EMBRY-RIDDLE AERONAUTICAL UNIVERSITY

AERONEWS

Department of Aerospace Engineering at Embry-Riddle Aeronautical University – Daytona Beach

DECEMBER 2016

Students at the Boeing Flight Competition

Message From the Chair

Dr. Tasos Lyrintzis

It has been a very exiting year! The Aerospace Engineering Department continues to be the largest in the country with enrollments of 1348 B.S., 109 M.S. and 29 Ph.D. students as of fall 2016. It is also the largest on the Daytona Beach Campus in both graduate and undergraduate enrollments. About 12% of our undergraduates are honors students, twice the Embry-Riddle average: in addition, we continue to have numerous design/build/test projects at both the undergraduate and graduate levels.

Our undergraduate program has been ranked No. 1 by the *US News and World Report* for the past 16 years as long as Embry-Riddle at Daytona Beach was classified among the non-Ph.D.-granting institutions. In 2016, for the first time, US News & World Report moved Embry-Riddle to the Ph.D.-granting category, which includes the most elite universities in the nation. In this new category, our undergraduate program was ranked No. 16 (tied with Penn State and 1st in the State of Florida) - one of 17 aerospace engineering programs among 65 nationwide that were viewed by peers as strong enough to be ranked. Our graduate program was ranked No. 36 (tied with Rutgers and Syracuse and 2nd in the State of Florida). This is a significant accomplishment for a first time appearance.

Embry-Riddle was also highly ranked in the 2016 *Aviation Week* "Aerospace and Defense Workforce," study. Embry-Riddle was ranked second in the category of "A&D Companies Preferred Suppliers of Talent," third in the category of "Universities that Young Professionals Indicate Most Influence Careers," Embry-Riddle, Georgia Tech, Purdue and Cal Poly, were the only schools mentioned in both categories, with only 5-6 Schools being mentioned in each category.

Our research expenditures increased by approximately 30% for the last fiscal year. Some notable current and recently awarded funded projects (including two Air Force Yound Investigator awards) are: "Virtual Flight Demonstration of Stratospheric Dual-Aircraft Platform" (NASA, $600K, PIs: Engblom, Moncayo, Barott); "Exploiting Non-linear Interactions within Wall Turbulence for Flow Control" (AFOSR Young Investigator Program, $360K, PI: Gnanamanickam); "An Ultra Miniaturized Star Tracker" (NASA, 210K, PI: Henderson); "Fidelity Requirements for Ship Airwake Modeling in Dynamic Interface Simulations" (U.S. Army/NASA/ONR/Penn State Vertical Lift Research Center of Excellence, $450K, PIs: Leishman, Gnanamanickam); "Free-Flying Unmanned Robotic Spacecraft for Asteroid Resource Prospecting and Characterization" (NASA, $385K, PIs: Moncayo, Prazenica); "Low-Cost Miniaturized Control System for Autonomous Flight" (DARPA, $459K, PIs: Prazenica, Moncayo, Henderson); and "Investigation of Load Path Based Topology Optimization" (AFOSR Young Investigator Program, $360K, PI: Tamijani).

Currently, researchers at the Eagle Flight Research Center (EFRC) are working on hybrid and full electric airplanes and have started the Embry-Riddle Hybrid Consortium to focus on hybrid electric airplanes. The consortium now includes Airbus, Textron, Rolls-Royce, P&W, Hartzell and GE. This consortium's vision is to explore the design space for turbine/electric aircraft propulsion systems. In addition, Embry-Riddle is now a Charter Member and the only University in GAMA (General Aviation Manufacturers Association) under the new EPIC (Electric Propulsion Innovation & Competitiveness) program for electric and hybrid propulsion innovation.

Finally, the Department has been involved in the planning for the new MicaPlex including a state-of-the-art wind tunnel with construction scheduled for completion in fall 2017.

Best Regards,

A Lyrintzis

Dr. Tasos Lyrintzis
Distinguished Professor, Department Chair

AEROSPACE NEWSLETTER

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New Facilities

New Engineering Building - Wind Tunnel

Embry-Riddle Aeronautical University has started the construction of a new engineering building (Advanced Aerodynamics Laboratory) and a state-of-the-art subsonic wind tunnel.

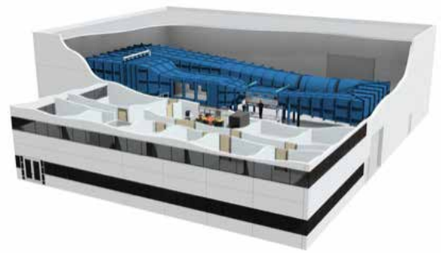
The 50,000-square-foot, $26 million building features 10,000 square feet of flex lease space to meet the needs of future tenants including the following laboratories:

- Thermal
- Anechoic Chamber
- Circuits, Sensors and Instrumentation
- Radar and Communications
- Robotics and Autonomous Systems
- Advanced Dynamics and Control
- Materials
- Microscopy
- Nanofabrication
- Composites
- Structures
- Computational Science
- Space Technology

This will be the first building of Embry-Riddle's 90-acre research park, which will include offices, laboratories, and hangar space with direct taxiway access to Daytona Beach International Airport.

Tenants of the Research Park, including established industry leaders and burgeoning enterprises, will have access to the facilities provided within Embry-Riddle's continually expanding areas of research.

Artist rendering of the Wind Tunnel



A new state-of-the-art subsonic wind tunnel will be located in an adjacent building. Aero Systems Engineering (ASE) is the primary contractor for the new wind tunnel. This tunnel will be focused on supporting the education and research needs of the Department as well as commercial applications. The tunnel will have a 4 ft x 6 ft x 12 ft test section, optimized for the use of advanced optical flow measurement techniques such as particle image velocimetry. The 12-ft long test section can be replaced with a 20-ft section when required. The tunnel will also have a secondary 10 ft x 14 ft upstream test section. The primary test section will have a flow speed capability up to 230 mph with exceptional flow quality. A six-component balance is used for force and moment measurements, complemented by a comprehensive multi-channel pressure measuring system.

The building is scheduled for completion in March 2017 and the wind tunnel building in fall 2017.

See recent updates at: news.erau.edu/park

Artist renderings of the new Engineering Building

Research News

Eagle Flight Research Center, Directed by Professor Pat Anderson

Green Aviation

eSpirit of St. Louis

The progress on the development and flight of a fully electric manned aircraft continues at the Eagle Flight Research Center. This demonstrator is part of the hybrid-electric research being conducted across several platforms ranging from this small fully electric aircraft, through hybrid turboprops and hybrid 737 sized aircraft. The target is to have this aircraft flying in spring 2017. This would be on time to celebrate the 90th anniversary of Charles Lindbergh's non-stop crossing of the Atlantic. In honor of Lindbergh's legacy of seeking balance between aviation and the environment, we have named our fully electric, green airplane the *eSpirit of St. Louis*.

This project has been crowd-sourced to date. It is likely that the final push for funding the flight will come from the U.S. National Park Service. Embry-Riddle has recently been accepted into their Center of Excellence. This opens the door for funding to demonstrate quiet flight over noise critical national parks. Providing both access to parks and a noise free environment has been a challenge, as several parks use tour aircraft for the majority of access.

While we have demonstrated that hybrid aircraft will be the architecture for larger aircraft, our eSpirit is playing an important role in the development of hybrid-electric propulsion systems. This aircraft has allowed our student researchers to develop common core elements to hybrid-electric airplanes. We have taken the challenging path of not using off-the-shelf software for the aircraft; students have been working on the control software for the electric motor and the battery management. With the help of our new Ph.D. researcher, Steven Daniel, we have successfully developed these algorithms on the bench. We are now scaling these to aircraft level systems.

As of October, the electric motor and electric variable pitch propeller are mounted on the aircraft. The motor has been cleared to operate up to 50% power and should reach 100% power, as the cooling systems are checked, by the end of October. The combination of a motor and propeller that can both vary RPM and torque is a unique combination. This allows for interesting research in the noise mitigation and propulsive efficiency optimization.

The remaining tasks leading up to first flight include the installation of the battery packs, battery cooling and system testing. We are in the home stretch and are hopeful of a first flight in the next six months.

Hybrid-Electric Research

The Hybrid-Electric Research (HER) Consortium has been established. At present, the Consortium includes Airbus, Textron (Cessna, Bell, Beechcraft, Lycoming), GE Aviation, Rolls-Royce, Pratt & Whitney and Hartzell. The Energy System division of Argonne National Labs is a special partner to the Consortium and brings expertise in automotive battery and hybrid vehicle research. The initial seed funding for the group has come from the companies themselves. Additional resources are being sought, with the aid of Senator Nelson's office, to use Air Force Research Laboratory (AFRL) funding through Argonne National Laboratory to support advanced research.

This year's research has focused on the development of physics-based tools that allow the design space to be searched for optimal hybrid propulsion solutions in the conceptual phase. These tools have shown that this is a difficult problem given the current state of battery weight, but there are combinations that result in lower emissions, lower direct operating costs and less noise using hybrid systems. While some organizations have focused on hybrid-electric systems

that rely on significant boundary layer control and distributed motors, this organization is focusing on classical aerodynamics and new propulsion. The ultimate goal of this Consortium is to determine the readiness level for a commercially viable hybrid-electric turboprop aircraft.

The Consortium research has been well received by the partner organization and external observers. More companies are seeking alignment with Embry-Riddle on research in alternative propulsion. There is now a push to move into the single-aisle jet design space with these innovative configurations. Additionally, this area of research has been officially adopted by the University as a signature area of research. With that, the University has pitched the development of green aviation propulsion to the MacArthur Grant, about $100k. This is for a demonstrable and scalable technology that will improve the quality of life on Earth. As the aerospace industry grows, its emissions and noise have become at odds with the environment and the people they serve. Green aviation is a solution that allows for the healthy growth of the aerospace industry, while, at the same time, minimizing its footprint on the environment. The winner will receive a $100-million-dollar grant.

Innovation Report: Accelerating Hybrid-Electric Propulsion

In 2009, a team led by Dr. Pat Anderson began developing a gas-electric hybrid aircraft in the Eagle Flight Research Center. Two years later, the EcoEagle competed in NASA's Green flight Challenge and featured a unique parallel-hybrid propulsion system.

It allows the propeller to be powered by the internal combustion engine during takeoff when the most power is required and then switch to electric power at cruising altitude when power demand is lower. The innovative EcoEagle's design prompted Embry-Riddle to file patent applications on both the hybrid aircraft parallel propulsion system and the novel clutching mechanism that was designed to shift between the two power sources. U.S. patents were issued to both in FY16 and have attracted the attention of aircraft manufacturers. To further strengthen the value of its hybrid aircraft intellectual property portfolio, in September 2015, the university filed its first foreign patent applications in the European Union, Canada, and Brazil.

Since the 2009 Green flight Challenge, Dr. Anderson's team has launched new research to redesign and improve the EcoEagle. For example, they are currently testing with the same batteries used by Tesla and are working to replace the standard air- and liquid-cooling systems with one that employs a cold plate with phase change material.

The greatest limitation to using battery-powered aircraft is weight. Dr. Anderson explained, "If the lithium-ion batteries that are used in cars today were converted for aircraft, the weight comparison for a Boeing 787 Dreamliner would be 223,000 pounds of jet fuel vs. 4.5 million pounds of battery. "Unless there is a cosmic change in the battery, it's just not going to work for bigger, faster airplanes," he said. "It's going to be a really long time before batteries weigh less than liquid fuel."

In collaboration with Argonne National Laboratory, a consortium of aircraft manufacturing industry leaders is being assembled to provide expertise and research funding for Embry-Riddle with a goal to design and test a hybrid turboprop aircraft. Anderson predicts that this project could be completed by 2019.

**This story was originally published in the InventER Annual Innovation Report 2016.*

Dual-Aircraft Platform, Directed by Professor Bill Engblom

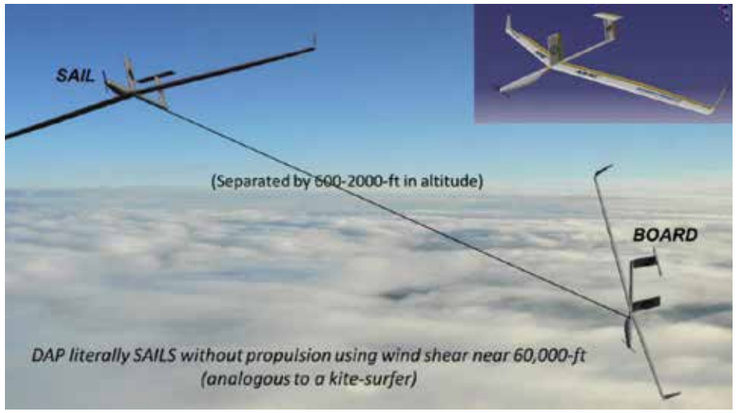
During the 2016-18 academic years, NASA Innovative Advanced Concepts (NIAC) is providing a $500k Phase 2 grant (in addition to the previous $100k Phase 1 grant) to develop a prototype and perform flight demonstrations of a patented atmospheric satellite concept that uses a sailing technique to fly without propulsion using modest levels of wind shear (i.e., changes in horizontal wind velocity with altitude). The research team includes two Embry-Riddle faculty (Drs. Engblom and Moncayo) and three COE graduate student leads (T. Stone, C. Jain and J. Willems) plus three part-time students, a well-known aircraft designer formerly of Lockheed Skunkworks (Mr. Joe Wurts), an atmospheric environments specialist from NASA MSFC (Mr. Ryan Decker), flight test expert Mike Galluzi from NASA KSC Swampworks, and KSC Chief UAV Flight Test Pilot, John Graves.

ERAU DAP Team Leads (from left to right: Dr. Bill Engblom, Chirag Jain (Lead: Controls), Tom Stone (Lead: Mechanical), Dr. Hever Moncayo, Jon Willems (Lead: Aerodynamics)

DAP consists of two autonomous solar aircraft connected via a ultra-thin cable that literally sails without propulsion, using levels of wind shear commonly found in the lower Stratosphere (e.g., near 60,000 ft.). The two aircraft are positioned at different altitudes, as far as 2,000 ft. apart, such that they encounter substantially different wind velocities. The device operates in a manner similar in principle to a kite-surfer in which the upper aircraft, referred to as the SAIL provides lift for both aircraft and aerodynamic thrust, while the lower aircraft, known as the BOARD, provides an upwind force to prevent the platform from drifting downwind.

The primary objective of the first year of effort is to demonstrate the sailing mode of flight using a small scale prototype (13-foot wingspan) and the wind shear occasionally produced by onshore winds at the shuttle landing facility (SLF) at Kennedy Space Center (KSC). The DAP will sail back and forth under 500 feet in altitude along the shuttle runway using the novel sailing technique.

Weather Tower 313 (located upwind from the SLF) will provide real-time wind profiles. Flight operations during the first year will utilize two pilots, augmented by auto-pilot functions, to develop the expertise and procedures required to attain and sustain the sailing mode of flight. Standalone software will also be completed that will provide pilots with all necessary flight condition targets. The second year will focus on introducing a higher degree of autonomous control.



Artist rendering of the DAP (in lower Stratosphere)

ERAU small-scale prototype (left); KSC's Shuttle Landing Facility and Weather Tower 313 (right)

Hardware-in-the-loop (HIL) approach applied to support pilot training and autopilot development in the Flight Dynamics and Controls Laboratory

Two faculty receive awards from the Air Force Young Investigator Program (YIP)

The Air Force Young Investigator Research Program supports scientists and engineers who have received a Ph.D. or equivalent degrees in the last five years and show exceptional ability and promise for conducting basic research. The idea is to foster creative basic research in science and engineering, enhance early career development and increase opportunities for the research scientist to recognize the Air Force mission and related challenges in science and engineering. Two Aerospace Engineering faculty were the first from Embry-Riddle to receive Air Force YIP awards in 2016.

Dr. Ebenezer Gnanamanickam, Assistant Professor of Aerospace Engineering at Embry-Riddle's Daytona Beach Campus, was awarded a three-year, $360,000 grant through the Air Force YIP Program. His proposal titled, "Exploiting the Non- Linear Interactions within Wall Turbulence for Flow Control," was one of 56 projects funded out of over 265 that were submitted by university researchers across the country and announced in spring 2016.

Gnanamanickam will be studying specific aspects of how an object that moves through a fluid (air, water) creates turbulence and how to make that object more efficient. "Pretty much any object that moves through the air creates turbulence, such as a car, an aircraft or even a bumble bee," said Gnanamanickam. "This turbulence generated is constantly interacting with itself and the object. I proposed to systematically study an aspect of this interaction and then learn to control this rather chaotic phenomenon that is turbulence. The long term goal of this basic research is to understand and control turbulence to make engineering systems more efficient, whether it is a car that gets better gas mileage or an aircraft with less fuel burn," said Gnanamanickam.

Dr. Ali Tamijani, Assistant Professor of Aerospace Engineering at Embry-Riddle's Daytona Beach Campus, was awarded a three-year, $360,000 grant through the Air Force Young Investigator Research Program. Tamijani's proposal titled "Investigation of load path based topology optimization" was one of 58 accepted out of 230 that had been submitted from across the country and announced in fall 2016.

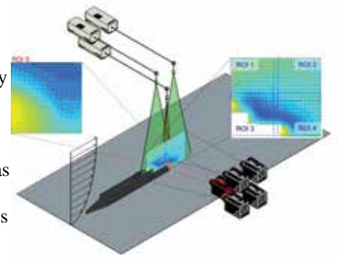
His research proposal focuses on the visualization and identification of structural load paths and load flow based on the streamline concept in fluid mechanics. As part of this award he will utilize the load paths in a topology optimization framework to improve the structural performance, functionality, and efficiency. This study makes innovative use of load patterns and load flows to establish the governing criteria for depositing weight resources and guiding the growth process to determine the structural lay-out. The development of an efficient topology optimization framework will enable designers to evaluate potential complex layouts that are optimized for particular design conditions, resulting in significant material savings for a wide range of applications, from aircraft and launch vehicles to automobiles and ocean-going vehicles.

Ship Airwake Modeling, Directed by Professor J. Gordon Leishman

The first research project to use Embry-Riddle's new state-of-the-art wind tunnel will measure the airflow behind a ship, called the airwake. This is a subcontract from the U.S.Army/NASA/ ONR through Penn State University as part of the Vertical Lift Research Center of Excellence (VLRCOE) program. The work will be conducted over 5 years. The PIs are Drs. Leishman and Gnanamanickam assisted by Ph.D. student Miss Dhuree Seth.

The wind tunnel work involves measurements of the airwake flow over the deck of a scale ship model, especially the area of highly unsteady, three-dimensional turbulent flow at the rear of a ship where helicopters take off and land. The unpredictable and sometimes violent response of the helicopter to the aerodynamic effects of the airwake can pose serious safety of flight issues, and has been the source of many accidents.

Embry-Riddle's new wind tunnel, with its large extended test section and fully integrated particle image velocimetry (PIV) flow measurement system, offers very unique capabilities to the study of this ship airwake problem. In the first year of the contract, preliminary time-resolved PIV measurements will be made in the smaller, boundary layer wind tunnel at Embry-Riddle. In years 2 through 5, PIV measurements will be made with much larger ship models in the new wind tunnel. To capture the relevant three-dimensional turbulent flow scales in the airwakes over relatively large fields of view, a unique PIV approach based on multiple high-resolution cameras will be used with different magnifications operating in synchronization. Cameras fitted with high magnification optics will be used to capture the flow regions near the ship, with lower magnifications used to capture outer flow regions. The resulting velocity fields can then be combined to yield a single realization of the total velocity field. The expected results from the Embry-Riddle study will provide benchmark quality airwake flow measurements that will allow thorough validation of computational fluid dynamics solutions of the airwake problem, as well as to help develop more rigorous mathematical models for use in piloted flight simulations of helicopters landing on a ship.



Free-Flying Unmanned Robotic Spacecraft for Asteroid Resource Prospecting and Characterization, Directed by Professor Hever Moncayo

Space exploration missions and in situ resource utilization have been a focus for increased research efforts in recent years. Exploitation of resources, such as water and nitrogen, that can be found on celestial bodies is of special interest due to their low demand on Earth's resources. The exploration, localization and extraction of these consumable resources will be a big challenge for future space missions. The unknown and extreme nature of celestial bodies requires the development of advanced space vehicles with "intelligent" on-board systems able to access terrains that would be inaccessible to traditional systems and to perform real time system diagnosis and make reliable decisions to guarantee mission safety and performance.

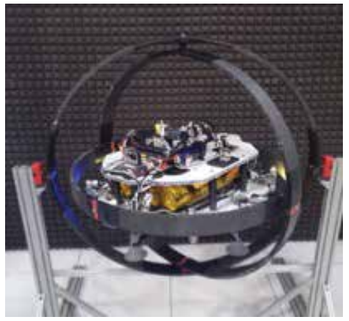
During Phase II of this NASA STTR project, Professors Moncayo and Prazenica, along with several graduate students, Honeybee Robotics (HBR)will continue with the development and flight testing of guidance, navigation and control algorithms integrated with sample-capture devices. That development increases the autonomy of space vehicles designed to better adapt within these complex and uncertain environments. Cold gas mini-free flyer systems are being integrated, validated and tested through Hardware-in-the Loop Simulations, gimbaled platform and flight testing.

The successful completion of Phase II is anticipated to provide enhanced capabilities for a marsupial-based robotic system to explore and extract samples from asteroids or terrains that would be inaccessible to traditional rover-type vehicles, such as lava tubes on Mars.

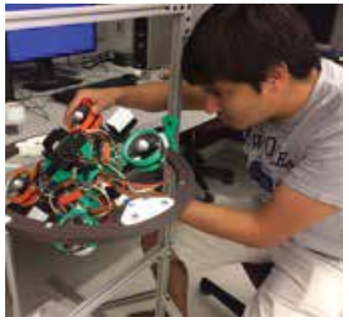
Terrestrial applications for this technology include sampling of contaminated soils and liquids from nuclear reactors, oil and chemical spills, etc. This would reduce the risk of sending personnel into contaminated environments. Geologists could use it to capture samples from hard to reach areas, such as lava tubes in Hawaii. Cameras and sensors could map the area and give the geological context. Commercial companies such as Planetary Resources and Deep Space Industries, that are interested in asteroid mining for economic gains, could also use this technology.

For more information about the project, visit:
Phase II sbir.nasa.gov/SBIR/abstracts/14/sttr/phase2/STTR-14-2-T4.02-9941.html

Vehicle During Flight Tests with a HoneyBee Sampling System



Cold Gas Asteroid Free Flyer Prototype



Thrust Vectoring Mini Free Flyer for Mars Missions

A Low-Cost, Miniaturized Control System for Autonomous Flight,

Directed by Professor Richard Prazenica

Embry-Riddle Aeronautical University and Creare LLC are developing an advanced autonomous flight control system to navigate unmanned aerial vehicles (UAVs) in unknown dynamic environments, such as urban environments. The system leverages recent developments in small, low-power, and low-cost sensor technology and improved computer hardware, along with high performance guidance, navigation, and control (GNC) algorithms. The Embry-Riddle team includes a group of faculty and graduate students in the Aerospace Engineering Department led by Drs. Richard Prazenica (PI), Troy Henderson (co-PI), and Hever Moncayo (co-PI). This summer, the Creare/Embry-Riddle team completed Phase I of this DARPA SBIR project, which was funded at $150K (with $45K allocated to Embry-Riddle) over a 10 month period, the Phase II program, which recently started in July 2016, is funded at $1 million (with $414K allocated to Embry-Riddle) over a 2 year period.

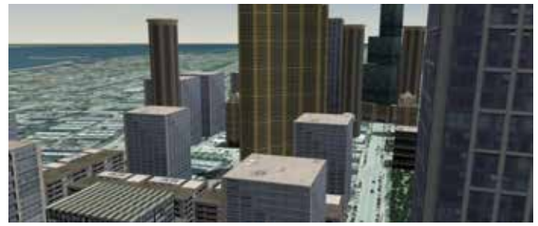
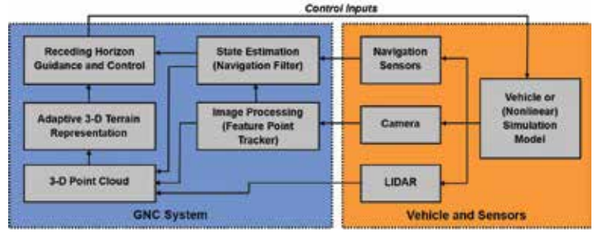


Image from a Simulated MAV Flight in a Virtual Urban Environment

The autonomous GNC system includes vision-based algorithms for improved navigation in GPS-denied environments, 3-D terrain algorithms to generate an adaptive terrain map from processed vision and LIDAR sensor data, and receding horizon algorithms to adaptively plan a 3-D path through the environment with obstacle avoidance. Also includes receding horizon algorithms to adaptively plan a 3-D path through the environment with obstacle avoidance. A bio-inspired, fault-tolerant flight control system is being developed to autonomously fly the vehicle along the planned path subject to disturbances such as wind gusts. The flight control system is designed to compensate for potential system failures such as sensor or actuator failures. The system will also incorporate a reactive obstacle avoidance algorithm to sense and avoid dynamic obstacles.

To support this research effort, Embry-Riddle has instrumented a SkyJib quadcopter UAV with a sensor suite that includes monocular and stereo cameras, an infrared camera, a scanning LIDAR, and an inertial navigation system (INS) with GPS. This UAV served as a test platform for data collection during the Phase I program, and it will be used for GNC system development and validation during the Phase II program. Embry-Riddle has also developed a high fidelity simulation environment to simulate autonomous UAV flight in virtual urban environments. The simulator includes detailed six degree-of-freedom UAV models, sensor models, and hardware-in-the-loop simulation capability. This simulation environment serves as an important tool for GNC system development and validation as well as the development of real-time processing algorithms.

Potential uses for this technology include search and rescue missions, remote surveillance and assessment of hazardous conditions, and exploring unknown environments such as lava tubes. There are also many potential military applications, such as precision urban munitions, bomb damage assessment, and intelligence, surveillance, and reconnaissance (ISR) missions.



General Architecture of the Autonomous GNC System

ERAU SkyJib Quadcopter UAV and Sensor Suite

New Programs

Embry-Riddle and Northrop Grumman Align for Nation's First Airworthiness Engineering Graduate Study Program

Northrop Grumman Corporation and Embry-Riddle Aeronautical University have joined forces to develop the nation's first airworthiness engineering graduate study program. Significant growth in Northrop Grumman's aeronautics business drove the development of this specialized technical curriculum designed to meet the anticipated needs of the company's government, military, civil and commercial space customers.

Students who pass the Embry-Riddle program will earn a Certificate of Study in Airworthiness Engineering (CSAE). The graduate certificate program is scheduled to launch in January 2017.

"We are proud to be the first university in the U.S. to offer a graduate program in Airworthiness Engineering," said Dr. Maj Mirmirani, Dean of the College of Engineering at Embry-Riddle in Daytona Beach. "Our alliance with Northrop Grumman, one of the nation's top and most respected aerospace companies, distinguishes our university as a preferred destination for students interested in exceptional educational opportunities toward building remarkable careers."

"Through our collaboration with Embry-Riddle, Northrop Grumman is helping to shape curriculum to greatly empower students interested in pursuing aerospace industry careers," said Doug Davis, director of the office of independent airworthiness with Northrop Grumman Aerospace Systems. "These university alliances create more effective, targeted pathways to employment in key areas of engineering critical to our mission of preserving freedom."

The Distance Master of Science in Aerospace Engineering (MSAE) Program

Recognized worldwide for aviation and aerospace excellence, ERAU has offered master's degrees in Aerospace Engineering since 1985 at the Daytona Beach Campus.

The Distance Master of Science in Aerospace Engineering (MSAE) program at Embry-Riddle is designed for students who already have a B.S. degree in aerospace engineering, or a related engineering field who wish to further their education. The courses are exactly the same as the MSAE courses at the Daytona Beach Campus (see catalog.erau.edu/daytona-beach/engineering/masters/aerospace-engineering/) and are taught by the Professors of the Embry-Riddle Department of Aerospace Engineering at Daytona Beach.

A minimum of 30 credit hours of graduate-level work (i.e. 10 courses, or 7 courses plus a thesis) is required for this degree. Courses in the structures and materials area began in January of 2017, while courses in the Aerodynamics and Propulsion and Dynamics and Control areas will be offered starting in the Fall of 2018.

More details can be found at: daytonabeach.erau.edu/degrees/master/aerospace-engineering/index.html.

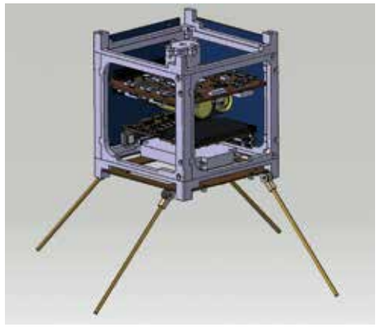
Faculty & Student News

Embry-Riddle Aerospace Engineering Professors Participate in Historic Air Race Classic

Embry-Riddle Aerospace Engineering Professors participate in Historic Air Race Classic. Four teams consisting of female student pilots and flight instructors represented Embry-Riddle's residential campuses in the flight competition that kicked off June 21, 2016 at the university's Prescott, Ariz., campus and ended June 24 2016 in Daytona Beach. Winners of the 2,716-mile race, which featured more than 100 women, were announced on June 26 during an awards banquet in Daytona Beach. For the first time, a team (Team Bernoulli) featuring two Daytona Beach Campus Aerospace Engineering faculty participated in the race. Naiara Petralanda (Visiting Professor) and Virginie Rollin (Assistant Professor), finished third overall in their first attempt at the race.

Centered, Left to Right: Virginie Rollin and Naiara Petralanda

Embry-Riddle's Spacecraft Development Club



Embry-Riddle Aeronautical University's Spacecraft Development Club (SDC) consists of a dedicated group of 38 students from diverse educational backgrounds, representing every college on campus. The current spacecraft mission is to design, build, test and operate the Radiation Data Acquisition Satellite, or RADSat, which will carry a highly miniaturized radiation monitor built by a European partner and collect important total radiation dose information for low earth orbit satellites. RADSat will securely house and orient the monitor while transmitting data back to the ground station, also built by the club. The team won the 2016 Florida University Nano-Satellite (FUNSat) competition, sponsored by the Florida Space Grant Consortium, and received a $10,000 award to be used toward building the satellite hardware. They are currently completing the design and beginning to acquire, integrate, and test hardware.

Rotor-Recovery of Sounding Rockets

Project Hummingbird is an undergraduate research opportunity to involve students with launching and recovering a rocket using an auto-gryo (non-powered rotor) system that will safely guide the rocket to land upright. Commercial space companies are attempting to recover first stage rocket boosters in order to drastically reduce the cost of launching rockets to space. Project Hummingbird aims to demonstrate an alternative approach to current methods of booster recovery that would, like the other techniques, reduce the cost per launch, but would also require a less complex system and far less fuel. The system is designed to launch with an internally stored rotor-hub and externally folded rotor-blades. At apogee, the rocket will upright itself and deploy the rotor blades, which will begin to auto-rotate. An onboard flight computer will control the guidance and descent of the rocket to land on its deployable landing legs. This project gives students the opportunity to gain experience with systems engineering and integration, helicopter aerodynamics, simulation and analysis programs, hands-on manufacturing, and solving real world engineering challenges in a team.

AIAA News

Design/Build/Fly Competition

This past April, the Daytona Beach campus set an Embry-Riddle record for placement in the AIAA Design/Build/Fly (DBF) competition. DBF is a collegiate UAV competition that is sponsored by the AIAA Foundation, Raytheon Missile Systems, and Textron Aviation. Finishing 11th overall out of 145 entries, Embry-Riddle Daytona Beach was one of only 9 teams to complete all of the missions in Wichita. Embry-Riddle Prescott finished 12th overall, and was also among the 9 that got the job done.

The Embry-Riddle Daytona Beach team was composed of 23 undergraduate students ranging from freshman to senior in experience level. Building off all of the experience of 2015-2016, the Embry-Riddle Daytona Beach team now has their goal set to win the 2017 event.

Go online and visit: daytonabeach.erau.edu/features/embry-riddle-students-celebrate-milestone-aircraft-competition for more details.

Speed of the Game: Science of Impact
What is the science of a golf ball's flight impact?

To answer this question, Dr. Richard Pat Anderson, Professor of Aerospace Engineering, was interviewed by the PGA. In this short documentary, Dr. Anderson explains why there are circular dimples on the golf ball and how that affects the ball's flight path.

Go online and visit: www.pgatour.com/video/2015/09/01/speed-of-the-game--science-of-impact.html to view the entire video documentary.

Aerospace Engineering Intern Shares Experiences, Offers Advice

One of our most experienced interns is Amreesh Raghavan, a recent Master of Science in Aerospace Engineering graduate who landed five internships to help advance his goal of becoming an aircraft structures specialist.

What made you go into Aerospace Engineering?

I have always been fascinated by the sight of an airplane giving the illusion of hanging in midair through magic.

Can you describe what you do each day at Gulfstream and what you are learning?

As a stress test support intern, I am currently working on the certification of the G600 aircraft. I work on aircraft components, conduct structural analysis and develop stress notes or stress calculations.

Based on your experiences at Gulfstream, Piper Aircraft Inc., Florida NextGen Test Bed and Bangalore Aircraft Industries, what advice do you have for student interns?

- Build your network. Be nice to your team members and talk to everyone around your desk. Ask people what they are working on, even if you are not part of their team. That's how you learn things and gain knowledge.
- Work with people who challenge you. It increases your confidence and improves your skills.
- Take initiative. When there is an open task, they need someone to take responsibility for it. Be the first person to raise your hand and say, "Yes, I will do it."
- Multitask and learn to handle pressure.
- Remember that an internship is the only time in your life when you can learn so many things while working as a student ambassador for your school. When you become a full-time employee, it is your duty to make your school proud.

Engineering Students win honors at the Boeing Flight Competition

Embry-Riddle engineering students took home several awards in the Boeing Flight Competition at the 42nd Annual National Society of Black Engineers Convention in Boston, March 23-27, 2016. The competition consists of taking a sheet of balsa wood with dimensions specified by Boeing and creating a glider. The gliders are launched from a table about waist high using a rubber band. The event also consists of a presentation portion as well as a distance competition. For the presentation portion, all teams go before Boeing senior engineers and vice presidents of various departments and explain and defend their thought process of how they arrived at their design. Three Embry-Riddle teams led by Jon Willems were formulated and advised on glider design by Aerospace Engineering Assistant Professor Dr. Snorri Gudmundsson. Flight instructor Patrick Metzger (not pictured), as a wooden glider building expert, also advised the teams. 29 other university teams participated as well. Our canard glider design ended up coming just feet from the all-time official record. The Boeing representatives asked us for an unofficial attempt at breaking the record, which was achieved. The three Embry-Riddle teams ended up taking home 1st and 2nd in the distance category, 1st, 2nd and 3rd in the presentation portion, as well as the overall award. It was an outstanding achievement for the Embry-Riddle chapter of the National Society of Black Engineers.

Ayanna Crear, Jeffrey Lewis (arm is around Ayanna), Isani Velasquez, Marcus Maiten (behind Isani), Jon Willems, Kevin Rolle (kneeling down), Chris Pierre and Naia Butler-Craig.

During The Boeing Company's Flight Competition, ERAU's three teams won:

1st in Presentation and Design Award
2nd in Presentation and Design Award
3rd in Presentation and Design Award
1st in Flight Distance Award
2nd in Flight Distance Award
1st in the Overall team Award

Embry-Riddle AIAA Student Branch

Over the past year, the Embry-Riddle AIAA Student Branch has held many events to develop its members to prepare them for careers in the Aerospace Industry. Every semester, the AIAA Student Branch at Embry-Riddle plans and holds many events including conferences, competitions, trips to Kennedy Space Center, and more to develop members into future engineers. Major events from the past year include: attending SciTech 2016; bringing Art Tank, a Lockheed Martin Technical Fellow, to speak to the membership; touring both Gulfstream and Boeing KSC; and building a Level II high powered rocket.

Art Tank, Lockheed Martin Fellow, Talking to the AIAA Student Branch

AIAA Student Branch Members Tour the Boeing CST-100 Facility at Kennedy Space Center

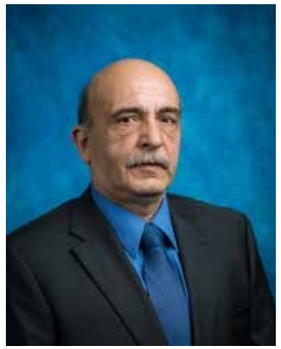
AIAA Student Branch High Powered Rocket Project

Faculty Awards

Dr. Mark Balas

Distinguished Professor of Aerospace Engineering and Professor of Electrical Engineering

Dr. Balas was named an August-Wilhelm Scheer Visiting Professor and Honorary Fellow of the TUM (Technical University of Munich) Institute for Advanced Study.



Dr. John Ekaterinaris

Distinguished Professor of Aerospace Engineering

Dr. Ekaterinaris received the 2016 Life Achievement Award from SARES (Sustainable Aviation Research Society).

Dr. Anastasios Lyrintzis

Distinguished Professor and Chair, Department of Aerospace Engineering

Dr. Lyrintzis received the 2016 Outstanding Member Award from AIAA, Region II, Cape Canaveral Section. Dr. Lyrintzis is also the current Chair (2015-17) of the ADCA (Aerospace Departments Chair Association).

Bailey Eaton ('15, BSAE) Receives Student of the Year Award from Florida Association of Employers and Colleges

While earning her bachelor's degree in Aerospace Engineering at Embry-Riddle's Daytona Beach Campus, Eaton was a student role model who mentored her peers and completed five internships that have helped her launch a career at The Boeing Company.

Those achievements paved the way to earning the ACE award in the private college category at the Florida ACE annual conference in Miami. Each year, FloridaACE presents an award to a student who demonstrates exceptional achievement in experiential learning.

Eaton, who graduated in December 2016, is currently working as an aerospace engineer under Boeing's Engineering Leadership Development Program. Based in Everett, Washington, she will rotate among four divisions over the span of two years. Eaton was recognized for achievements both inside and outside the classroom – including service as a peer mentor for younger students through Embry-Riddle's University 101 class. Eaton spent two years on the cross country/track and field team, worked as a resident advisor, instructed yoga at the fitness center and participated in organizations including the National Society of Collegiate Scholars and the National Society of Black Engineers.

While working toward her degree, Eaton also completed five internships. Most recently, she spent a summer as a Boeing propulsion test methods and technology engineer intern. Previous internships included two summers with Synergy Aircraft, another summer at Northrop Grumman and a fall experience with GE Aviation.

Ph.D. Students Graduation

In December the Department celebrated the graduation of its first three Ph.D. students. Drs. Lap Nguyen (Advisors: Professors Golubev and Mankbadi), Alfonso Noriega (Advisors: Professors Anderson and Balas) and Andres Perez (Advisors: Professors Moncayo and Balas) were awarded their Ph.D.'s during the December graduation ceremonies and now gainfully employed at Northrop Grumman, Rockwell Collins and Flight Level Engineering (a new start-up company currently residing at the new Mica Plex), respectively. Also, Aerospace Engineering Professor Snorri Gudmundsson obtained his Ph.D. from the Mechanical Engineering Department at Embry-Riddle. Congratulations to all of them!

Alfonso Noriega

Andres Perez

Lap Nguyen

Professor Snorri Gudmundsson

XCOR Engineer Talks about being a Rocket Scientist

Midland Reporter-Telegram (mrt.com)
By: Erin Stone
Photo: Tim Fischer
Published: January 9, 2016

Anita Solanki (’12, BSAE) grew up watching rocket ships soar across the sky. She could see the shuttle launches taking place at Kennedy Space Center nearly 125 miles away from the backyard of her family’s home in Tampa, Florida.

She remembers the yellow-orange burn of the engine and the thin trail of smoke it left behind as the rocket ascended, climbing higher and higher into space.

From that point, Solanki fell in love with space travel and she dreamed of becoming an astronaut. She loved math and science as a kid, and with her father being an engineer, she naturally gravitated toward the field herself.

Now, Solanki is the lead hydrogen test engineer for XCOR Aerospace, which develops rocket-propelled spacecraft and aircraft, rocket propulsion systems and propulsion components.

Getting to this point wasn’t easy. It took Solanki plenty of hard work, perseverance and patience. Her parents supported her goals, but Solanki remembers the strong support of her mother most. Solanki ended up getting an undergraduate degree from Embry-Riddle Aeronautical University in Daytona Beach.

She interned for various companies before coming to XCOR. She knew that what she really wanted was to build things with her own hands.

What immediately drew Solanki to XCOR was a single line at the very bottom of their engineer job description. It read: Must be able to carry 50 pounds and climb a ladder.

“That’s when I knew, I was like yes, I want that,” Solanki said. “Because if it’s an engineering post and they have something like that then you know you’re gonna get hands-on experience. I hadn’t seen any other company like that.”

XCOR has a staff of 63 employees, mostly engineers. Solanki is one of only three female engineers there. The fact that the engineering field is still overwhelmingly male-dominated has never bothered Solanki. If anything, her biggest obstacle has been herself.

“Every day I’m growing a little bit more confident that I can do it and that I deserve it,” Solanki said. “So that’s kind of a growing experience I’ve been having the last six months.”

“My mom really made sure that I followed my dreams,” Solanki said. “She just always gave me the confidence to go for it.”

Robert Glasscock (’88, BSAE) Named Vice President and Lead ODA Administrator for Gulfstream

Staff Report From Savannah CEO
Published: October 14th, 2016

Gulfstream Aerospace Corp. has appointed Robert Glasscock vice president and lead Organizational Designation Authorization administrator. He will lead Gulfstream’s ODA activities, which include efforts to obtain amended Type and Production Certificates, as well as Supplemental Type Certificates.

Robert is a ten-year Gulfstream veteran, who led the certification activity on the Gulfstream G650 as well as the G500 and G600. Prior to joining Gulfstream, Glasscock was employed at the Federal Aviation Administration, New Piper Aircraft Co. and Bombardier Aerospace Group in various engineering roles.

Derrick Stanley (’06, BSAE), 2016 Black Engineer of the Year Awards (BEYA) Modern Day Technology Award Winner

Derrick Stanley, an Embry-Riddle Aerospace Engineering alumni, Adjunct Professor of Embry-Riddle worldwide, and Boeing Engineer, has won the 2016 Black Engineer of the Year Awards (BEYA) Modern Day Technology Award. Boeing recognized his contributions to the aerospace industry and to the technological advancements of The Boeing Company.

Derrick was presented with the award at the Modern Day Technology Leaders Luncheon on Friday, February 19, 2016.

Where Are They Now?

Mark Phillips ('80, BSAE) retired in June 2016 after 33 years with the Northrop Grumman Corporation. He worked as engineer/program manager mostly on the B-2 bomber and E-2 programs. He began his career at Boeing as a flight test engineer on the 757 program.

Retired U.S. Navy Lt. Cmdr. ***Jeffrey M. Post*** ('82, BSAE) is president of Sargent Aerospace and Defense, which is a new acquisition by RBC Bearings.

Tim Farley ('86, WW; '02, BSAE) is now the vice president of design engineering at Daniel Defense, which engineers and manufactures firearms and accessories.

Lissi Mojica ('88, BSAE) will serve as a principal at Brooks Kushman, an intellectual property law firm located in the greater-Washington D.C., area. Prior to joining Brooks Kushman, Mojica was a principal with multinational law firm Dentons' intellectual property and technology practice group. Mojica was previously an examiner with the U.S. Patent and Trademark Office for 19 years.

Joseph T. McGilley ('91, BSAE) U.S. Coast Guard Cmdr. became commanding officer of Training Squadron Two during an Oct. 9 Change of Command ceremony. Training Squadron Two is attached to Naval Air Station Whiting Field located in Milton, Fla.

William D. Miller ('91, BSAE) recently celebrated 11 years at Dassault Falcon Jet Corp., including 10 years as manager of sales engineering.

Todd Engelman ('93, BSAE) was appointed the engineering lead and senior technical adviser to the Air Force Research Laboratory's Advanced Structural Concepts branch at Wright-Patterson Air Force Base in Ohio, where he will help develop and transition new aircraft technologies.

Shawn R. Brueshaber ('94, BSAE), a doctoral candidate at Western Michigan University, has earned a NASA Earth and Space Science Fellowship. Brueshaber is one of only 28 applicants to be awarded a $30,000 award for 2016-17 from the fellowship's planetary science research division. He is investigating polar vortices, which are large patches of air circulating near the Earth's poles.

Eric Heinzer ('95, BSAE) recently joined Honeywell's Flight Operations department as a flight test engineer. He has worked for Honeywell since 1998 in a number of capacities, including engineering, quality and customer support. He and his wife, ***Kimberly Kosola Heinzer*** ('95, BSAE and '00 MSAE), live with their three children in Phoenix, Ariz.

Gregory J. Bowles ('98, BSAE) was promoted to Vice President of Global Innovation and Policy at the General Aviation Manufacturers Association (GAMA). Bowles, who joined GAMA in 2005, will focus on the integration of emerging general aviation technologies, such as electric and hybrid propulsion aircraft, into aviation systems; and how new products and capabilities for GA aircraft will be designed, manufactured, certified, maintained and operated.

Kaare Erickson ('01, BSAE) and his wife ***Laura Campbell*** ('00, DB) attended a recent Rolls-Royce Centennial celebration in Indianapolis, Ind. "We are honored to represent Embry-Riddle working for Rolls-Royce and congratulate the university on 90 years and Roll-Royce on 100 years!" said Erickson. Campbell, who graduated with a degree in engineering physics, is the aerospace engineering engine family turbine and rotatives technical lead. Erickson, who earned an aerospace engineering degree, is the chief of advanced propulsion concepts in the Liberty Works division.

Jigarkumar Patel ('09, MSAE) Air Force National Guard Airman graduated from basic military training at Joint Base San Antonio-Lackland.

Karl Jahnke ('10, BSAE) is a systems engineer at Virgin America headquartered in San Francisco, Calif. He holds a B.S. in Aerospace Engineering and an MBA-Aviation from Embry-Riddle. On the engineering team, he develops and implements the maintenance program and manages regulatory changes to ensure fleet safety and compliance. He specializes in the landing gear, hydraulic systems, fuel system, fuel tank inerting system, ice and rain protection systems, and maintaining compliance to the Environmental Protection Agency's (EPA) Aircraft Drinking Water Rule.

William B. Collier Jr. ('11, BSAE) is an associate at Fish & Richardson, joining the Intellectual Property Litigation Group at the firm's Dallas, Texas, office. He is admitted to practice in Texas and the U.S. District Courts for the Northern, Southern, and Eastern Districts of Texas.

Benjamin Breitberg ('12, BSAE) completed a master's degree in systems engineering from the Naval Postgraduate School and was accepted into Class 152 at the U.S Naval Test Pilot School. He is currently an AIM-120 AMRAAM flight test engineer for the Naval Air Warfare Center, Weapons Division, at China Lake, Calif. He will be enrolled in the Airborne Systems course at the U.S Naval Test Pilot School and commence the year-long course in January 2017.

Matthew Grasso ('12, BSAE) has designed software for a fleet of FAA approved advanced aviation training devices for one-G simulation, a Seattle, Wash. company. Grasso, who now lives in Seattle, got his start building flight simulation devices at Embry-Riddle's Advanced Flight Simulation Center. An Embry-Riddle President's Award winner, Grasso was instrumental in the programming of one-G Access, a program that places a one-G AATD in flight schools on a pay-per-use basis.

Lt. ***Trevor Tomlin*** ('13, BSAE), Lt. ***Kyle Matissek*** ('13, BSAE), and Lt. ***Abby Hall*** ('12, BSAE) met with Cadet Alex Best, Cadet Steve Harding and Cadet Anthony Santoro at the first Dayton- area Cadet-Alumni Meet Up. The cadets, who were at Wright-Patterson for their flight physicals, met for dinner with three lieutenants. The hope is make this a regular occurrence with all the cadets coming up this summer. All of the cadets passed their flight physicals and will commission in May 2017.

Justin Martin ('14, BSAE) is an aerospace engineer and safety inspector for the Office of Commercial Space Transportation's Safety Inspection (CSTSI) division of the Federal Aviation Administration (FAA). The FAA licenses and regulates all commercial launch operations within the United States. Its CSTSI division is responsible for ensuring that operators remain compliant with these regulations. Martin is based out of the office in Cape Canaveral, Fla. He previously worked as a general engineer for the FAA's NextGen National Air Space Lifecycle Integration office.

Zachary Goff ('15, BSAE) was hired as a systems engineer for Rockwell Collins.

Faculty Roster

Marwan Al-Haik
Professor (Ph.D., Florida State University)

Richard Anderson
Professor & Director of Eagle Flight Research Center (Ph.D., University of Central Florida)

Magdy Attia
Professor & Associate Chair (Ph.D., Texas A&M University)

Mark Balas
Distinguished Professor (Ph.D., University of Denver)

Yechiel Crispin
Professor (Ph.D., Israel Institute of Technology)

John Ekaterinaris
Distinguished Professor (Ph.D., Georgia Institute of Technology)

Bill Engblom
Professor Joint Appointment with Mechanical Engineering Department (Ph.D., University of Texas)

Habib Eslami
Professor (Ph.D., Old Dominion University)

Ebenezer Gnanamanickam
Assistant Professor (Ph.D., Purdue University)

Vladimir Golubev
Professor (Ph.D., University of Notre Dame)

Luis Gonzalez-Linero
Assistant Professor (Ph.D., California Institute of Technology)

Glenn Greiner
Associate Professor & Undergraduate Program Coordinator (M.S., Embry-Riddle Aeronautical University)

Snorri Gudmundsson
Assistant Professor (Ph.D., Embry-Riddle Aeronautical University)

Troy Henderson
Assistant Professor & Honors Program Coordinator (Ph.D., Texas A&M University)

Dae Won Kim
Assistant Professor (Ph.D., Virginia Polytechnic Institute & State University)

James Ladesic
Professor & Associate Dean of Industry Relations & Outreach (Ph.D., University of Florida)

J. Gordon Leishman
Distinguished Professor (D.Sc., Glasgow University)

Anastasios Lyrintzis
Distinguished Professor & Chair (Ph.D., Cornell University)

Reda Mankbadi
Distinguished Professor (Ph.D., Brown University)

Hever Moncayo
Assistant Professor (Ph.D., West Virginia University)

Claudia Moreno
Assistant Professor (Ph.D., University of Minnesota)

Sirish Namilae
Assistant Professor (Ph.D., Florida State University)

Lakshman Narayanaswami
Professor (Ph.D., Georgia Institute of Technology)

Eric Perrell
Professor (Ph.D., North Carolina State University)

Richard Prazenica
Assistant Professor (Ph.D., University of Florida)

Frank Radosta
Professor (Ph.D., University of Florida)

Mark Ricklick
Assistant Professor (Ph.D., University of Central Florida)

Bertrand Rollin
Assistant Professor (Ph.D., University of Vermont)

Virginie Rollin
Assistant Professor (Ph.D., University of Vermont)

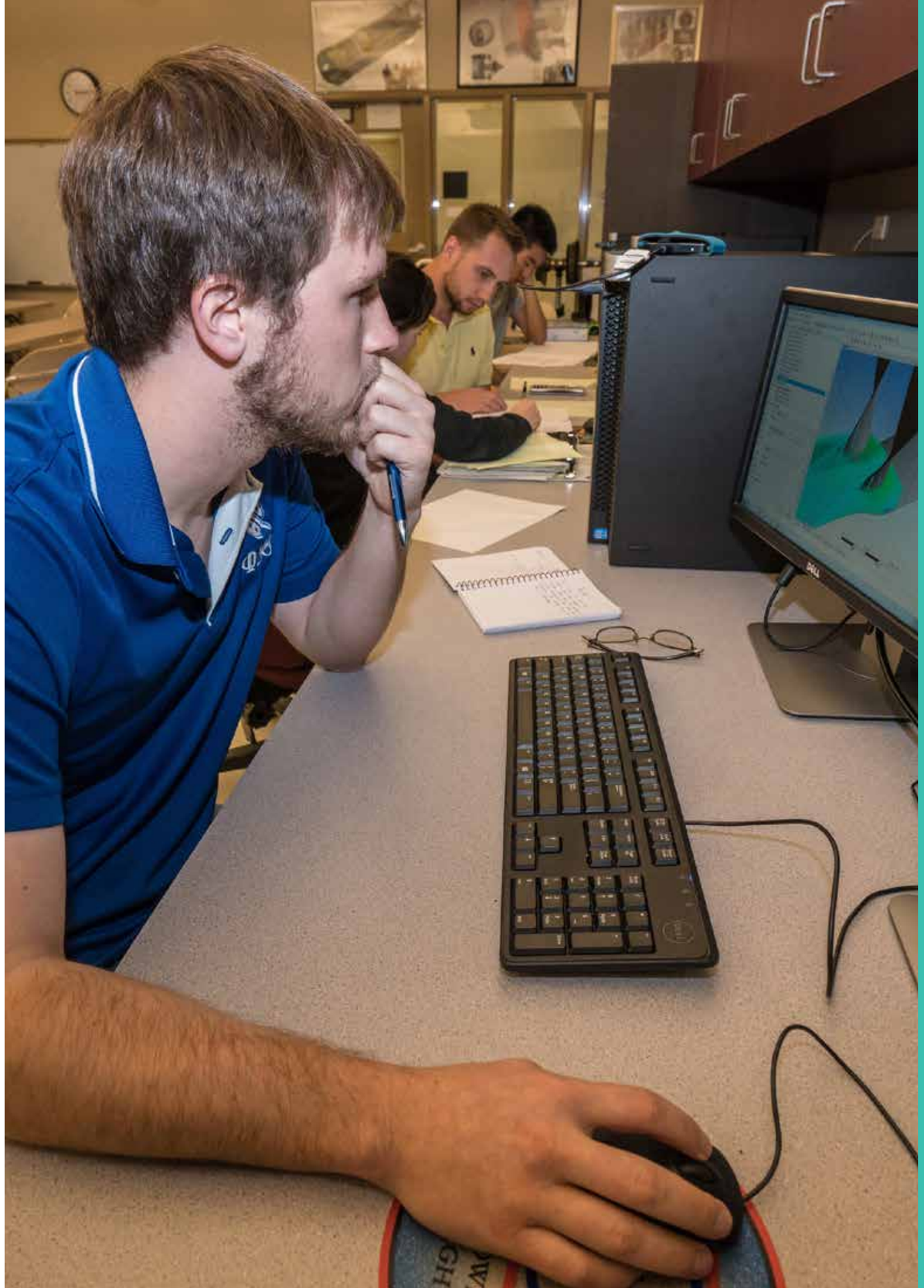
Dongeun Seo
Assistant Professor (Ph.D., University of Texas)

David Sypeck
Professor (Ph.D., University of Virginia)

Bogdan Udrea
Associate Professor (Ph.D., University of Washington)

Ali Yeilaghi Tamijani
Assistant Professor (Ph.D., Virginia Polytechnic Institute and State University)

Yi Zhao
Professor and Associate Dean (Ph.D., Louisiana State University)



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