

POSTER PRESENTATION



AIRCRAFT LEADING EDGE STRAKES ON CONVENTIONAL NACA WINGS

IGNITE AWARD

Anthony Pirone

Aerospace Engineering Department, College of Engineering

Mentor:
Shigeo Hayashibara

Aerospace Engineering Department, College of Engineering

The prevention of stall on aircraft wings has been a great challenge over the history of airplanes. As the aircraft become more and more complex, it becomes harder to fit high lift devices and leading-edge devices onto high camber, supercritical airfoil aircraft wings. In the fighter jet class of aircraft the obstacle of stall is usually delayed by the implementation of leading-edge root extensions or strakes. Strakes create a tip vortice along the sharp leading edge that transitions over the surface of the wing preventing separation on both the upper and lower surface of the wing allowing the fighter jet to experience higher angles of attack. Implementation of a strake has been proven to be effective on thin, low aspect ratio wings since there is not an aggressive curve that vortice must overcome at the leading edge of the wing. In this study, using Computation Fluid Dynamics (CFD) via the Department of Defense's new program HPCMP Create Genesis we are creating a series of geometry sets that will be run though the CFD flow simulation program to show what each iteration of strake does for a conventional NACA airfoil with camber and a much thicker cross section and if strakes aid in delaying onset of stall allowing aircraft, such as passenger planes, to safely operate at higher angles of attack. This information can be of great use as it can help prevent airline crashes that involve stall at take-off.

POSTER PRESENTATION

BRINGING AWARENESS TO AMERICAN AND CHINESE CULTURAL DIFFERENCES

Jessica Rader, Tyler Smith, Ethan Muntz, Kaya Learned and Tatiana Chacon

Global Security and Intelligence Studies Department, College of Security and Intelligence

Mentor:
Hong Zhan

Global Security and Intelligence Studies Department, College of Security and Intelligence

IGNITE AWARD

Whether looking at China's rapid development from an economic, national security or political point of view, there is a distinctive need for culturally aware individuals. Sino-American development has been historically stagnant and the need for stimulation is becoming ever more important. Bringing an overarching awareness of Chinese culture will be achieved by classifying culture into five categories: political views, family life, diet, fashion and relationships. Data collection from Chinese natives and literature will provide empirical data in order to effectively supply a credible and empowering source of cultural information.

POSTER PRESENTATION

GRAVITATIONAL WAVE CALIBRATION ERROR FOR SUPERNOVAE CORE COLLAPSE

Brad Ratto

Physics and Astronomy Department, College of Arts and Sciences

Mentor:
Michele Zanolin

Physics and Astronomy Department, College of Arts and Sciences

ARIZONA SPACE GRANT AWARD

The existence of gravitational waves reveals yet another method in which information is transmitted across the cosmos, bringing with it further insight into the inner workings of our universe. In order to detect such phenomena, we use ground based Laser Interferometers to measure the microscopic deformations in space-time and explore a new frontier in gravitational astronomy. However, such instrumentation also induces distortions in the gravitational waves henceforth diminishing the ability to extract accurate physical information. Moreover, the ability to extract a coherent signal amongst the noise remains an issue that requires constant improvement. The aim of this study is to understand the consequences of the distortions produced by the laser interferometer on the reconstructed gravitational waves from core collapse supernova. We will check the impact of the distortions on the astrophysical parameters that we compute from a gravitational wave candidate as seen in the LIGO instruments and existing software excess power algorithms. The results of which will be used to quantify the calibration errors for the ongoing optical triggered core collapse supernova search for the so called O3 data set. As a consequence, this study is to provide reports that introduce a wider range of calibration errors so that the impact on detection ranges and parameter estimations can be accurately estimated.

POSTER PRESENTATION

WHAT DOES THE EFFECT OF GEOGRAPHICAL POSITIONING HAVE ON FITNESS ASSESSMENT SCORES AT DETACHMENTS LOCATED IN THE SOUTHWEST REGION?

Fitness Assessment scores separate detachments and are a representation of the physical fitness levels of those detachments. Average Fitness Assessment scores differ across detachments in the southwest region. Our goal is to gather these scores, create a schematic of the results, and try and draw a conclusion as to how the geographical positioning of these detachments might correlate to the scores. San Diego State University Detachment 075 elevation is 436 feet above sea level. When compared to Embry-Riddle Aeronautical University Detachment 028, the elevation difference is 4,864 feet respectively. The Fitness Assessment scores are not adjusted at ERAU to accommodate this difference in elevation. This dramatic difference in elevation is going to have an effect on cadet's cardiovascular system and likely lead to a lower Fitness Assessment score. Additionally, the weather differences at these different detachments influence cadet's ability to exercise outside. For these reasons, Fitness Assessment scores should be analyzed to compare and contrast scores to accurately find explanations to the differences in scores across detachments in the Southwest Region.

POSTER PRESENTATION
AIR FORCE ROTC UNDERGRADUATE RESEARCH AND LEADERSHIP PRESENTATION

Tyler Reid, Danielle Mangila, and Emerson Pereira

Aeronautical Science Department, College of Aviation

James Embro

Aerospace Engineering Department, College of Engineering

Mentor:
Nickolas Mondragon

Applied Aviation Sciences Department, College of Aviation

Brian Zeltins

Air Force ROTC Cadre

GRAVITATIONAL WAVE MEMORY: SUPERNOVA

Colter Richardson

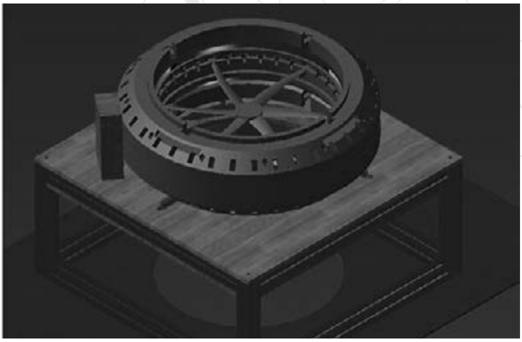
Physics and Astronomy Department, College of Arts and Science

Mentor:
Michele Zanolin

Physics and Astronomy Department, College of Arts and Science

Memory is a low frequency signal produced in asymmetric core-collapse supernova explosions. The memory is dependent on three facets in the supernovae: the matter emission, the anisotropic neutrino emission, and the neutrino energy density. This low frequency component can be modeled by applying a long-term cosine to the end of simulated explosions. In order to make a detection (at either ground-based or space-based detectors) a complete understanding of the transfer functions at low frequencies is required, which involves the motion of the ground and harmonic oscillations from the suspensions. The memory is investigated by comparing a the previously mentioned toy model and the spherical harmonic decomposition of numerical simulations. Here we present our initial investigation of the toy model and the numerical simulations.

POSTER PRESENTATION



MAGONUS INNOVATION: TIP DRIVEN ROTOR SYSTEM

Jeffrey Ryan, Dominic Domingo, Nathaniel Larson, Amandeep Singh, and Patrick Wentz

Aerospace Engineering Department, College of Engineering

Mentor:
William Crisler

Aerospace Engineering Department, College of Engineering

IGNITE AWARD

The objective of our project is the preliminary design, refinement, risk reduction and ground demonstration of components for a tip-driven rotor system designed by KRyanCreative LLC. The five (5) person team has designed a static test demonstrator, capable of determining scalability and will use it to determine power requirements and manufacturing feasibility of a large-scale rotor. The rotor system will consist of several blades connected to an outer annulus that will be driven by an electric motor. The motor will be mounted and thrust measurements will be taken from three (3) load cells. Data gained through these tests will be used to advise KRyanCreative on large scale blade designs.

POSTER PRESENTATION AND DEMONSTRATION

EAGLE ROBOTICS

EAGLE PRIZE AWARD

Eagle Robotics is a club dedicated to building and programming an autonomous robot to tackle the international Intelligent Ground Vehicle Competition (IGVC). Pitting a robot against a maze of painted lanes and obstacles, this competition requires teams to develop an autonomous robot capable of detecting lanes, obstacles, and planning its own path through a course; all without human intervention. To address these challenges, Eagle Robotics is divided into two teams; Software and Mechanical. Using AXFAB facilities and URI funding, the mechanical team cut and sized both aluminum and plastic chassis parts; guided by a finalized Computer Aided Design (CAD) model of the robot in SOLIDWORKS. With this foundation, the mechanical team is projected to complete structural and mechanical assembly of the robot by the end of the Spring 2020 semester. To address the issue of computer vision, the software team concluded a set of introductory tutorials, Practical Python and OpenCV, and used the techniques therein to develop a versatile lane detection algorithm that can be applied to still images. Moving forward, video-fed lane detection will be implemented on miniature robotic prototypes; enabling rapid testing of obstacle avoidance algorithms. Once this software is optimized and combined with the full-scale robot, advanced sensory such as lidar and gyroscope will be added. The final phase will be integration of sensory into an advanced path-planning sequence that has yet to be developed.

POSTER PRESENTATION AND DEMONSTRATION

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THE EFFECTS OF MOUT TACTICS ON LEADERSHIP ABILITY

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Scott M. McCloud

Air Force ROTC Cadre

Military Operations in Urban Terrain (MOUT) is a major part of today's military conflicts and is a major contributor to our success in many modern-day conflict locations, such as the Middle East. MOUT is simply how a military unit would traverse a town or village that have buildings in them, both effectively and with little casualties. Every military training program from the Navy SEALs to an Air Force ROTC detachment needs to go through this training. Locally, the biggest problem is the lack of MOUT-like training at Detachment 028 Embry-Riddle, Prescott Arizona. One way to overcome this short fall is to get a MOUT training Facility on campus and implement it into the detachments training program. The question then becomes if teaching cadets MOUT tactics would benefit them as they prepare to become officers in the Air Force? With this research we would be able to learn if teaching MOUT tactics benefits cadets' Field Training performance, a deciding factor if a cadet is well prepared for active duty. We anticipate the data to show that implementing MOUT training will increase Field Training performance and ultimately produce better officers for the Air Force.

POSTER PRESENTATION
AIR FORCE ROTC UNDERGRADUATE RESEARCH AND LEADERSHIP PRESENTATION

FEMALE RETENTION RATES IN AIR FORCE ROTC

The United States Air Force in this past year has reached a new high in retention rate averages, an average of 90% between both enlisted airmen and officers. Although there are 332,800 airmen, women only make up 23% of it. In addition, the number of females is sufficiently lower amongst female officers. This research project will provide an examination of the issues that are faced by females in the military and how on a smaller aspect of how Air Force ROTC can give more opportunities and resources which will help attract/retain females in the U.S. Air Force. We strive to give more information to the female cadets about the different factors of opportunities and treatment that play an important role in being a female in the military. Education about things such as maternity leave, height waivers, and job options in addition to family life is just the beginning of goal. We would also like to bring more female personnel in the Air Force to our Detachment's Career Day so our female cadets can learn even more from those living in the day-to-day Air Force. Ultimately our goal is to have our female cadets feel the most prepared and ready for active duty and thus attract/retain more females in the U.S. Air Force starting from the foundation of cadet life.

POSTER PRESENTATION
AIR FORCE ROTC UNDERGRADUATE RESEARCH AND LEADERSHIP PRESENTATION

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Air Force ROTC Cadre

SELF-CONTAINED MICROWAVE THERMAL ROCKET ENGINE

William (Hojin) Surh

Aerospace Engineering Department, College of Engineering and Physics and Astronomy Department, College of Arts and Sciences

Zachary Sadaghiani

Aerospace Engineering Department, College of Engineering

Mentor:
Daniel White

Mechanical Engineering Department, College of Engineering

IGNITE AWARD

This paper presents the preliminary design and results of the ERAU Electric Propulsion Using an Inductively Coupled Plasma Source (EPICS) experiment. The EPICS experiment seeks to capitalize on the availability of compact, simple inductive plasma sources as a means of producing an ionized reaction mass. The EPICS experiment is similar to many of the inductively coupled plasma sources used in lithography, plasma cleaning and some manufacturing processes.

POSTER PRESENTATION

STATISTICAL ANALYSIS OF THE NORTHERN ARIZONA TORNADO OUTBREAK

ARIZONA SPACE GRANT AWARD

The 2010 Tornado Outbreak in Northern Arizona was the largest tornado outbreak in history on the west side of the Continental Divide, with 11 confirmed tornadoes touching down. This event is unique because so many tornadoes occurred, touching down only in high terrain, enabling us to study how topography affects tornadogenesis. We have analyzed the precise tracks of mesocyclones identified by Doppler radar in relation to the terrain and the damage paths of the 11 confirmed tornadoes. Statistical correlations between terrain slope and elevation, with respect to normalized rotation observed by radar, reveal the influence of topography on the development of mid-level rotation along the path of every strong, persistent thunderstorm that formed. This study documents the extraordinary characteristics of the 2010 Tornado Outbreak and gains insight into the relationship between terrain and tornadogenesis.

POSTER PRESENTATION

Paige Swenson

Applied Aviation Sciences Department, College of Aviation

Mentor:
Curtis James and Ronny Schroeder

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LEADERSHIP IN THE EYES OF A WC-130

The project examines the rank structure in the crew of a WC-130 when completing missions by analyzing the communication between crew members. In order to examine the structure, we analyzed the leadership styles that improved work dynamics and those that did not in each member of the crew. Additionally, we considered the idea that trust overrides rank in a stressful environment. Overall, we looked at what sort of team hierarchy exists when the crew is presented with the dangerous situation of flying into a hurricane.

POSTER PRESENTATION
AIR FORCE ROTC UNDERGRADUATE RESEARCH AND LEADERSHIP PRESENTATION

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SECOND ORDER ASYMPTOTIC EXPANSION OF THE FISHER INFORMATION MATRIX

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Mentor:
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ARIZONA SPACE GRANT AWARD

Fisher Information has been used throughout the field of Physics for parameter estimation. Some recent papers have discussed that it is reaching its limit in usefulness in light of other methods like Monte-Carlo Simulations. However, these papers have not taken into account that Fisher Information is actually part of a series expansion, of which the higher powers provide more useful and detailed estimation. In this paper, we will be outlining the method in which one applies the Second Order Asymptotic Expansion of the Fisher Information Matrix for a given model. We show how First Order Fisher Information provides quick and powerful parameter estimation and what the benefits of Second Order are. We also one of the direct derivations of Fisher Information so it can be adapted to any project.

POSTER PRESENTATION

COMBAT COMMAND AND CONTROL LESSONS: WE CAN LEARN FROM THE BATTLE OF BRITAIN AND APPLY TO MODERN AIR COMBAT

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Mentor:
Brian Zeltins

Air Force ROTC Cadre

Combat Command and control is the management of a battle space by a unified commander. The Battle of Britain was a turning point in World War II that utilized airpower and superior command and control to repel a larger attacking force. Using case studies, we will learn from the Battle of Britain to identify what gave the British the advantage and how we can apply this to modern air combat. The end goal of this project is to provide a recommendation, based on lessons learned in the Battle of Britain, as to how modern air combat can be more effective.

POSTER PRESENTATION
AIR FORCE ROTC UNDERGRADUATE RESEARCH AND LEADERSHIP PRESENTATION


EFFECTS OF ARTIFICIAL INTELLIGENCE ON PILOTS AND THE FUTURE OF THE PILOTING CAREER FIELD

Artificial Intelligence (AI) is a technique that is being used to increasingly automate aviation processes. The slow cleansing of pilots from the cockpit seems to be the next logical step based on the past, i.e. the removal of the navigator career field from commercial and military aviation. However, our team sees glaring problems with this progression based on historical examples (Boeing's 737 MAX program) and the worries of the future (non-human initiated weapons deployment). The goal of our research is to slow the implementation of AI into the aviation community due to its current lack of technical progress as well as the unparalleled human grasp on complicated decision making.

POSTER PRESENTATION
AIR FORCE ROTC UNDERGRADUATE RESEARCH AND LEADERSHIP PRESENTATION

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STATOR FINS AND STATOR SKIRTS OF VERTICAL AXIS WIND TURBINES

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Mentor:
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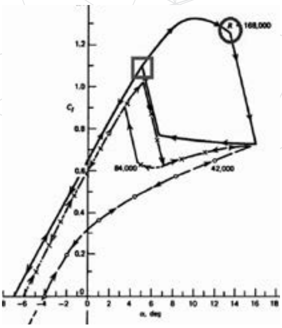
IGNITE AWARD

While massive horizontal axis wind turbines are great for producing large amounts of energy, they are impractical for renewable energy generation in certain locations due to geographical constraints and smaller power needs. Savonius type vertical axis wind turbines can fill this gap in modern energy production. Stator skirts and stator fins are modifications to these turbines that can amplify and direct wind speeds as they pass through the rotor fins, but the extent of their favorable effects is unknown. This project will use computational fluid dynamics, mainly through the software ANSYS Fluent, to model Savonius turbines and stators. The powerful ANSYS suite will be utilized to construct the turbine's geometry, store material properties, run simulations, and provide feedback regarding what adjustments can be made to better capture the wind's energy. The entire process will consist of making incremental and iterative changes to the size, shape, and style of the stators. This project's end goal is to produce a stator skirt and fin design that maximizes energy production at wind speeds less than ten miles per hour and to determine the difference in power output between said design and a comparable one without the stator additions.

POSTER PRESENTATION AND DEMONSTRATION



CONTINUAL ANALYSIS OF THE RELATIONSHIP BETWEEN STALL HYSTERESIS AND CIRCULATION PARAMETER

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Mentor:
Wallace Morris

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As an airfoil's AOA is increased, a small separation bubble forms on the upper surface, and grows until it bursts. This causes the laminar flow to massively separate from the upper surface. The bursting of the bubble coincides with the onset of stall. Stall hysteresis is the phenomenon where an airfoil produces less lift than expected for a given angle of attack as recovery from stall is attempted.

Stall hysteresis is a well-documented phenomenon that has been shown to affect all aircraft and turbo-machinery (wind turbines, jet engines, etc.) This hysteresis poses a problem for aircraft control in the event of a stall, where the lift produced by the wing becomes dependent on the history of its AOA.

The present work, as an extension of Morris 2009 and Morris and Rusak 2013, suggests that the flow state around a 2D airfoil is dominated by the circulation parameter, which includes airfoil geometry, angle of attack, and Reynolds number effects. It is proposed that stalled airfoils have a significantly different circulation parameter than that of the attached states for the same airfoil. This variance in circulation parameter has associated stall-circulation parameters for each state (attached vs stalled), and it, therefore, necessary to reduce the angle of attack, or the circulation parameter, below that of the effective body (stalled flow field). The flow field is dominated not by the physical airfoil, but rather by the effective body encompassing both the physical airfoil and its trailing wake.

POSTER PRESENTATION

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