EMBRY-RIDDLE URI UNDERGRADUATE RESEARCH INSTITUTE

UNDERGRADUATE RESEARCH ABSTRACTS

EMBRY-RIDDLE DISCOVERY DAY 2016

Prescott, Arizona

Discovery Day Schedule of Events

Friday, 8 April 2016

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

Oral Presentations
AC1-107 | 11:15 AM-1:00 PM

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

Invited Speaker: Dr. Stefano Gonella,
Electronic Traps for Elastic Wave Manipulation
AC1-107 | 3:15-4:15 PM

Chancellor's Reception
Eagle Gym | 5:30-7:30 PM

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

Welcome to Discovery Day 2016

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

Warm Regards,

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

ANNE BOETTCHER
Director, Undergraduate Research Institute and Honors Program

It has been an exciting year for our ERAU-Prescott undergraduates, as is reflected in the breadth and depth of the presentations and demonstrations included in our 4th Annual Discovery Day. During the 2015-2016 Academic Year, the Undergraduate Research Institute was able to award a total of 19 *Ignite* research/scholarship, 8 Eagle Prize, and 16 travel grants. *Ignite* Projects ranged from one focused on airline performance ratings to one examining the design of human-powered aircrafts. This fall, our Eagle Prize VEX Robotics teams hosted a VEX U Competition on our campus, the Hyperloop team competed in the SpaceX Hyperloop Pod Competition, and our our AIAA-Design-Build-Fly and Intercollegiate Rocketry teams are preparing for competition. In addition, our students have been conducting independent and team research projects through course-based and student organization opportunities. Linked to their research and scholarship, these students have been active in numerous outreach efforts with regional elementary, middle, and high schools, as well as the Prescott community as a whole.

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

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

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

Undergraduate Research Institute Advisory Board

Stephen Bruder, Electrical, Computer, and Software Engineering; Elizabeth Davis, Humanities and Communication; Iacopo Gentilini, Aerospace and Mechanical Engineering; Brennan Hughey, Physics; Karen Meunier, Intelligence Studies and Global Affairs; Jennah Perry, Applied Aviation Sciences; Patricia Watkins, Hazy Library and Learning Center; and Gary Yale, Aerospace and Mechanical Engineering

Undergraduate Research Institute

Anne Boettcher, Director; Ginger MacGowan, Administrative Assistant; and Mary Alys Lillard, Program Manager

A special note of thanks to all of our mentors!

Invited Oral Presentations

LOCATION: AC1-107

11:15 AM-1:00 PM

Jeff Harjehausen[1] and Isaac Hein[2]. Eagle Aero Sport: Student-Built Aircraft. Mentors: Brian Davis[3] and Wallace Morris II[2]. [1]Department of Aeronautical Science, College of Aviation and Department of Business College of Arts & Sciences Aviation Business Administration; [2]Department of Aerospace & Mechanical Engineering, College of Engineering; [3]Department of Computer, Electrical, & Software Engineering, College of Engineering

Kiranjyot Gill. Gravitational Waves in Advanced LIGO Supernova Science. Mentor: Michele Zanolin. Department of Physics, College of Arts & Sciences

Cameron McCauley and Cat McClure. Analysis of Response Procedures to CBRN Attacks in US. Mentor: Tyrone Groh. Global Security and Intelligence, College of Security & Intelligence.

Abanob Mourkus[1]. NextGen Anti-Ice. Mentor: Jacqueline R. Luedtke[2]. [1]Department of Aeronautical Science, College of Aviation and Department of Aerospace & Mechanical Engineering; [2]College of Engineering Department of Applied Aviation Sciences, College of Aviation

Bryce Chanes. Eagle Space Flight Team. Mentor: Julio Benavides. Department of Aerospace & Mechanical Engineering, College of Engineering

Posters and Demonstrations Presentations

(Number Corresponds to Poster/ Demonstration Number)

LOCATION: AC1-ATRIUM

1. **Eagle Aero Sport: Student-Built Aircraft (Poster & Demonstration)**
   Jeff Harjehausen and Isaac Hein
   Mentors: Brian Davis and Wallace Morris II

2. **Contra-Rotating Propulsion System for Human-Powered Aircraft (Poster & Demonstration)**
   Mark Van Bergen, Kevin Horn, Michael Chastain, Ryan Burns, and Chris Jacobs
   Mentor: Gary Yale

3. **Aerodynamic Effects of a Two Parallel Forward Swept Flat Plates**
   Mark David Miller Jr.
   Mentor: Jeffrey C. Ashworth

4. **Improving Aircraft Performance and Decreasing Operational Costs via Synthetic Jet Flow**
   Brian Cowley, Dakota Burklund, Benjamin Eastman, Duke Millett, and Luke Peterson
   Mentor: Wallace Morris II

5. **Pedagogical Case Study Research Capstone Course Experiences**
   Madeline Kuhn
   Mentors: Jacqueline Luedtke, Juan Merkt, and Brent Bowen

6. **Supersonic Advanced Trainer Aerodynamics Research: Conceptual Studies of Compressible Aerodynamics for the Next Generation of Advanced Military Trainers**
   Tyler Eiguren
   Mentor: Shigeo Hayashibara

7. **Analysis of Response Procedures to CBRN Attacks in US**
   Cameron McCauley and Cat McClure
   Mentor: Tyrone Groh

8. **Creating a Multi-Factor Index to Model Performance in the U.S. Airline Industry**
   Michelle Bennett and Catie Willard
   Mentors: Jaqueline Luedtke and Brent Bowen

9. **Gravitational Waves in Advanced LIGO Supernova Science**
   Kiranjyot Gill
   Mentor: Michele Zanolin

10. **Mesoscale Modeling of Hurricane Norbert Moisture Surge and Arizona Flooding**
    Jennie Halverson
    Mentor: Dorothea Ivanova

11. **NextGen Anti-Ice**
    Abanob Mourkus
    Mentor: Jacqueline R. Luedtke

12. **A.G.E. - Amplified Golf Experience**
    Anthony Munson, Lauren Kruszewski, Kelsey Merrigan, Barry MacNeill, and Justin McBurney
    Mentors: Mark Sensmeier, Lance Traub, Shigeo Hayashibara, and Matt Haslam

13. **Development of Micro-Hydroponic Systems for Space Travel**
    Daniel Dyck
    Mentors: John Pavlina and Peter Merkle

14. **Arctic Power System, Capstone Detail Design**
    Emily Davy, Dee Dozier, Lisa Ferguson, Austin Sverdrup, and Dylan Schindler
    Mentors: Dennis Kodimer and Samuel Siewert

15. **Supersonic High Altitude Remotely Piloted Unmanned Aircraft System (SHARP UAS)**
Ryan Ashey and John Lewandowski
Mentor: Michael Fabian

16. **Ultralight Turbine-less Jet Engine**
Tre Buchanan, Isaac Anderson, and Stephen Woodard
Mentors: Brenda Haven and Shigeo Hayashibara

17. **Networking of Autonomous Small Unmanned Aerial Systems (NASUAS)**
Jacob Heilmann, Nicholas Arnold, and Robert Noble
Mentor: Jeffrey Ashworth

18. **American Institute of Aeronautics and Astronautics Cessna/ Raytheon Design-Build-Fly Competition Team (Poster and Demonstration)**
Andres Sandoval
Mentors: Jacob Zwick and David Lanning

19. **Effects of a Leading Edge Wire on Stall Control**
Jeromy Smith
Mentor: Lance Traub

20. **Application of Shape Memory Alloys to Unmanned Aerial Vehicles**
Bryce Milnes and Andres Sandoval
Mentor: David B. Lanning, Jr.

21. **Alternate Composite Team: Feasibility Study of Graphene for Structural Component Applications**
Trupti Mahendrakar, Alexandria Brown, Yoohyun Song, and Trishen Patel
Mentor: Wahyu Lestari

22. **Phoenix Aerospace Launch Systems: Project Legacy – High Powered Rocket**
Michelle Machado, Andrew Delarosa, Sage Bauer, Kyle Hosler, Joskua Carrillo, Laila Shams, Wesley Goldner-Carver, Neil Nunan, Austin Leonard, Johnathan Winters, Clark Anderson, Myles Howard, Jaron Wong, Cris Ricario, Isaac Perry, David Gomez Herrera, and Akash Joseph
Mentor: Julio Benavides

23. **A Study on Sugar Propellant Grain Geometries**
Cameron Kurtz and Robert Myers
Mentor: Michael Fabian

24. **Thrust Comparison of an Ethanol-LOX Rocket Engine and an Air Augmented Ethanol-LOX Rocket Engine through CFD Simulations**
Nicholas Wright
Mentor: Shigeo Hayashibara

25. **Eagle Aerospace**
Bryce Chanes, Reece Cabanas, Daniel Dyck, Silas Graff, Travis Hansen, Ethan Higgins, Nicole Shriver, and Bryce Smoldon
Mentor: Michael Fabian

26. **Eagle Space Flight Team**
Bryce Chanes
Mentor: Julio Benavides

27. **Eagle Space Flight Team – Electronics Team (Poster & Demonstration)**
Brandon Klefman, Jonathan Strang, Ryan Claus, Anthony Islas, Christian Moncada, and Sarah Pearson
Mentor: Dennis Kodimer

28. **Eagle Space Flight Team – Aerodynamics Team (Poster & Demonstration)**
Carl Leake, Catherine Ayotte, Neil Nunan, Alex Lubiarz, Nicholas Liapis, Jesse Ives, Cristopher Ricario, Damian Rivas, and Jacob Underwood
Mentor: Julio Benavides

29. **Changes in Performance Parameters of Solid Rocket Motors as They Increase in Size**
Julia Levitt, Tyler Gulden, William Carpenter,

Raeann VanSickle, Bryce Smoldon, Christopher Sample, Rebecca Tobin, and Richard Reksoatmodjo
Mentor: Dr. Brenda Haven

30. **ESFT Structures Team: How to Get to Space in One Piece**
Nicole Shriver, Clark Anderson, Benjamin Bahr, Loren Bahr, Jayanth Bangalore, Alexander Collins, Alexander Denslow, Daniel Dyck, Nina Rogerson, Claire Schindler, Adam Scott, Ryan Tanner, Oleksandr Vladyka, and Chad Reinart
Mentor: Julio Benavides

31. **Eagle Robotics Fire-Fighting Robot (Demonstration)**
Kevin Horn, David Gomez-Herrera, Ricardo Fernandez Garcia, David Sanders, Tharun Sankar, Kaitlynn Shostrom, and Daniel Cohen
Mentors: Douglas R. Isenberg and Stephen Bruder

32. **2015-2016 VEX Robotics Team**
Adam Scott, Michael Buck, Kristin Sandager, Jesse Ives, Jonathan Buchholz, Magnus Bergman, Ferrin Katz, Lucas Widner, Rachel Rise, Ryan Stewart, Kyle Lutterman, Annika Howell, Braxton Kendall, Jared Delinger, Geoffrey Winship, Gregory Klatchko, and Ben Mohorc
Mentor: Joel Schipper

33. **Micro Gravity Simulator**
Narendran Muraleedharan and Ricardo Fernandez
Mentors: Iacopo Gentilini and Douglas Isenberg

34. **Designing a High Speed Hyperloop Pod**
Dakota Burklund, Emma Figuroa, Alexandra Indritz, Eli Olson, Trentin Post, Jacobus Smit, and Max Starkel, Nick DiPinto, and Amy Walker
Mentor: Sam Siewert

35. **Team Eagle Wingsuit Research**
Glenn Borland, Benjamin Salisbury, Brian Cowley, and Joseph John Gomez
Mentor: Timothy Sestak

36. **Society of Women Engineers Team Ocelot: NASA Human Exploration Rover Challenge (Poster and Demonstration)**
Jessica Turcios, Jessica Chow, Cristina Clawson, Cassie Freeman, Blaise Golden, Robin Loch, Chloe McClellan, Johnnie Perry, Josh Schoenherr, Raeann VanSickle, Joshua Warshaw, Shayla Watson, and Samantha Wyeth
Mentor: Brenda Haven

37. **Modeling Project for Digital Circuits Application (Poster)**
Nicholas Mallott
Mentors: Iacopo Gentilini and Akhan Almagambetov

38. **Observational Study of Convective Events Delaying Flight Operations at the Atlanta Hartsfield Internatinoal Airport (Poster)**
Celeste H. Moreno
Mentor: Curtis N. James

Stefano Gonella
Department of Civil, Environmental, and Geo-Engineering
University of Minnesota

INVITED SPEAKER

Location: AC1-107
3:15-4:15 PM

Stefano Gonella received Ph.D. and M.S. degrees in aerospace engineering from the Georgia Institute of Technology in 2007 and 2005, respectively. Previously, he received a Laurea, also in aerospace engineering, from the Politecnico di Torino, Italy, in 2003. He joined the faculty of the Department of Civil Engineering at the University of Minnesota in 2010, after 3 years of post-doctoral and teaching experience at Northwestern University. His main research interests revolve around the modeling and simulation of complex wave phenomena in unconventional structures and materials, with emphasis on cellular solids, phononic and granular crystals, and acoustic metamaterials. He is also interested in the development of new methodologies for structural and material diagnostics through the mechanistic adaptation of concepts of machine learning and computer vision.

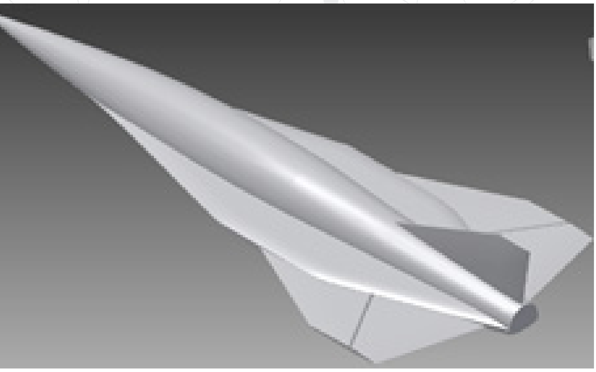
Electronic Traps for Elastic Wave Manipulation

A framework for piezo-enabled tunability of mechanical waves

One of the main challenges in the design of versatile engineering devices is achieving tunability, i.e., the ability to tune a system's response to an evolving operating environment. In the context of vibration control, for example, this can lead to the design of semi-active mechanical filters. The opportunities are even broader in the realm of wave control, due to the ability of certain media to experience directional wave propagation. In this context, it is possible to switch on and off certain spatial features of a wavefield and even control the pattern of the available energy paths. These effects can be valuable in many aerospace applications, e.g., the design of smart airfoil skins.

The piezoelectric avenue toward tunability requires inserting a number of piezoelectric elements in the domain to actively modify its mechanical response. Of particular interest are methods involving shunts, whereby the piezo patches are passively connected to appropriately designed electric circuits, to yield a modification of the effective properties of the material and a correction of the global behavior of the host medium. Our investigation focuses on resistive-inductive (RL) circuits, which act as electrical resonators, and negative capacitance (NC) circuits, which produce a modulation of the material stiffness.

In this presentation, we will provide some experimental evidence of vibration cancellation in 1D structures using RL shunts, and we will report on the implementation of a so-called tunable rainbow trap. We will then show some preliminary simulation results of spatial wave control in lattice materials.



Ryan Ashey and John Lewandowski
Department of Aerospace & Mechanical Engineering, College of Engineering

MENTOR:* *Michael Fabian
Department of Aerospace & Mechanical Engineering, College of Engineering

Supersonic High Altitude Remotely Piloted Unmanned Aircraft System (SHARP UAS)

IGNITE Grant Award

A research team known as North Texas Near Space decided to test whether or not a RC plane could reach supersonic speeds only through freefall. The most recent test was conducted on October 19 2013. They sent a purchased RC model kit into the air via a weather balloon that rapidly deflated at a height of 88000 feet. The speeds that RC plane reached upon freefall was roughly 493 mph. Our team plans to succeed where they failed by building our own unmanned vehicle that focuses on reducing drag, resulting in a faster maximum velocity via freefall. As such the concept design focuses primarily on reducing the drag of the aircraft. With this primary objective and base concept in mind, further designs can be created in the future as a solution to other real world issues that can be solved with the use of unmanned vehicles. This is possible due to the fact that the forces experienced by the drone during freefall will simulate or exceed the projected forced experienced on the drone with a payload falling at a lower velocity as a result from being released at a lower height.

Poster Presentation

Creating a Multi-Factor Index to Model Performance in the U.S. Airline Industry

Michelle Bennett and Catie Willard
Department of Business, College of Arts & Sciences

MENTOR:
Jaqueline Luedtke
Department of Applied Aviation Sciences, College of Aviation

Brent Bowen
Department of Aeronautical Sciences, College of Aviation

IGNITE GRANT AWARD

The Airline Quality Rating (AQR) is a formula first created in 1991 used to measure operational performance of domestic airlines in the aviation industry to produce an index. The AQR was designed by developing a formula that compiles factors the traveling public views as most critical to an airline's performance, including baggage handling, customer complaints, denied boarding and on-time arrivals. With this weighted average, an index measuring operational performance has been created. When all criteria, weights and impacts are combined for an airline over the year, a single interval scaled value is obtained. This value is comparable across airlines and time periods. This formula is employed and computed on a monthly basis using mandatory reporting data from the Department of Transportation. A panel of experts was used to conduct research to produce the weighted average and continues to authenticate the validity of the index every few years to ensure reliability. This approach can produce reliable outcomes through the use of objective data and the continuous analysis of the industry. Airline Quality Rating reports are released consistently every year for 25 years and the technique to create the index is repeatable. Airlines are able to utilize this data to employ strategies, and consumers are able to analyze the movement of the airline market place.

Poster Presentation

Glenn Borland and Benjamin Salisbury
Department of Aeronautical Science, College of Aviation

Additional Team Members:
Brian Cowley
Department of Aerospace & Mechanical Engineering, College of Engineering

Joseph John Gomez
Department of Applied Aviation Sciences, College of Aviation

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

Team Eagle Wingsuit Research

EAGLE PRIZE AWARD

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

Poster Presentation

Tre Buchanan, Isaac Anderson, and Stephen Woodard
Department of Aerospace & Mechanical Engineering, College of Engineering

MENTORS:
Brenda Haven and Shigeo Hayashibara
Department of Aerospace & Mechanical Engineering, College of Engineering

Ultralight Turbine-less Jet Engine

IGNITE GRANT AWARD

This Ignite Project Proposal for Unmanned Aerial Vehicle (UAV) Propulsion Research is a continuation of last year's Ignite Grant Project (Eiguren/Douglass/Buchanan) in conceptual studies of "Ultra-Compact Shaft-less Jet Engine". Following the comprehensive study involving Computational Fluid Dynamics (CFD) and preliminary experimental testing, this second design iteration will receive structural and combustion modifications to further improve efficiency and fabrication potential.

The basic idea behind the engine design involves an integrated Electronically Ducted Fan (EDF), simplified combustion region, and nozzle. The reason behind this innovative concept is to improve current jet engine designs relying on shaft-driven compressors via turbines - shaft driven compressors can significantly decrease component and system losses as well as the costs associated with complex production and maintenance. This second stage in the design process will utilize CFD simulations alongside experimental testing, gathering data from both subsonic wind tunnels for in-flight data and static combustion tests. Our research team believes that our renovated "Ultralight Turbine-less Jet Engine" can create an energy efficient, reliable, and cost effective next generation small-scale jet engine for UAVs. By continuing this project under a Senior Capstone Project next year, we expect to conduct full airframe integration of the entire engine system into a production capable UAV. The data and results gathered over the course of these three years will result in research publication(s) to be presented at Research Conferences, such as the A3ICON 2016 as well as the AIAA Regional VI Student Conference in April 2016

Poster Presentation

Dakota Burklund, Emma Figuroa, Alexandra Indritz, Eli Olson, Trentin Post, Jacobus Smit, and Max Starkel
Department of Aerospace & Mechanical Engineering, College of Engineering

Nick DiPinto
Department of Computer, Electrical, & Software Engineering, College of Engineering

Amy Walker
Department of Behavioral & Safety Sciences, College of Art and Sciences

MENTOR:
Sam Siewert
Department of Computer, Electrical, & Software Engineering, College of Engineering

Designing a High Speed Hyperloop Pod

EAGLE PRIZE AWARD

Students from Embry-Riddle Aeronautical University are designing and building a pod to compete in Space-X Hyperloop competitions. The vehicle requires powerful linear induction motors (LIM's). The concept behind the design is as follows: the pod will drive into the tube, then the pod will levitate and be propelled by the LIM's, accelerate to a high speed within the low-pressure environment of the tube, and then slow to a complete stop after traveling one mile. This project is part of a competition to improve the design of the proposed Hyperloop high speed transportation system. The first production system from Space-X will operate between San Francisco and Los Angeles and will complete the trip in much less time than a high speed rail line. Several benefits of the program include a significant emissions reduction and a modernization of the current rail transit system employed today. The team successfully competed in the first two phases of the 2015-16 competition this year and has begun work for next year's competition.

Poster Presentation

Eagle Space Flight Team

Bryce Chanes
Department of Aerospace & Mechanical Engineering, College of Engineering

MENTOR:
Julio Benavides
Department of Aerospace & Mechanical Engineering, College of Engineering

The Eagle Space Flight Team was created with the goal of becoming the first undergraduate team to design, build, and launch a rocket capable of suborbital space-flight. In order to achieve this goal, the team will have to design a rocket capable of atmospheric flight at speeds over Mach 5 and launch it on one of the largest amateur rocket motors ever made. Before the space flight, the team will build a 4” diameter rocket and fly it over 40,000 ft. This rocket will allow the team to develop, test, and refine the technologies needed for the final flight to over 350,000’. With the advancement in propulsion systems including nearly a dozen 100 pound thrust motor tests, the team continues to move forward toward the technical development of a space capable rocket.

Poster Presentation
Invited Oral Presentation

Bryce Chanes, Reece Cabanas, Daniel Dyck, Silas Graff, Travis Hansen, Ethan Higgins, Nicole Shriver, and Bryce Smoldon
Department of Aerospace & Mechanical Engineering, College of Engineering

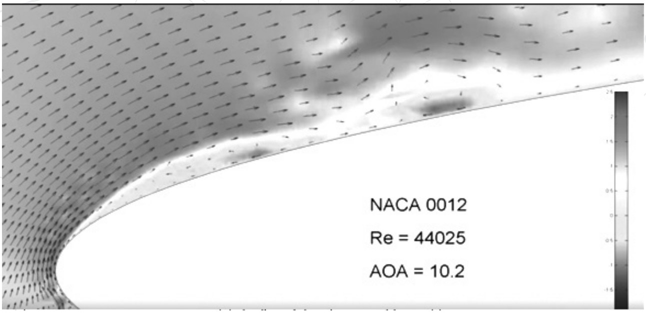
MENTOR:
Michael Fabian
Department of Aerospace & Mechanical Engineering, College of Engineering

Eagle Aerospace

EAGLE PRIZE AWARD

The goal of this team is to compete in the Intercollegiate Rocket and Engineering Competition (IREC) hosted by the Experimental Sounding Rocket Association (ESRA) . The competition takes place every summer in Green River, Utah. Teams must compete against other Universities from all over the world in two categories. The Basic Category involves flying a rocket with a 10-pound payload to exactly 10,000ft AGL. To accomplish this task the team has made large strides in the field of additive manufacturing. Last year the team flew 3D printed fins to over Mach 2, and this year we are attempting to fly the largest 3d printed nosecone supersonic. With the team's dedication toward the advancement of high power rocketry, this team will be rewarded with an exceptional showing in this year's competition.

Poster Presentation



Improving Aircraft Performance and Decreasing Operational Costs, Via Synthetic Jet Flow

IGNITE GRANT AWARD

Brian Cowley, Dakota Burklund, Benjamin Eastman, Duke Millett, and Luke Peterson
Department of Aerospace & Mechanical Engineering, College of Engineering

MENTOR:
Wallace Morris II
Department of Aerospace & Mechanical Engineering, College of Engineering

The Computational Flow Control (CFC) Research Group is investigating mechanisms and applications of flow control techniques to increase the operational envelope of aircraft and reduce aircraft and fleet operational costs. The group is currently modelling flow control actuators, which have been experimentally and computationally demonstrated to re-attach boundary layer for post-stalled (separated) conditions and to reduce boundary layer thickness at attached flow conditions. The computational simulations include a model of synthetic jet actuators with a peak amplitude of one percent of the free stream velocity running in a DNS solver at moderately high Reynolds numbers. This reduction of boundary layer thickness leads to a reduction of drag for the aircraft, resulting in burning less fuel to fly the same distance or speed. The reduction of fuel burn translates directly into saving tens of millions of dollars annually for an average fleet with lower environmental impact. The CFC group is conducting a parametric study for trends and effectiveness of flow control techniques to guide both physical experiments and illuminate the underlying mechanisms. It is hypothesized that there exists a parameter space that will optimize the control of the boundary layers, which will enable an increase in the operational envelope and the reduction of drag with attendant operational costs.

Poster Presentation

Emily Davy, Dee Dozier, Lisa Ferguson, Austin Sverdrup, and Dylan Schindler
Department of Computer, Electrical, & Software Engineering, College of Engineering

MENTORS:
Dennis Kodimer and Samuel Siewert
Department of Computer, Electrical, & Software Engineering, College of Engineering

Arctic Power System, Capstone Detail Design

The Arctic Power System (APS) is a remote power conditioner that will receive unregulated power from a combination of wind, solar, and hydrogen energy sources and regulate the power to a fixed 20W output. This output will be used to power multispectral cameras for one year without external support in the Arctic Circle. Utilizing a combination of Texas Instruments, Delfino Microcontroller Unit, Super Capacitor Storage and Several Buck-Boost Architectures the conditioning will provide two outputs for a 5V and 12V output. Currently, the project is being examined by the U.S. Coast Guard for implementation in defense functions. The five student, two faculty member team will have completed subsystem test for demonstration at the conclusion of the semester.

Poster Presentation

Daniel Dyck
Department of Aerospace & Mechanical Engineering, College of Engineering

MENTORS:
John Pavlina
Department of Computer, Electrical, & Software Engineering, College of Engineering

Peter Merkle
Civil Engineering Department, College of Engineering - Daytona

Development of Micro-Hydroponic Systems for Space Travel

IGNITE GRANT AWARD

As man ventures farther and farther away from earth, we must become more flexible in the art of survival. One technology which holds vast potential to aid in space exploration is hydroponics. Hydroponics is the process of growing plants by adding nutrients to water, instead of using soil. All of hydroponics' many advantages culminate to grow plants that will: feed astronauts, aid in the process of producing oxygen, cleaning water, and raising morale. NASA has already started to utilize this technology, and is growing plants and vegetables on the international space station. This project will research the ability to modularize and minimize the size of a hydroponic setup, allowing for ease of expansion, and a decrease in volume. The decrease in volume and weight would decrease cost of transportation and storage, allowing deep space exploration to occur. Efforts will be focused on utilizing technologies such as 3D printing and micro-controllers, to manufacture lightweight custom parts, and introduce automation/computer operations, to increase efficiency.

Poster Presentation

Tyler Eiguren
Department of Aerospace & Mechanical Engineering, College of Engineering

MENTOR:
Shigeo Hayashibara
Department of Aerospace & Mechanical Engineering, College of Engineering

Supersonic Advanced Trainer Aerodynamics Research: Conceptual Studies of Compressible Aerodynamics for the Next Generation of Advanced Military Trainers

In response to a Request for Information published by the United States Air Force regarding a T-38C replacement aircraft (known as T-X), Turaco Aerospace has identified a market for a next-generation advanced jet trainer. This aircraft will provide pilots in training with a platform that more resembles the performance and systems capabilities of fifth-generation fighters, such as the F-22 and F-35.

In order to successfully design throughout the transonic/ supersonic regions of the flight régime, both computer simulations and wind tunnel data will be used to design and iterate performance criteria. Simulations will be done using Computational Fluid Dynamics (CFD) in order to validate forthcoming wind tunnel and water tunnel results. Simulations are performed using Pointwise mesh, Cradle SC/Tetra, and Intelligent Light FieldView provided by Embry-Riddle Aeronautical University.

CFD will be used as a design/ analysis tool, alongside wind tunnel and water tunnel results. For the Spring 2016 semester, computational research will coincide with testing and evaluation. In conjunction with wind tunnel tests, water tunnel tests will be conducted to evaluate the effectiveness of four (4) Leading Edge Root Extensions (LERX) in combination with three (3) different vertical tail angles. Computational methods will validate the qualitative data gathered from water tunnel testing, while quantitative data (CL, CD, and CM) will be compared to that gathered from wind tunnel testing. If small percent differences are seen between wind tunnel values and computational values, full-scale predictions for the YT-80 will be performed.

Poster Presentation

Gravitational Waves in Advanced LIGO Supernova Science

IGNITE GRANT AWARD

By specializing the rate toward gravitational wave detection, we improve the estimated rate of core-collapse supernovae (CCSNe) happening within the Local Universe. Using the Gravitational Wave Galaxy Catalog, a collection of galaxies containing electromagnetic counterparts within a volume of 20 Mpc were identified. Recognizing that the CCSNe galaxy hosts are morphologically dependent, the estimation of the rate of CCSNe took into the account the production of CCSNe happening within the Local Field at 10 Mpc, as well as the Virgo Cluster situated at 15 Mpc, by using both blue light luminosity and far-infrared luminosity to trace star formation. The improved estimation of the CCSNe rate within 20 Mpc is 432.1 ± 20.78 CCSNe Century-1 Mpc-1. Overall, when taking the existence of major biases against CCSNe discoveries such as progenitor misclassification, the assumed mix of faint and bright supernova types, as well as the uncertainties in obscuration provided by factors such as absorption due to sources of dust and stellar remnants, light pollution from galaxy nuclei and the limited sky coverage of ground-based telescopes, our measurements provide an improvement in comparison to previously published rate standards within shorter CCSNe distance estimations.

Poster Presentation
Invited Oral Presentation

Kiranjyot Gill
Department of Physics, College of Arts & Sciences

MENTOR:
Michele Zanolin
Department of Physics, College of Arts & Sciences

Jennie Halverson
Department of Applied Aviation Sciences, College of Aviation

MENTOR:
Dorothea Ivanova
Department of Applied Aviation Sciences, College of Aviation

Mesoscale Modeling of Hurricane Norbert Moisture Surge and Arizona flooding

In early September 2014, remnants of Hurricane Norbert brought record-setting rainfall that swept across the Southwest U.S. Flash flooding in Phoenix area caused major damage to infrastructure, roadways, and many human casualties including two fatalities.

The overall goal of this study is to use the Weather Research Forecast (Advanced Research Weather model) (WRF ARW) to simulate the status of the atmospheric boundary layer before, during and after Hurricane Norbert. It is utilized to analyze wave-like sea surface temperature variations and resulting moisture surges in the Gulf of California. It determines if and to what extent the SW monsoon is the instigator. WRF ARW is also used to determine if the rain bands left behind were influenced and propagated by the monsoonal south/southwest flow over the Phoenix and Chandler area. This gives insight to WRF ARW effectiveness in forecasting similar monsoon based storms and tropical cyclones in the future.

Our WRF modeling study supports the hypothesis that higher than usual for early September SSTs significantly enhanced the intensity of Norbert and influenced the rainfall rates and the intensity of the flash flood. To test this hypothesis, we investigate boundary layer and the atmospheric circulation in Arizona before and during the heavy rain events. WRF ARW (Advanced Research WRF model) successfully simulated the boundary layer properties and CAPE during the flood. The simulated Norbert moisture movement triggers strong winds, damaging rain, and thunderstorms for several days across Arizona.

Poster Presentation

Eagle Aero Sport: Student-Built Aircraft

EAGLE PRIZE AWARD

Eagle Aero Sport (EAS) is the first student operated aircraft build team at Embry-Riddle Aeronautical University. Our team allows students to gain hands-on experience in all aspects of aircraft production such as; aircraft riveting and assembling, engineering, management of production operations, accounting, finance, marketing, and team building skills. After intensive research and consulting sessions with the Experimental Aircraft Association, our airplane of choice is the Vans RV-12. EAS plans to modify this airplane in order to add real time flight test instrumentation for research. One of these instruments is an integrated Alpha Beta and pitot static sensor designed by students. Presently, the build progress is at about 40% completion with the fuselage and the empennage partly finished. The RV-12 build is currently predicted to be finished by December 2016. EAS implements OSHA standards and mandates that all build teams are led by a certified A&P Mechanic to ensure that the build process is done as safely as possible. Once complete, EAS will have the opportunity to conduct novel research in regards to airframe structural analysis and fatigue, aerodynamic flow characteristic around airframe including vorticity shedding, and other flight test studies. Some of the research will be sent to the Van's Aircraft company for their own benefit. Most of the research will be used in classrooms here at Embry-Riddle. The research and information gathered by the EAS team is a rare asset that can be utilized by students to enhance Embry-Riddle's curricula.

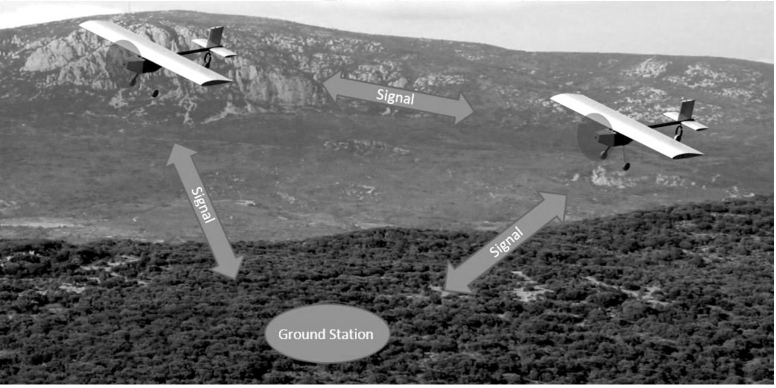
Poster Presentation and Demostration
Invited Oral Presentation

Jeff Harjehausen
Department of Aeronautical Science, College of Aviation and Department of Business College of Arts & Sciences Aviation Business Administration

Isaac Hein
Department of Aerospace & Mechanical Engineering, College of Engineering

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

Wally Morris
Department of Aerospace & Mechanical Engineering, College of Engineering



Jacob Heilmann and Nicholas Arnold
Department of Aerospace & Mechanical Engineering, College of Engineering

Robert Noble
Department of Computer, Electrical, & Software Engineering, College of Engineering

MENTOR:
Jeffrey Ashworth
Department of Aerospace & Mechanical Engineering, College of Engineering

Networking of Autonomous Small Unmanned Aerial Systems (NASUAS)

IGNITE GRANT AWARD

The development of a network between autonomous Small Unmanned Aerial Systems (SUAS) will advance the robotics industry and increase the usage and effectiveness of Robotic systems. Multiple networked Aerial robots can divide labor to decrease mission time; relay signals of robots outside the signal range for the ability to broadcast real-time data; provide the ability to change mission parameters and division of labor if new robots enter the mission zone or an assigned robot experiences a critical failure.

Poster Presentation

Eagle Robotics Fire-Fighting Robot

EAGLE PRIZE AWARD

**Kevin Horn,
David Gomez-Herrera,
Ricardo Fernandez Garcia,
David Sanders,
Tharun Sankar,
Kaitlynn Shostrom, and
Daniel Cohen**
Department of Aerospace & Mechanical Engineering, College of Engineering

MENTOR:
Douglas R. Isenberg
Department of Aerospace & Mechanical Engineering, College of Engineering

Stephen Bruder
Department of Computer, Electrical, & Software Engineering, College of Engineering

The Eagle Robotics team has designed and built a robotic system to participate in the Trinity College Fire-Fighting Home Robot competition. The competition challenges teams of students to create a fully autonomous robot capable of starting at the sound of an alarm, navigating through a random maze of rooms, locating a lit candle, and extinguishing the flame.

The team has implemented a variety of sensors that allow the robot to accurately navigate the maze in search of the fire. A 360o laser distance scanner allows the robot to track its location and orientation while scanning the environment for any obstacles that may be present. An array of infrared (IR) sensors continuously monitors light intensity to indicate the presence and direction of the fire relative to the robot. Finally, a servo controlled valve extinguishes the fire using compressed CO2.

The competition poses an additional challenge by scoring teams based upon the ability to return to the starting position once the fire is extinguished. This is made possible through an advanced control algorithm that not only tracks the position, but stores the location as a digital map and allows the robot to achieve localization. Returning to the start location becomes as simple as following the map in reverse.

Demonstration

Brandon Klefman and Jonathan Strang
Department of Aerospace & Mechanical Engineering, College of Engineering

Ryan Claus, Anthony Islas, Christian Moncada, and Sarah Pearson
Department of Computer, Electrical, & Software Engineering, College of Engineering

MENTOR:
Dennis Kodimer
Department of Computer, Electrical, & Software Engineering, College of Engineering

Eagle Space Flight Team – Electronics Team

IGNITE GRANT AWARD

The Eagle Space Flight Team was created with the goal of becoming the first undergraduate team to design, build, and launch a rocket capable of suborbital spaceflight. To accomplish this task, the team is broken down into multiple sub teams, each focused on a specific aspect of research. The Electrical sub-team's concentration is on the development of an avionics package for a suborbital rocket. The requirements of the avionics package include main and drogue parachute deployment, the transmission of telemetry data, sensor data logging and a real time vehicle performance model as part of a ground station. The drogue and main parachute deployment is vital to mission success as errors or miscalculations may cause catastrophic failure of the vehicle. The transmission of telemetry data, specifically GPS location data, is vital to vehicle recovery. Finally, data logging of sensor data will be used to provide sub teams with vehicle performance data as feedback for future designs. Over the next few years, the Electrical team will continue to improve the avionics package and design a ground station that will display a 3D model of the rocket in real time. Additional future goals include live video feed during the flight, custom rocket ignition system and redundant telemetry systems to improve the reliability of the avionics package.

Poster Presentation and Demonstration

Madeline Kuhn
Department of Business, College of Arts & Sciences

MENTORS:
Jacqueline Luedtke
Department of Applied Aviation Sciences, College of Aviation

Juan Merkt and Brent Bowen
Department of Aeronautical Sciences, College of Aviation

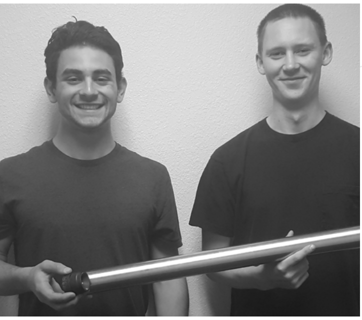
Pedagogical Case Study Research Capstone Course Experiences

The Capstone course, Aviation Research Methods, is the culminating experience for students at Embry-Riddle Aeronautical University (ERAU). This course provides fixed and rotary-wing flight students, among other majors, the opportunity to explore an issue of personal or professional interest and to address that issue through study and applied research under the direction of a faculty member. The Capstone project allows students to demonstrate their ability to apply knowledge and skills acquired in the previous 3 ½ years of coursework to real-world issues and problems through a case research framework.

The College of Aviation implemented case research as the primary capstone experience methodology in the fall of 2014. A potential for significant research outcomes was purported to be a potential outcome of this teaching/learning style and is now evidenced in the results. This capstone technique has been completed with multiple sections of senior students since its introduction. This work in progress summarizes, compares and contrasts the research outcomes over a three-semester period through a qualitative review of the research results. During the search for synergies, several common themes emerged and were reported. Within the case framework, many research tools have been employed including interviews, use of archival data, observation research and more.

Comparative analysis of works to date, along with those in process, provide a foundation for future techniques to enhance the capstone and undergraduate research experience, validate the process and to ensure the results have meaningful application.

Poster Presentation



Cameron Kurtz and Robert Myers
Department of Aerospace & Mechanical Engineering, College of Engineering

MENTOR:
Michael Fabian
Department of Aerospace & Mechanical Engineering, College of Engineering

A Study on Sugar Propellant Grain Geometries

IGNITE GRANT AWARD

Embry-Riddle Aeronautical University is one of the world's top universities for students seeking to develop a career in propulsion. However, in order to properly prepare students for the professional arena, it is imperative for students to gain hands on experience with the design and construction process of propulsion systems. Currently, experimental rocketry research can only be conducted on campus under the Undergraduate Research Program, the Eagle Space Flight Team, and Eagle Aerospace. In the past, many students have successfully created solid rocket motors; however, their research was constrained to a simple circle grain geometry. Embry-Riddle currently lacks the required equipment to effectively shape any other rocket motor grains. Therefore, the primary goal of this project is to design and manufacture a mandrel extractor which can be used to effectively shape solid rocket motor grains. The secondary goal of this project will be to perform an apples-to-apples comparison between two different grain geometries. In order to accomplish the primary goal of the objective, a mandrel extractor was designed. Not only must the mandrel extractor be light enough for easy transportation, but powerful enough to remove the mandrel without twisting. In order to accomplish the secondary goal of this project, a Matlab code was written which simulated the thrust curve of solid rocket motors. This not only allowed the team to theoretically predict motor performance, but ensured that explosive decomposition will not occur. Below are the equations which were used to predict the solid rocket motor's performance. Furthermore, a mandrel has been designed which has a different surface area, yet identical volume to the circle. The mandrel chosen for manufacturing was an equilateral hexagon star.

Poster Presentation

Eagle Space Flight Team – Aerodynamics Team

Carl Leake,
Catherine Ayotte,
Neil Nunan, Alex Lubiarz,
Nicholas Liapis, Jesse Ives,
Cristopher Ricario, Damian Rivas,
and Jacob Underwood
Department of Aerospace & Mechanical Engineering, College of Engineering

MENTOR:
Julio Benavides
Department of Aerospace & Mechanical Engineering, College of Engineering

The Eagle Space Flight Team was created with the goal of becoming the first undergraduate team to design, build, and launch a rocket capable of suborbital spaceflight. To accomplish this task, the team is broken down into multiple sub teams, each focused on a specific aspect of research. Aerodynamics sub-team's concentration is on the flight profile of the rocket. Research goals for the team include finding the center of pressure and the coefficient of drag of the rocket. Trajectory models are being created in MATLAB and being updated to include wind forces and recovery events, such as the deployment of the drogue and main parachutes. Research into thermal profiles is also being accomplished using ANSYS. Aero team has so far designed both a 3" and 4" diameter rocket and over the next three years will have major contributions to the design of the space capable rocket.

Poster Presentation and Demonstration

Julia Levitt, Tyler Gulden, William Carpenter, Raeann VanSickle, Bryce Smoldon, and Christopher Sample
Department of Aerospace & Mechanical Engineering, College of Engineering

Rebecca Tobin
Department of Aerospace & Mechanical Engineering, College of Engineering and Department of Physics, College of Arts & Sciences

Richard Reksoatmodjo
Department of Physics, College of Arts & Sciences

MENTOR:
Dr. Brenda Haven
Department of Aerospace & Mechanical Engineering, College of Engineering

Changes in Performance Parameters of Solid Rocket Motors as They Increase in Size

IGNITE GRANT AWARD

In order to successfully design, build, and launch a solid rocket capable of surpassing the internationally-recognized boundary of space, 100 kilometers, the Propulsion Team will have to manufacture one of the largest amateur rocket motors ever made. To accomplish this goal, the team will design and test a series of scaled motors, including a six-inch diameter motor, an eight-inch diameter motor, and the final spaceflight motor, estimated to be roughly ten inches in diameter. To complete tests of all three motors, the team must design, construct, and test the motor case and its respective components, the nozzle, and the actual motor itself. In the case of the spaceflight vehicle, the motor will be roughly 300 pounds of ammonium perchlorate composite propellant that will power the rocket to speeds over Mach 5 in under fifteen seconds. The team hopes that with successful motor testing and acquisition of data, trends in the behavior and performance of solid rocket motors as they increase in size can be identified. It is known that the relationship between motor size and performance parameters (total impulse, thrust, and burn rate) is not linear. For this reason, the team expects to encounter and overcome the challenges of designing motors that are scaled in size. In the future, this data can be used to simplify the process of designing a rocket motor that can generally fluctuate in size and diameter without a significant loss in performance.

Poster Presentation

Phoenix Aerospace Launch Systems: Project Legacy – High Powered Rocket

IGNITE GRANT AWARD

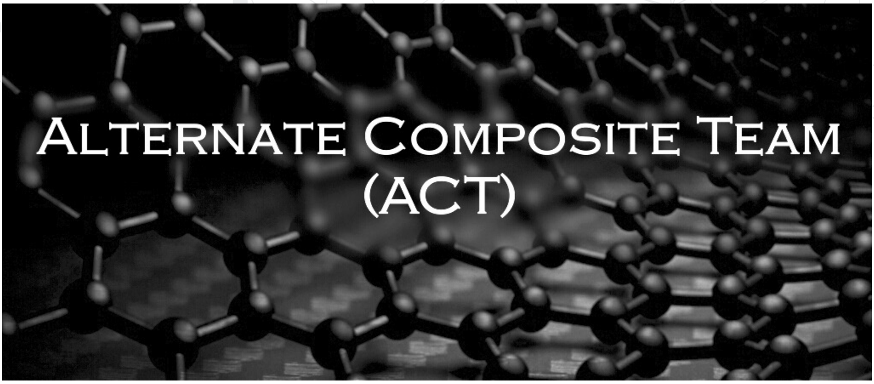
This project's objective is to provide an alternative launch system that could potentially replace the high-altitude balloon launch system (typically carrying scientific payloads) used in the Experimental Space Systems class at Embry-Riddle Aeronautical University, Prescott, Arizona. Senior capstone design group, Phoenix Aerospace Launch Systems (PALS), will provide a high-powered rocket as the alternative launch system called Legacy. PALS has conducted research on similar projects and weighed the risks and benefits that involve a high-powered rocket. Initial research was conducted in the fall 2015 semester, calculations and analysis was done to finalize a design for Legacy. Legacy is in currently under the fabrication process and will be completed by March 16th, 2016. Once Legacy has completely fabricated, tests will be conducted in order to validate that all subsystems and system will satisfy mission requirements.

Poster Presentation

Michelle Machado, Andrew Delarosa, Sage Bauer, Kyle Hosler, Joskua Carrillo, Laila Shams, Wesley Goldner-Carver, Neil Nunan, Austin Leonard, Johnathan Winters, Clark Anderson, Myles Howard, Jaron Wong, Cris Ricario, and Isaac Perry
Department of Aerospace & Mechanical Engineering, College of Engineering

David Gomez Herrera and Akash Joseph
Department of Aerospace & Mechanical Engineering, College of Engineering and Department of Physics, College of Arts & Sciences

MENTOR:
Julio Benavides
Department of Aerospace & Mechanical Engineering, College of Engineering



Trupti Mahendrakar, Alexandria Brown, and Yoohyun Song
Department of Aerospace & Mechanical Engineering, College of Engineering

Trishen Patel
Engineering Major, El-Camino College

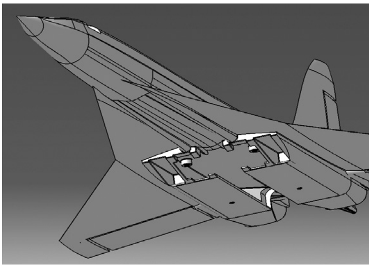
MENTOR:
Wahyu Lestari
Department of Aerospace & Mechanical Engineering, College of Engineering

Alternate Composite Team: Feasibility study of Graphene for structural component applications

IGNITE GRANT AWARD

Graphene oxide (GO) is a newly discovered material with a variety of industrial applications from composites to paint. Due to its high young's modulus (2.0±0.5 TPa) and tensile strength it can serve as a replacement for several mainstream materials such as carbon fiber, fiberglass, and epoxy resin. In this study, the effects of GO in the resin will be compared to the standard epoxy, vinyl, acrylic, and alkyd polymers. In order to accomplish this, we will first make a graphene based paint by preparing the binding component known as the vehicle for the paint and adding graphene powder, allowing the compounds to bond, to increase strength. Secondly, we will make fiber glass composites using the previously developed GO infused resin. Lastly, we will reinforce graphene nanosheets in aluminum matrix composites using flake powder metallurgy. The overall goal is to conduct material tests to confirm that GO can enhance the properties of standard materials and composites. These properties will then be compared to industry standard materials to show the benefit of these GO composites and resins.

Poster Presentation



Modeling Project for Digital Circuits Applications

Nicholas Mallott
Department of Aerospace and Mechanical Engineering, College of Engineering

MentorS:
Dr. Iacopo Gentilini
Department of Aerospace and Mechanical Engineering, College of Engineering

Dr. Akhan Almagambetov
Department of Computer, Electrical and Software Engineering, College of Engineering

The Tupolev TU-144, the world's first supersonic transport aircraft (SST), stands at 12.55 meters (41 feet) tall, has a length from nose to tail of 65.70 meters (215.54 feet), and a wingspan of 28.80 meters (94.48 feet).

This aircraft was selected by Dr. Almagambetov for use in Dr. Almagambetov's CEC-222L (Digital Circuits) lab course. This aircraft would have to be modelled and printed in order to facilitate a Field Programmable Gate Array (FPGA) board that would be able to control four servos connected to control surfaces throughout the aircraft. This would allow CEC-222 students to use VHSIC [Very High-Speed Integrated Circuit] Hardware Design Language (VHDL) as an additional application of the course material in a "real world" application.

The objective Nicholas Mallott had to undertake was to design a scale model of the Tupolev TU-144 within the program CATIA (computer aided three-dimensional interactive application) with the final model being approximately three feet in length, capable of supporting four servos and the FPGA board, and allowing space for movement of the canards, flaps and tail of the aircraft via the servos to be installed.

The outcome of this project is to have a fleet of four working models for use by the College of Engineering in CEC-222 courses for the coming years, which will be implemented by three-dimensionally printing the CATIA model Mr. Mallott has designed with the assistance and supervision of Dr. Gentilini. The final product should be a relatively accurate and precise 1/71 scale model of the actual, functioning aircraft with adjustments made to accommodate the servos and FPGA board used on the scaled model.

Poster Presentation

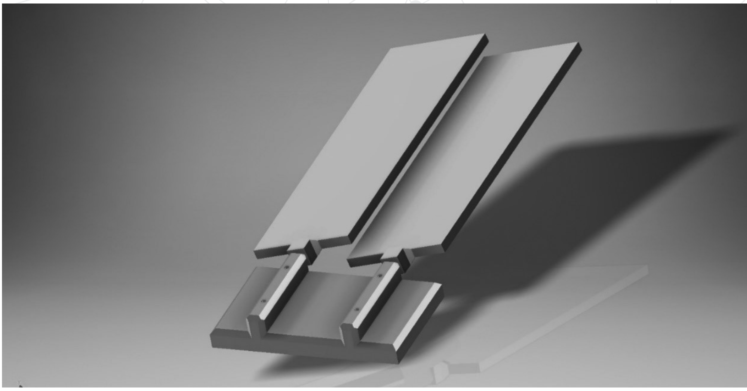
Cameron McCauley and Cat McClure
Global Security and Intelligence and Eagle Eye Intelligence, College of Security and Intelligence

MENTOR:
Tyrone Groh
Global Security and Intelligence, College of Security & Intelligence

Analysis of Response Procedures to CBRN Attacks in US

The goal of our research is to gather data on both emerging and established chemical, biological, radiological, and nuclear (CBRN) threats in the US homeland, with a primary emphasis on non-state actors. The end goal is to provide a risk assessment as well as a strengths, weaknesses, opportunities, and threats (SWOT) analysis of the attacks that pose the greatest threat. This will be done by using open source research and analysis techniques as well as applying relevant coursework in terrorism and security, particularly threat and risk assessment techniques. The research will likely examine the difference between the threats the US faces from traditional actors compared to the new threat posed by homegrown terror and criminal groups. Due to the nature of the topic, there will also likely be a cursory examination of current foreign and domestic US policy, as it pertains to security concerns. The research has a short deadline, but I foresee the potential for it to be continued in an expanded format in the fall of 2016.

Poster Presentation
Invited Oral Presentation



Aerodynamic Effects of a Two Parallel Forward Swept Flat Plates

Mark David Miller Jr.
Department of Aerospace & Mechanical Engineering, College of Engineering

MENTOR:
Jeffrey C. Ashworth
Department of Aerospace & Mechanical Engineering, College of Engineering

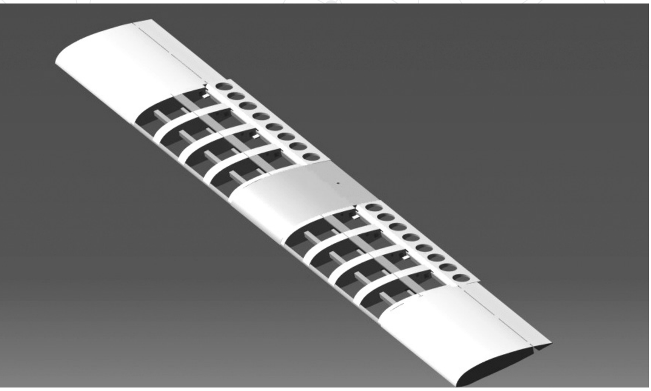
IGNITE GRANT AWARD

The purpose of this study is to analyze the orientation of two parallel forward swept flat plates or "wing" segments and the aerodynamic effects based on their orientation. This orientation is necessary for a possible wing design that is capable of rotating and retracting into the fuselage of an aircraft. A wing with this capability would be very useful on a Reusable Launch Vehicle (RLV) where the wing could be retracted into the fuselage to greatly reduce the drag while an external rocket engine is ignited to boost the aircraft into Low Earth Orbit (LEO).

The model will consist of two plates of equal geometry that are parallel to one another. The aerodynamic effects of two parallel plates will be examined where the downwash from the first plate is swept underneath the second plate.

The data collected will include the pitching moments of the wings at a 15° tilt, as well as the lift coefficient and drag coefficient associated with this orientation. The data will reveal whether or not the design is applicable based on the stability of the orientation of the wings during flight. If the current design is not applicable on a RLV, possible other uses include a fighter jet as deployment/retraction would occur while the aircraft is stationary and would only be used for storage of said aircraft.

Poster Presentation



Bryce Milnes and Andres Sandoval
Department of Aerospace & Mechanical Engineering, College of Engineering

MENTOR:* *David B. Lanning, Jr.
Department of Aerospace & Mechanical Engineering, College of Engineering

Application of Shape Memory Alloys to Unmanned Aerial Vehicles

IGNITE GRANT AWARD

The feasibility and effectiveness of implementing "smart" materials on UAVs has been investigated by the authors over the course of the 2015-2016 academic year. This study has consisted of characterizing the fatigue behavior of nitinol shape memory alloy components and the design and construction of experimental adaptive aircraft systems. A 30"x40" poster and demonstrations of test hardware will be presented at Discovery Day demonstrating the accomplishments of this student-run project. The success of this project was enabled by IGNITE funding received to support our efforts throughout the year. To date, this project has led to significant improvements to the research capabilities of the university and future work will include testing a working flight test article.

Poster Presentation

Observational Study of Convective Events Delaying Flight Operations at the Atlanta Hartsfield International Airport

Celeste H. Moreno
Department of Applied Aviation Sciences, College of Aviation

MENTORS:
Curtis N. James
Department of Applied Aviation Sciences, College of Aviation

This observational study investigates convective storms causing flight delays at Atlanta Hartsfield International Airport (KATL) for three consecutive years (2012, 2013, and 2014). Convective events causing at least 100 delays were included in the analysis and classified as either organized squall lines, multicellular storms, or scattered airmass thunderstorm events. These events were further categorized by the direction of storm propagation. The squall lines generally propagated either southward or eastward, whereas the scattered airmass thunderstorms propagated northward, southward, or most commonly, eastward.

For each type of convective event, superposed epoch analyses (or composites) of mean synoptic weather patterns and thermodynamic profiles were created using NCEP gridded synoptic reanalysis and sounding data. The synoptic weather patterns and thermodynamic properties of each type of event analyzed. The results indicate that low-level moisture transport, low-level vertical wind shear, and atmospheric instability are the environmental characteristics common to these convective events affecting aviation operations in Atlanta.

Poster Presentation

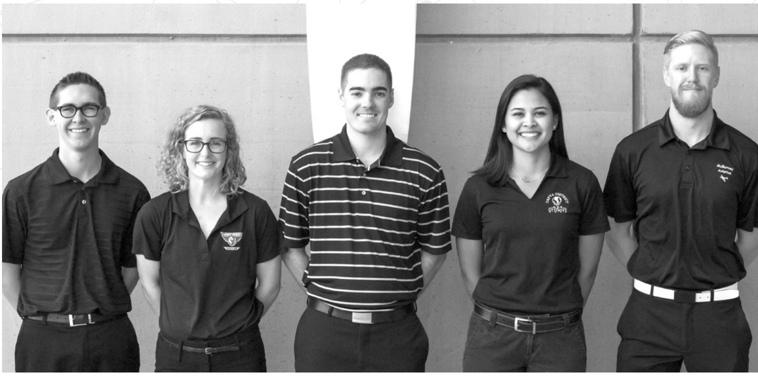
Abanob Mourkus
Department of Aeronautical Science, College of Aviation and Department of Aerospace & Mechanical Engineering, College of Engineering

Mentor:
Jacqueline R. Luedtke
Department of Applied Aviation Sciences, College of Aviation

NextGen Anti-Ice

Most manufacturers in the aviation industry are focusing on anti/de-icing techniques to reduce the risk of inflight-icing. While current anti/de-icing systems get the job done, they are inefficient as they use a lot of energy that could otherwise be used for the betterment of engine efficiency. This was concluded from analyzing other experimental research journals and from personal interviews. It is also worth mentioning that anti/de-icing systems put extra weight on the aircraft due to the parts and pipes that have to be placed around the aircraft. This research paper focuses on an alternate strategy of anti/de-icing that works by not having ice form on aircraft structures in the first place. This is accomplished by using hydrophobic/ superhydrophobic materials technology. This new technique of anti/de-icing has the potential to save a lot of time delays, money, weight, and energy, which could be used to increase the efficiency and safety of aircrafts because aircraft manufacturers are constantly looking for ways to reduce cost without sacrificing safety.

Poster Presentation
Invited Oral Presentation



A.G.E. - Amplified Golf Experience

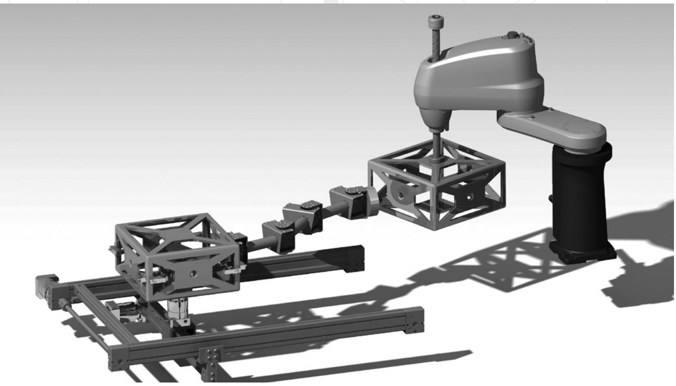
Anthony Munson, Lauren Kruszewski, Kelsey Merrigan, Barry MacNeill, and Justin McBurney
Department of Aerospace & Mechanical Engineering, College of Engineering

MENTORS:
Mark Sensmeier, Lance Traub, and Shigeo Hayashibara
Department of Aerospace & Mechanical Engineering, College of Engineering

Matt Haslam
Humanities and Communication Department, College of Arts & Sciences

Our preliminary/detail design team has partnered with PING Golf in order to develop a driver clubhead to optimize performance for senior players. Many senior golfers experience a decrease in accuracy, physical comfort, and clubhead speed while using current club designs. In order to address these issues, design parameters of a driver will be investigated, which will provide insight for clubhead modifications. The first area of improvement is minimizing the dispersion of the ball off the tee. By manipulating certain aspects of the clubface geometry, improvements to accuracy can be made. In addition to accuracy, a decrease in clubhead speed also becomes a detriment for this demographic due to physiological issues. Aerodynamic simulations and testing provide knowledge on the plausibility of increasing clubhead speed and drive distance with a new design. Another design feature to be incorporated is the use of ribs and materials to create a moderate sound at impact. The sound at impact must appeal to players, thus study into acoustics and the effects of these club attributes will be investigated. Repeated vibrational effects from current driver designs can also induce physical discomfort.
To address this, research into club weight, vibrational cushion inserts, and other possible installments will be investigated. Upon completion of the capstone courses, a design of a driver clubhead will be available to PING Golf for prototyping.

Poster Presentation



Narendran Muraleedharan and Ricardo Fernandez
Department of Aerospace & Mechanical Engineering, College of Engineering

MENTORS:
Iacopo Gentilini and Douglas Isenberg
Department of Aerospace & Mechanical Engineering, College of Engineering

Micro Gravity Simulator

IGNITE GRANT AWARD

The main objective of this project is to build a robotic platform to recreate microgravity environment on Earth. Different methods have already been implemented for this purpose but they present some limitations. For example, zero gravity flight is a very expensive procedure that has a very short duration per test. On the other hand, the robotic platform proposed on this project will allow for extensive testing at low operational cost. The first step of the proposed research is to developed a two dimensional platform with two linear axis and one rotational axis. A force sensor will be mounted on the third axis to maintain zero force at the interface between the robotic platform and the space robot recreating free floating conditions. Afterwards, a second robotics platform will be developed to test satellite tracking and docking operations. This system will allow for testing projects developed by other teams where a micro gravity environment simulation is required.

Poster Presentation

American Institute of Aeronautics and Astronautics Cessna/ Raytheon Design-Build-Fly Competition Team

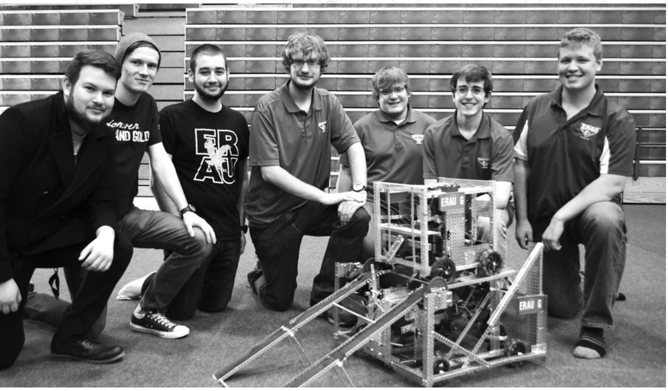
EAGLE PRIZE AWARD

The mission of the ERAU AIAA D-B-F team for the 2015-2016 academic year is to apply engineering and problem-solving skills to design and fabricate an aircraft with outstanding flight performance qualities that surpass all mission requirements effectively, efficiently, and consistently. Members will gain experience pertinent to their respected fields by working in teams, voicing their ideas, and competing against collegiate engineering teams from around the globe. The design phase of the project will begin immediately at the release of the mission requirements, followed by the construction of the first prototypes by the end of the fall semester, and completion of competition-capable aircraft by March 2016.

Poster Presentation and Demonstration

Andres Sandoval
Department of Aerospace & Mechanical Engineering, College of Engineering

MENTORS:
Jacob Zwick and David Lanning
Department of Aerospace & Mechanical Engineering, College of Engineering



Adam Scott, Michael Buck, Kristin Sandager, Jesse Ives, Jonathan Buchholz, Magnus Bergman, Ferrin Katz, Lucas Widner, Rachel Rise, Ryan Stewart, Kyle Lutterman, Annika Howell, Braxton Kendall, and Jared Delinger
Department of Aerospace & Mechanical Engineering, College of Engineering

Geoffrey Winship
Department of Business, College of Arts & Sciences

Gregory Klatchko and Ben Mohorc
Cyber Intelligence and Security, College of Security & Intelligence

MENTORS:
Joel Schipper
Electrical & Computer Engineering, College of EngineeringDepartment of Computer, Electrical, & Software Engineering, College of Engineering

2015-2016 VEX Robotics Team

EAGLE PRIZE AWARD

The VEX Robotics Team is a competition-based group on the Embry-Riddle Aeronautical University, Prescott Campus. The team designs and constructs robots using standard VEX parts, and competes in university-level VEX Robotics competitions. This year, the organization had two teams: Blue Team and Gold Team. Each team builds two robots and represents Embry-Riddle Aeronautical University at competitions. The VEX game for the 2015-2016 season is named “Nothing But Net.” In the game, each robot alliance scores as many 4-inch foam balls as possible into its respective net, which lies at the opposite corner of the 12’ by 12’ field. Then, during the last 30 seconds of the 2-minute match, one robot from each alliance elevates its partner robot off the ground either 4 inches for a low elevation, or 12 inches for a high elevation. The teams began the year with brainstorming ideas for robot designs, conducting research, and constructing prototypes. Then, the teams constructed their final designs, programmed their robots using the RobotC programming language, and conducted final testing in preparation for competition.

The VEX Robotics Team successfully hosted its first VEX-U competition at Embry-Riddle Aeronautical University, Prescott Campus in November of 2015, and is planning on hosting future competitions. Additionally, the team competed at the Southwest VEX-U Tournament on March 5th, 2016 at Arizona State University in Tempe, AZ.

Poster Presentation

ESFT Structures Team: How to Get to Space in One Piece

Nicole Shriver, Clark Anderson, Benjamin Bahr, Loren Bahr, Jayanth Bangalore, Alexander Collins, Alexander Denslow, Daniel Dyck, Nina Rogerson, Claire Schindler, Adam Scott, Ryan Tanner, and Oleksandr Vladyka
Department of Aerospace & Mechanical Engineering, College of Engineering

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MENTOR (ESFT):
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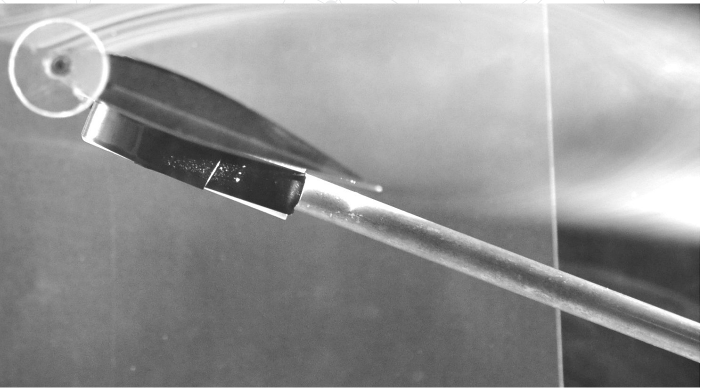
The Structures Team is the sub-section of the Eagle Space Flight Team (ESFT) that primarily concentrates on the physical attributes of the rocket that will be sent to space. This includes the design, analysis, construction, and testing of the rockets that will be built in the process of getting a rocket to space. The Structures Team works closely with the Aerodynamics Team to verify that the numbers they give will contribute to an easy-to-construct design and will hold up under the loads that will be applied to the rocket. Additionally, they work with the Propulsion Team to design a rocket that will be able to handle the forces that the motor will inflict upon the rocket's frame. The team also coordinates with the Electronics Team to ensure that the electronics are protected that there is enough space to house them. With all of the information from the other teams, the Structures Team makes decisions regarding the materials, size, and construction techniques needed to create the rocket. Another important task of the team is to test the rocket subsystems to ensure that they work in real-life situations. Recently, Structures Team has been working on testing the parachute deployment system under several different conditions in preparation for the launch of the 4-inch diameter rocket later this semester.

Poster Presentation



Jeromy Smith
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MENTOR:
Lance Traub
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Effects of a Leading Edge Wire on Stall Control

EAGLE PRIZE AWARD

Along with lift and drag, one of the most important characteristics of an airfoil or wing is how it stalls. The angle of attack at stall and how violent the stall is can drastically effect the usefulness or ability of a wing or airfoil to perform certain tasks. There are several methods currently used on aircraft to adjust the stall characteristics of a wing, these modify the shape of the wing through deflecting leading and or trailing edge surfaces in the form of flaps and slats. Flaps and Slats have proven to be very effective on large (manned) aircraft. However, as aviation vehicles continue to get smaller and smaller, in the form of Unmanned Aerial Vehicles (UAV's), these moving surfaces contribute a substantial weight penalty due to the complexity of their mechanism's, and the devices needed to move them. The idea behind spanning a thin wire in front of the leading edge of the wing is that the vortex street it causes will inevitably strike the leading edge of the wing and potentially promote boundary layer transition from laminar to turbulent flow, thus making it harder for the wing to stall. Wind tunnel testing has shown that the presence of the wire has a profound impact on both the angle of attack at which the wing stalls, and effects how violent, or docile the stall is.

Poster Presentation

Society of Women Engineers Team Ocelot: NASA Human Exploration Rover Challenge

EAGLE PRIZE AWARD

The purpose of this project is to give students an opportunity to gain valuable hands-on engineering experience. The students participating in this project are designing and building a human-powered vehicle, similar to those in the NASA Human Exploration Rover Challenge, to be used as an outreach tool by the university and the Society of Women Engineers. The vehicle will be used at outreach events to allow people to experience an interactive example of the work that students do at Embry-Riddle, it will also garner interest in STEM careers from school aged children by giving them a hands on experience. The skills gained during this difficult engineering project will be applicable to other engineering courses, especially senior capstone projects. Students working on the project gain experience in design, fabrication, leadership, and teamwork. This project gives student the unique experience of working on a full-scale engineering project as early as their freshman year.

Poster Presentation and Demonstration

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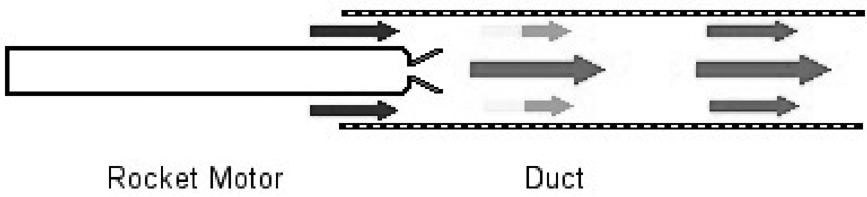
Contra-Rotating Propulsion System for Human-Powered Aircraft

IGNITE GRANT AWARD

The Human-Powered Aircraft Project is focused on the design and development of technologies to be used in the next generation of human powered aircraft. Human-powered aircraft are a specific and unique type of aircraft powered by only the physical input its pilot (or pilots) can provide. These aircraft require the use of the most current composite technologies combined with creative engineering solutions to create a strong, efficient, and extremely lightweight design. These engineering solutions involve making an aircraft with a wingspan of a commercial airliner (~120 ft.) that weighs less than 80 pounds and achieves flight using only the 0.35 horsepower that its human pilot can provide.

The current focus of the Human-Powered Aircraft Project is to explore the effectiveness of contra-rotating propellers for improving the efficiency and flight qualities of human powered aircraft. It is expected that the new propeller design will increase efficiency of the propulsion system and aircraft stability while reducing overall aircraft size. The team has already created a prototype of the contra-rotating gearbox and is in the process of fabricating the propellers and test stand. The prototype has served as a proof of concept proving the idea that a simple light and efficient contra-rotating gearbox can be developed. By May 2016, full-scale tests will be used to compare the efficiency of the contra-rotating system to the conventional single-propeller design.

Poster Presentation and Demonstration



Thrust Comparison of an Ethanol-LOX Rocket Engine and an Air Augmented Ethanol-LOX Rocket Engine through CFD Simulations

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MENTOR:
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An air augmented rocket engine mixes the exhaust flow from the base rocket engine with air flow in an outer duct or nozzle in order to increase the thrust produced by the base rocket engine. The objective of this project is to determine the difference in thrust produced by a rocket engine without air augmentation and a rocket engine with air augmentation through computational fluid dynamics (CFD) simulations. The rocket engine that is simulated is an ethanol and liquid oxygen (LOX) rocket engine that was designed to produce 100 lbf to 200 lbf of thrust without air augmentation. The air augmented rocket engine that is simulated is the same ethanol and liquid oxygen rocket engine but outfitted with a cylindrical outer duct around the rocket engine nozzle to allow air flow to mix with the exhaust flow of the rocket engine. The rocket engine without air augmentation and the rocket engine with air augmentation are simulated in two quasi-2D CFD simulations. The two CFD simulations are compared to determine the difference in thrust produced by the two rocket engines.

Poster Presentation

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