AERONEWS

COLLEGE OF ENGINEERING | DEPARTMENT OF AEROSPACE ENGINEERING

2023-EARLY 2024 ISSUE

#4 BEST UNDERGRADUATE AEROSPACE ENGINEERING

U.S. News & World Report

INSIDE THIS ISSUE

Image credit: NASA

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Message From the Chair

2023 was a year of significant growth and exciting accomplishments for the Department of Aerospace Engineering (AE). The department continues to rank as the largest in the country with 2,145 bachelor's, 111 master's and 68 doctoral students as of Fall 2023 – another record year where enrollment is concerned. It should be noted that about 10% of our undergraduates are honors students, while the rest of the Daytona Beach Campus has 5% honors students.

I am also proud to report that our undergraduate AE program continues to rank very highly at #4 in the nation according to U.S. News and World Report (September 2023). This is the fifth time that our program has been ranked in the top 10. Our program offers unique experiential learning through various competitions throughout the year and yields excellent results, including first place among all schools in the AIAA Design/Build/Fly (DBF) competition in April 2024. The DBF team is guided by Professor Leishman and has placed in the top three overall in each of the past three years – an unprecedented feat.

The graduate program continues to thrive, ranking #25 (tied) in April 2023. Thanks to the Graduate Assistance in Areas of National Need grant from the Department of Education, we are able to support 10-12 American Ph.D. students per year, increasing the percentage of U.S. citizens in our Ph.D. program to roughly 50%. This is also the 10th anniversary of our thriving Ph.D. program; 37 Ph.D. degrees have been awarded and the program has grown to 68 students in those 10 years.

Recently, the AE department and the EagleCam team (discussed further on pages 2-3) also achieved a historic first. The team's student-designed and student-built CubeSat became the first university student-created payload to land on the moon.

Researchers and students at the Eagle Flight Research Center (EFRC) are continuing to advance uncrewed flight, with a current focus on electric propulsion, noise reduction, advanced and urban air mobility and the controls that guide these aircraft.

Research expenditures also continue to increase significantly, tripling in the last five years. Sample grants that were awarded in 2023 include:

- **Office of Naval Research (ONR)** – "Fused Deposition Modeling and Additive Fusion Technology for Continuous Fiber-Reinforced Composite 3D Printing." PIs: Tamijani, Gnanamanickam and Namilae.
- **U.S. Air Force** – "Experimental Testbed for Development and Validation of Autonomous ISAM/OSAM Systems." PIs: Nazari, Lovell and Dogan.
- **NASA University Leadership Initiative** (subcontract from Boston University) – "Safe, Low-Noise Operation of UAM in Urban Canyons via Integration of Gust Outcomes and Trim Optimization." PIs: Golubev, Lyrintzis and Mankbadi.
- **Air Force Office of Scientific Research** – "The Response of Wall Turbulence to Large-Scale, Space-Time Perturbations." PI: Gnanamanickam.
- **NASA** – "Novel Dual Quaternion-Based Model and Control for Gravity Recovery Missions." PI: Bevilacqua.
- **FAA ASSURE** – "Safety Risk Management Analysis on Small Unmanned Aircraft Detect and Avoid Systems." PIs: Moncayo and Prazenica.
- **NASA** – "Wayfarer Aircraft Research and Development for NASA STTR Phase II 'Integrated High Lift Propulsor.'" PI: Collins.
- **Bansi Aviation** – "Feasibility Study for Bansi Aviation AeroLift." PI: Collins.

Many of these research endeavors are detailed in the forthcoming pages. I hope you enjoy this edition of AeroNews.

Best regards,

A Lyrintzis

Dr. Tasos Lyrintzis
Distinguished Professor, Department Chair

College of Engineering Celebrates Historic Moon Landing

Dr. Troy Henderson

Cheers roared through the Mori Hosseini Student Union on Feb. 22, 2024 as students, faculty and staff watched Intuitive Machines' Odysseus Nova-C class lunar lander touch down on the moon.

The event was historic, both for the United States — which celebrated its return to the moon for the first time since Apollo 17 — and for the university, which had student-built hardware onboard.

After years of design and development, EagleCam — the entirely student-built miniature camera system housed within a CubeSat — had finally landed.

But the team's work was not done yet.

As the lunar lander began its final descent onto the moon, the plan was for EagleCam to spring, literally, into action, ejecting from the spacecraft about 100 feet before touchdown to snap photos of Odysseus as it settled onto the lunar surface. After complications forced EagleCam to shut down during landing, preventing the ejection mechanism from triggering when initially expected, the EagleCam team had to pivot. For days, they worked tirelessly to adapt their mission plans and procedures in order to deploy its CubeSat camera system.

As Intuitive Machines' CEO Steve Altemus ('87) explained on Feb. 28, EagleCam was ultimately reactivated and ejected, landing about four meters away from the lunar lander.

However, challenges presented by the off-nominal landing configuration of Odysseus prevented EagleCam from returning an image.

"With respect to EagleCam — what an amazing team of faculty and students at Embry-Riddle Aeronautical University," Altemus said during a video event captured on YouTube. "I think it's a wild success. I would love to fly the EagleCam again. Those students put their heart into it and it's a really innovative design."

"This was an incredibly ambitious project, from start to finish," said Dr. Troy Henderson, director of Embry-Riddle's Space Technologies Laboratory, where EagleCam was dreamed up and built from scratch. "I couldn't be more proud of what these students accomplished."

In addition to Henderson, faculty members working on the EagleCam project have included Dr. Eduardo Rojas-Nastrucci, associate professor in the Department of Electrical Engineering and Computer Science (EECS) and director of the Wireless Devices and Electromagnetics Laboratory; Dr. M. Ilhan Akbas, associate professor in EECS; and Dr. Jennifer Smith, professor in AE, as well as more than two dozen undergraduate and graduate students.

"There was always the possibility that something failed," said Daniel Posada, an Aerospace Engineering doctoral student who served as a lead engineer on EagleCam. "But what is important is the work we did to get here."

"Being able to say that this team came out of the classroom, applied what they've been learning in a whole variety of ways — from mechanical, electrical to software — and were able to successfully complete this project and deliver it, that in and of itself is a great thing," Henderson added. "Lots of these students have also already gone on to really good jobs for the reason that they have hands-on experience in the lab."

Plus, the EagleCam project led to the creation of a new scholarship program at Embry-Riddle to support outstanding women in STEM. The "Intuitive Machines and Columbia Sportswear Advancing Women in Technology Program" provides funding and fellowships for both undergraduate and graduate students. Taylor Yow, an Aerospace Engineering graduate student and EagleCam project manager, was one of its first recipients.

"I would not have been able to pursue my dream without scholarships, awards and grants," said Yow, who noted that her participation in the EagleCam project is what motivated her to pursue a master's degree.

Lessons Learned

For teams forging into the "final frontier," there is only one true certainty. Henderson states it simply: "Space is hard."

For the EagleCam team, embracing those unknowns was always the point. "One of the most exciting things is that this is a real problem," Posada said of the project. "First you have to know how the math works, but then there is the hands-on part, where you have to constantly test, design and iterate."

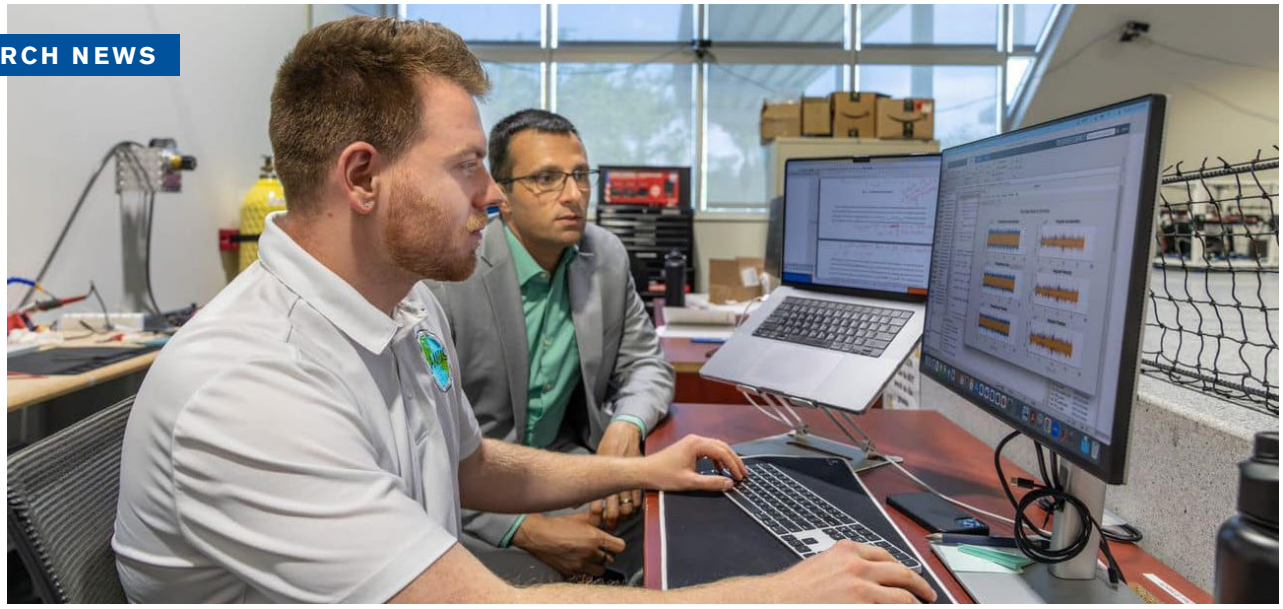
"There are never any guarantees in space travel, and we knew that going in," Yow added. "Mission complications don't take anything away from the incredible experience we gained along the way. We put everything we had into this project, and it gave us more knowledge and experience than we ever could have learned from books."

Dr. Jim Gregory, dean of the College of Engineering, added, "I'm deeply impressed by the innovation, dedication and creativity of the EagleCam team. The students and faculty have accomplished great feats, and we're extremely proud of all that they have learned, experienced, developed and achieved."

This story was originally written by Mike Cavaliere with Embry-Riddle's News Team.

Image credit: Intuitive Machines

Top left: Odysseus and EagleCam travel to the moon. Top right and bottom: Students, faculty and staff enjoy an on-campus moon landing party for EagleCam, including remarks from Dean Gregory.



Star Researcher's Leadership Inspires Student Success

Dr. Riccardo Bevilacqua

Dr. Riccardo Bevilacqua, professor of Aerospace Engineering, recently published an article in the AIAA Journal that opens a new path to predicting the behavior of fragmentation from explosive warheads, reducing the risk of collateral damage.

The publication, which also lists one of Bevilacqua's Ph.D. students as an author, is an example of the success that the professor, who was named 2023 Researcher of the Year by the College of Engineering, has had in publishing — and in providing his students a platform on which to participate in major projects.

"Dr. Bevilacqua has been an extremely important influence on my academic career," said Katharine Larsen, the student who is one of the paper's four authors. "Without him as my advisor, I would only have completed my master's degree, probably in the non-thesis track at that, but he has encouraged me to meet my full potential. I am now a Ph.D. candidate, as well as a DoD SMART Scholar and an Intuitive Machines and Columbia Sportswear Advancing Women in Technology Program fellow. I'm not saying I wouldn't be successful without Dr. Bevilacqua, but I definitely wouldn't be where I am right now."

Since joining Embry-Riddle in 2021, Bevilacqua has secured research funding of more than $1 million, hiring five Ph.D. students and two undergraduate researchers to participate in his projects, and he is the principal investigator or co-investigator on several pending research proposals.

"Riccardo's research program highly engages doctoral students, offering immense value through research exposure and direct contribution to the discovery of process knowledge," said Jeremy Ernst, vice president for research and doctoral programs. "Dr. Bevilacqua's work not only has disciplinary impact but provides meaningful experiences that shape the research agendas of future scholars."

Ph.D. student Nicolo Woodward, who first studied with Bevilacqua at the University of Florida and then followed him to Embry-Riddle, said Bevilacqua's mentorship has had "a huge impact on my educational career and made me the engineer and researcher I am today."

Graduate student Pol Fontdegloria said Bevilacqua provided him with the opportunity to work with aerospace hardware in open-ended projects, "taking me out of my comfort zone and providing me with valuable experience that will help me in my future career. Furthermore, Dr. Bevilacqua's work and passion for engineering motivated me to keep pursuing my education after graduation and keep doing research with him."

This story was originally written by Michaela Jarvis with Embry-Riddle's News Team.

Soaring Eagles

- **Ryan Kinzie**, an Aerospace Engineering Ph.D. student working with Bevilacqua, was selected as a NASA Space Technology Graduate Research Fellow. This recognition includes an $84,000 grant and a yearly stipend.
- Students **Pol Fontdegloria** and **Spencer John** achieved an unusual feat for undergraduates — publication in Acta Astronautica. The research, conducted with Bevilacqua, investigates the problem of space debris.

Research Team Aims to Improve Aerospace Systems Safety

Dr. Hever Moncayo (FAA, NASA and the Embry-Riddle Boeing Center for Aviation and Aerospace Safety)

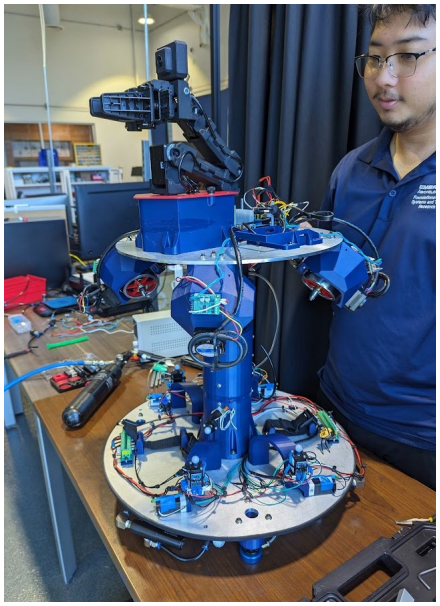
A research team at the Advanced Dynamics and Control Laboratory (ADCL), led by Dr. Hever Moncayo, is working to increase the autonomy and safety of aerospace systems operations. ADCL's research includes three separate projects — the first funded by the NASA Jet Propulsion Laboratory, the second funded by the FAA and the third funded by the Embry-Riddle Boeing Center for Aviation and Aerospace Safety.

The increase in the operational capabilities of aerospace robotic vehicles for a variety of missions demands a significant improvement in their levels of reliability, effectiveness, efficiency and autonomy. As part of their NASA project, entitled "Adaptive Distributed Health Management for Space Robotic Systems," the research team is investigating data-driven algorithms using bio-inspired mechanisms to design a comprehensive health-management system that can detect and identify potential failures and threats in distributed spacecraft systems. The approach is applied to the problem of providing resiliency to potential failures for a fleet of spacecraft that are performing on-orbit inspection missions. Two artificial intelligence-based concepts, Artificial Immune System and Deep-Reinforcement Learning, are being integrated within an adaptive architecture to introduce the onboard intelligence necessary to perform health management of the network.

In the second project, entitled "Conduct Safety Risk Management Analysis on Small Uncrewed Aircraft Detect and Avoid Systems," ADCL is implementing safety analysis methods to assess potential hazards for uncrewed aircraft systems (UAS) detect and avoid (DAA). This research helps to apply hazards and new risk assessment strategies and to explore their application to DAA systems and DAA-enabled UAS operations. The research will ultimately develop toolsets and methods for assessing risk for DAA systems and operations while identifying significant contributions to risk and strategies for mitigation. The outcomes from this project should advance criteria to regulate the operation of small UAS in close proximity to flight obstacles and identify threats and solutions to increase their operation safety.

In the third project, entitled "Deep Learning-Based Unobtrusive Estimation of Pilot Adverse Interactions and Loss of Energy State Awareness," the lab intends to identify the dynamic fingerprints of pilot behavior using machine learning — specifically generative adversarial neural networks. The team is developing onboard intelligent schemes capable of predicting and detecting dangerous phenomena associated with pilot reactions to different flight conditions. The outcomes of this project will support the development of tools to increase aviation safety and provide mitigation strategies for pilot-induced oscillation events.

The ADCL team includes Ph.D. students Rocio Jado Puente and Michael Budihartono, as well as master's students Ayush Raminedi, Gabriela Gavilanez, Sebastian Serna and Stephen Brutch.



Air Force Grant Propels Eagle Efforts to Test Robotic Arm for In-Space Servicing and Assembly

Drs. Morad Nazari, Merve Dogan and Alan Lovell (Funded by the Air Force Office of Small Business Programs)

Aerospace Engineering researchers recently received $450,000 to participate in an Air Force Small Business Innovation Research project with ControlX Engineering. The goal: Optimize and test a space vehicle with a robotic arm capable of performing in-space servicing, assembly and manufacturing (ISAM) on spacecraft.

“Similar to how we need occasional maintenance, assembly, repairs and management of our cars, spacecraft also require operational maintenance,” said Marco Fagetti, Ph.D. candidate in Aerospace Engineering and researcher on the project. “As our presence in space only continues to grow, so will the need for these ISAM space vehicles.”

The aim of the project is to build a testbed that will simulate space environments; there, the control systems that operate the vehicle and robotic arm can be tested.

“Control is a fundamental research area that helps in all kinds of advancements,” said Islam Aly, a third-year Ph.D. candidate in Aerospace Engineering who is also participating in the research. “This testbed will accelerate the development of feasible systems that are needed to build the space infrastructure and economy.”

Fagetti said the testbed will allow the researchers “to improve the efficacy and accuracy of our mathematical methods and systems, and to see if they can help us perform these operations more effectively.”

The research is being led by Drs. Morad Nazari, Merve Dogan and Alan Lovell.

“The experimental setup will help improve autonomous space missions via the investigation of several factors, including the effects of the space environment on the space vehicle’s operations,” Dogan said, noting that additional expenses for the testbed’s development, approximately $200,000, will be paid by ControlX.

Dr. Jim Gregory, dean of the College of Engineering, commended the researchers on their work.

“Professors Nazari, Dogan and Lovell are creating innovative approaches to maintaining spacecraft in orbit,” he said. “Their visionary research will help ensure a sustainable future for humans in space.”

Fagetti said the project will help him greatly as he heads toward a career in similar research.

“This research program has served as an excellent experience in applying the academic knowledge I gained — in my classes, through my past and current research and from my professors — to a more real-life application,” Fagetti said. “I look forward to when I find the career that will allow me to work in other programs and projects that will contribute to our expansion into space.”

This story was originally written by Michaela Jarvis with Embry-Riddle’s News Team.

Eagle Flight Research Center Advances Aviation Innovation

The Eagle Flight Research Center's (EFRC) mission is to advance manned and uncrewed flight through the fusion of theoretical and hardware-based research related to alternative propulsion, flight control, autonomy and the development of novel aircraft. Its current projects include:

Integrated Propulsion and Flight Control for Rotorcrafts

This project evaluated the performance of various control strategies that multi-rotor vertical take-off and landing (VTOL) aircraft could employ for nominal and degraded flight modes.

During Phase 1 — completed in 2022 — the team developed and built two quad-heli testbeds. Each of the four rotor systems has four controls (collective pitch, lateral cyclic, longitudinal cyclic and rotor-speed), with 16 total controls that can be utilized. Such systems are over-actuated, leading EFRC to determine how to blend controls to perform pitch, roll and yaw motions. EFRC designed and tested various control system strategies, some using over-actuation to improve control power. At least one of the strategies that utilizes cyclic pitch for control held promise in allowing control redundancy in the event of a rotor malfunction.

During Phase 2, EFRC explored control allocation methodologies. The team also developed simulation-based methods of predicting the envelopes of forces and moments the system could attain and compared that with what the system requires to fly a given trajectory. This led to novel pilot display concepts that could show pilots how much control authority the vehicle had during maneuvering flight. EFRC also demonstrated that the over-actuated system could respond to a rotor failure in flight and allow the system to maintain stable flight with zero pitch, roll and yaw and continue flying a complicated mission task element.

Hybrid-Electric Research

EFRC has, for a number of years, been researching hybrid-electric power generation systems for aviation applications. Using a hybrid-electric system provides better specific energy than any modern lithium-ion battery pack. Longer-range flights can be achieved for systems requiring electric power than by using batteries alone.

In 2019, the EFRC built a hybrid-electric power generation system capable of producing 88 kW of continuous power. Using this knowledge, EFRC built a more compact system that utilized a rotary (or "Wankel") engine known to have a higher power to weight fraction compared to conventional reciprocating engines. Testing on the system commenced in 2023, achieving a max continuous power of 52 kW.

Integrated High Lift Propulsor

EFRC partnered with Wayfarer Aircraft Research and Development under a sub-contract award. Wayfarer has developed and patented an Integrated High Lift Propulsor (IHLP) that improves the efficiency of lift augmentation via blowing with distributed electric propulsion.

The EFRC's role during 2023's Phase 1 was to design the electric drive system for a 12-rotor IHLP system across the leading edge of a Cessna 182 flight test vehicle. Team members analyzed the noise the IHLP-equipped Cessna would make compared to a standard Cessna.

2024 marks Phase 2. EFRC will assist with the build of a 1/3 scale model for testing and also develop the control system with autopilots and parameter identification maneuver injections. In 2025, EFRC will perform full-scale test flights to gather data for comparison with the sub-scale model without IHLPs attached.

Researchers Work to Advance Urban Air Mobility, Supported by $1.4 Million Grant

Drs. Vladimir Golubev, Tasos Lyrintzis and Reda Mankbadi (Funded by NASA)

High noise levels during flight have long been a barrier to the advancement of urban air mobility (UAM) vehicles. Thanks to new research being conducted at Embry-Riddle and backed by a $1.4 million NASA grant, however, low-noise multirotor aircraft are becoming a reality.

“By some estimates, UAM operations may become a reality in some urban areas by 2024-2025, first piloted then gradually shifting to autonomous operations controlled from the ground,” said Dr. Vladimir Golubev, professor of Aerospace Engineering and a principal investigator on the project.

Working in collaboration with Boston University, Virginia Tech, Tuskegee University and Joby Aviation, Golubev’s team will focus specifically on how air taxis can take off and land quietly at vertiports located in dense urban environments where wind gusts tend to be unpredictable. These turbulent flight conditions present unique aerodynamic and aeroacoustic challenges.

Over the span of the project, the team will also provide guidance on suitable locations for city-based rooftop vertiports and flight corridors that would minimize noise during takeoff and landings.

“Noise is a critical aspect for public acceptance,” Golubev said of electric-powered UAM vehicles, noting that major strides have already been made to mitigate their sound and pressure levels.

Last year, for example, NASA and Joby Aviation released preliminary findings from a simulation to capture noise profile data from a full-size UAM prototype. A remotely piloted aircraft loaded to near-maximum weight capacity (the equivalent of a pilot plus four passengers) was flown during a two-week test period at Joby’s Electric Flight Base in California. The aircraft registered decibel levels almost 1,000 times (30dB) quieter than that of a typical helicopter.

Embry-Riddle’s research, conducted as part of NASA’s University Leadership Initiative, addresses the sustainability of such noise reduction in highly unsteady flow conditions. The work, which began in September 2023, is led by Golubev, along with co-principal investigators Dr. Tasos Lyrintzis and Dr. Reda Mankbadi. Three Ph.D. candidates and 1 M.S. student are engaged in various analyses. Two additional Ph.D. students will join the team in Fall 2024.

“The advent of UAM will revolutionize the future of transportation,” Lyrintzis said, noting that this is the largest federal grant the Aerospace Engineering Department has ever received. “However, one of the persistent issues that needs to be addressed is noise. The proposed NASA project addresses several key issues for noise reduction, and the hope is that it will help move UAM closer to reality.”

A Bright (and Quiet) Future

By focusing on the sound levels associated with UAM's vertical lift capabilities, the team hopes to reduce the environmental impact of these vehicles.

"Addressing this aerodynamically generated noise is a new technology challenge, and the demand for trained engineers is high," said Mankbadi. "Because of this market demand, one of our tasks is to involve undergraduate students to train them on the design and development of small multi-rotor vehicles and to prepare them for this emerging market."

Graduate students will also play a part by focusing on creating computational simulations of noise aerodynamics and controlling multi-rotor vehicles in urban environments.

Several papers related to the project were presented at AIAA's 2024 SciTech Forum. An all-team meeting is also planned for May 2024 in conjunction with organizing a UAV workshop for undergraduate students from various universities, particularly focusing on HBCU and MSI schools.

This story was originally written by Mike Cavaliere with Embry-Riddle's News Team.

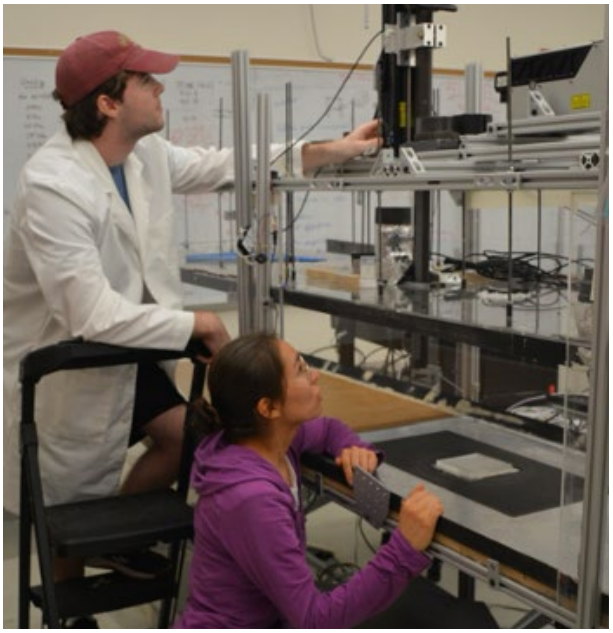
Nature-Inspired Investigation into High Aspect-Ratio Micropillars Continues

Dr. Ebenezer Gnanamanickam (Funded by the National Science Foundation)

Bats, fish, spiders and other animals often seem to navigate their surroundings with very little effort. This is partly believed to stem from tiny, hair-like structures on the animals' bodies. These structures are hypothesized to act as sensors, and scientists are now working to create their own versions called high aspect-ratio micropillars.

These micropillars mimic naturally occurring features like a fish's lateral line sensors or a bat's airflow detectors. Structures like these may reduce drag, improve an animal's sensing abilities and aid in flight control. In work funded by the National Science Foundation, Associate Professor Ebenezer Gnanamanickam is studying the role of these hair-like structures on surfaces within Embry-Riddle wind tunnels. The effort includes graduate student Pratik Deshpande and undergraduate student Keyu Vadaliya.

Their recent results show that these structures can alter the airflow near the surface depending on how stiff they are and how they are distributed on a given surface. The team's current efforts are focused on larger surfaces covered with these microstructures. By measuring the vibration/deflection of said structures, the team hopes to understand how they can be used as sensors to detect far-away objects.



Researchers Work to Decipher Particle Dynamics

Drs. Ebenezer Gnanamanickam and Zheng Zhang (Funded by the U.S. Army Research Office)

In both industrial and natural environments, the interaction between the air and particles within turbulent boundary layers is a complex phenomenon. From the natural ebb and flow of sand to the industrial operation of chemical reactors and combustion chambers, such dual-phase processes play a crucial role.

Drs. Ebenezer Gnanamanickam and Zheng Zhang are hoping to understand this phenomenon. In work supported by the U.S. Army Research Office, a team that includes graduate student Vaishak Thiruvenkitam and undergraduate students Robert Bryan II and Kaitlyn Williams are focusing on two key aspects of the air-particle dual-phase flows that remain unexplained despite previous studies.

The team will first challenge the conventional theories of the initiation of particle mobilization. To do so, they will explore the role of unsteady carrier phase eddies, which has been observed to have a significant impact on particle erosion and transport. The first year of this effort, recently completed, focused on generating systematic, controlled flow eddies to carefully study this unsteady mobilization process.

In subsequent years, the team will delve into the dynamics of these two-way coupled flows, where mobilized particles modify carrier phase turbulence, creating a feedback loop of mutual influence. They aim to gain insights into these complex interactions and overcome longstanding challenges.

Engineering Team Works to Unravel the Secrets of Turbulent Boundary Layers

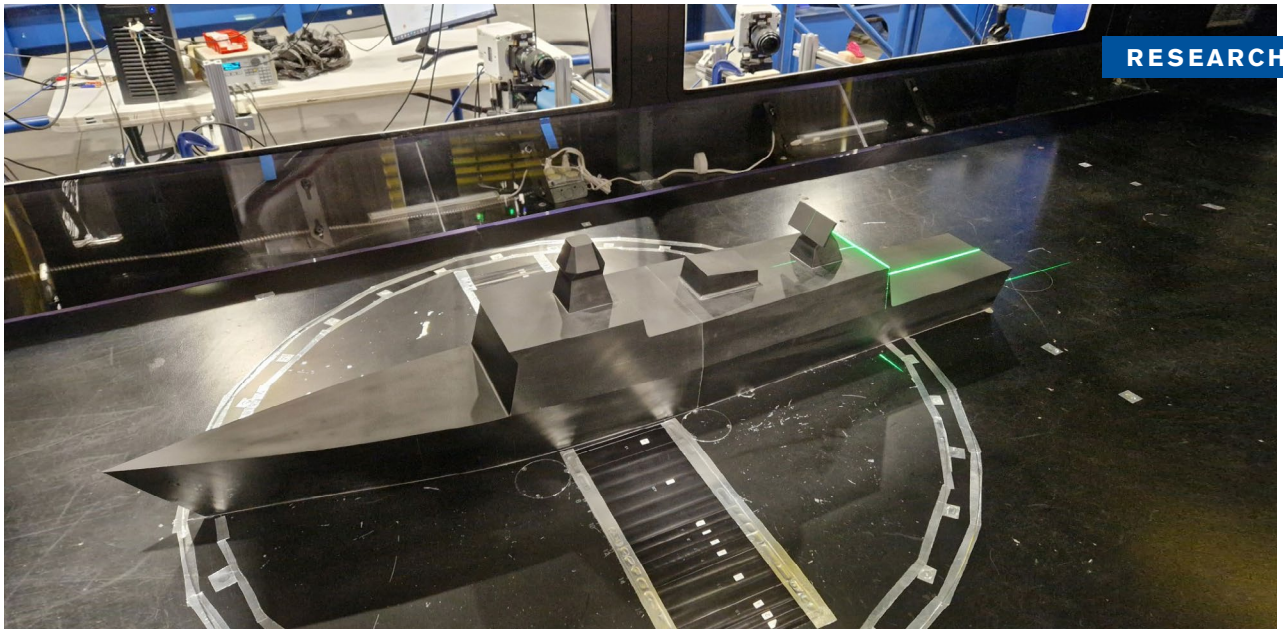
Dr. Ebenezer Gnanamanickam (Funded by the Air Force Office of Scientific Research)

Certain objects, such as specific airplane wings or boat hulls, seem to move through air and water more effortlessly than other items. The reason lies within turbulent boundary layers, or thin layers of fluid that adhere to the surfaces of moving objects. These layers exert substantial influence on an object's drag.

One approach to understanding turbulent boundary layer interactions involves studying their response to systematic disturbances – for example, examining the ripples on a once-tranquil pond and then applying these observations to understand and predict how water behaves when set into motion on a more complex scale.

At the forefront of this endeavor to introduce systematic disturbances to better understand the behavior of turbulent boundary layers is Miriam Theobald-Deschine, a Ph.D. student. Theobald-Deschine is assisted by undergraduate students Shreyas Madhvaraju and Luke Sylliaasen. Spearheading this initiative is Dr. Ebenezer Gnanamanickam, associate professor of Aerospace Engineering, with funding from the Air Force Office of Scientific Research.

The team is leveraging advanced measurement tools such as high-speed imagery to conduct their research. They hope to uncover methods for controlling turbulent flows and optimizing the overall efficiency of systems like airplanes and ships.



College Works Toward a Better Understanding of Ship Airwakes

Drs. J. Gordon Leishman and Ebenezer Gnanamanickam (Subcontract from the Georgia Tech Vertical Lift Research Center of Excellence)

Ship airwakes and their highly unsteady and turbulent characteristics can cause significant difficulties where aircraft operations are concerned. Addressing this challenge is a key component of the Vertical Lift Research Center of Excellence (VLRCOE) subcontract.

Embry-Riddle has continued to pursue its research on ship airwakes with the assistance of a new state-of-the-art, closed-return subsonic wind tunnel. This facility can simulate a representative atmospheric boundary layer — the wind — and its optically flexible test section provides new opportunities for particle image velocimetry (PIV) setups and time-resolved flow measurements.

Over the past year, the airwake of the NATO Generic Destroyer (NATO-GD) was measured using synchronous dual-plane time-resolved PIV. The NATO Generic Destroyer is a concept ship with a simplified geometry that can be utilized in research like the VLRCOE subcontract.

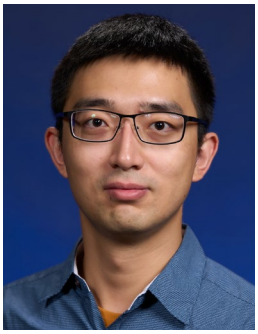
This technique yielded spatially and temporally correlated measurements that are crucial for gaining a comprehensive understanding of ship airwakes. The datasets were also utilized to generate a reduced-order model of the flow field, which captured a substantial portion of the turbulent kinetic energy and large-scale motion. It was likewise used for computational fluid dynamics validation with Embry-Riddle's partners at Georgia Tech.

In the future, the effects of an external flow, such as that caused by a rotorcraft or drone, will be examined using a scaled helicopter rotor and a multi-fan system. The rotor ensures practical significance, while the fan appropriately matches ship-rotor time scales and aerodynamic frequencies. The synchronous PIV measurements will give a deeper dive into aerodynamic interactions and continue building on our understanding of this complex aerodynamic problem.

New Faculty

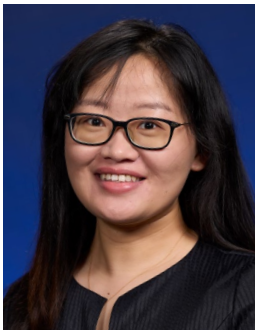
Dr. Luis Estefano Ferrer-Vidal Espana-Heredia

Dr. Ferrer-Vidal Espana-Heredia holds a Ph.D. in Gas Turbine Performance and Aerodynamics from Cranfield University (earned in 2019). He has worked for Mitsubishi Power Systems, as a postdoctoral researcher at Rolls-Royce Performance UTC and as a turbomachinery design consultant for PCA Engineers Ltd. in the UK. His research interests include the aerothermal sciences, turbomachinery and propulsion. He is also an Embry-Riddle alumnus (BSAE '12, MSAE '14).



Dr. Hao Peng

Dr. Peng holds a Ph.D. from Beihang University (China), earned in 2016. He held a postdoctoral position at Rutgers University for seven years before joining Embry-Riddle. His research interests include machine learning with applications, in-orbital dynamics, attitude dynamics, guidance, navigation and control (GNC) and trajectory design. He has published 23 journal papers and 27 conference papers.



Dr. Yue Zhou

Dr. Zhou holds a Ph.D. from Binghamton University, earned in the spring of 2023. Her research focuses on laser-based additive manufacturing of metallic materials, including process development, in situ process monitoring, characterization and numerical modeling.

Faculty Accomplishments and Awards

In 2023, the Aerospace Engineering Department celebrated a number of faculty accomplishments and awards:

- Dr. Seetha Raghavan was named editor-in-chief of the AIAA Progress in Aeronautics and Astronautics book series.
- Drs. Riccardo Bevilacqua and Tasos Lyrintzis were named Fellows of the Royal Aeronautical Society.
- Drs. Alberto Mello, Sirish Namilae and Ali Tamijani were named AIAA Associate Fellows.
- Dr. Riccardo Bevilacqua was selected to receive the College of Engineering's Researcher of the Year award.
- Dr. Hever Moncayo was selected to receive the Department of Aerospace Engineering's research award.
- Dr. Alan Lovell was selected to receive the Department of Aerospace Engineering's undergraduate teaching award.
- Dr. Morad Nazari was selected to receive the Department of Aerospace Engineering's graduate teaching award.
- Professor Glenn Greiner was selected to receive the Department of Aerospace Engineering's inaugural service award.

Eagles Take No. 1 at AIAA's Design/Build/Fly Competition

For the first time, students from Embry-Riddle's Daytona Beach Campus took top honors at the AIAA Design/Build/Fly Competition. This year's event included more than 1,000 students representing 93 universities from all over the world.

"Embry-Riddle students who participate in the AIAA Design/Build/Fly Competition are impressive in their dedication, innovation and leadership," said Dean Gregory. "They are learning critical skills that will serve them well throughout their careers! Their first-place win is outstanding evidence of their excellence."

The challenge required students to design, build and test a remotely operated, radio-controlled airplane for urban air mobility. The aircraft had to conduct a delivery flight, a medical transport flight and an urban taxi flight, plus a ground mission that demonstrated how quickly the aircraft configuration could be changed from delivery to medical transport to urban air taxi.

Making History

The Daytona Beach team dominated the competition with its aircraft, christened "W.R.E.N.C.H.," standing for Wind Resistant Emergency Navigator for Civilians and Healthcare.

"The team has worked tirelessly to design, build and test the best aircraft possible, oftentimes pushing themselves to their limits," said Andrew Bunn, a senior Aerospace Engineering student who served as the project lead. "This victory represents the culmination of 10 years of DBF activities at the Daytona Beach Campus and was made possible through our culture of continuous improvement and dedication to learning above all else."

Bunn said that the team's primary focus throughout the project was to provide industry-like engineering experience to all students involved. Ashley Brown, an Aerospace Engineering student who served as the team's propulsion lead, added, "The experience you gain from working with DBF is unlike anything you will learn in class." Brown also said the team had more female members this year than ever before.

Students have spent the past two semesters focusing on this project, according to Distinguished Professor of Aerospace Engineering Dr. J. Gordon Leishman, the team's faculty advisor.

"The team has been ranked in the top three positions for the past three years, so this first-place win also crowns off an unprecedented string of previous DBF successes," he said. "Winning this year is a testament to the DBF team's continued dedication, creativity, technical proficiency and exceptional teamwork, and it sets the gold standard for excellence in aerospace engineering education."

In 2023, the Daytona Beach team ranked third among more than 80 teams from around the world, as well as highest among 28 U.S. teams.

Kimberly Heinzer, an associate professor of Aerospace Engineering who also helps advise the team, added, "Their dedication, driven by a genuine thirst for learning, fostered a family-like dynamic of continuous improvement and mutual support."

This story was originally written by Melanie Azam with Embry-Riddle's News Team.

Experimental Jet Engine Performance (XJEP) Club

Advised by Dr. Mark Ricklick

XJEP continues to grow and to serve as an outlet for Embry-Riddle students who hope to gain hands-on experience in air-breathing propulsion and jet engines. The club, which boasts more than 150 members, recently presented multiple conference papers at the AIAA SciTech Forum. Student researchers presented work related to their design and testing of a novel afterburner and variable nozzle system for their JetCAT P300pro turbojet engine. The group is continuing afterburner development while also investigating the design of ramjet inlets and upgraded test stands.

Embry-Riddle Orbital Research Association (ERORA)

Advised by Dr. Jennifer Smith

ERORA currently has three ongoing projects: Project Hermes, Project Copernicus and Project SATLASS. Project Hermes, led by Jacob Lahue, is a 1U CubeSat named Radiation Orbital Shielding Investigation Satellite (or ROSIsat). ROSIsat will be researching radiation shielding with various materials, including lunar regolith and Martian soil simulant. Project Copernicus, led by JT Lozano, is a 3U CubeSat that is still in its research phase, with a mission objective to be determined. Project SATLASS, led by Akshay Kaudinya, is a single dynamic CubeSat deployer. The team has focused on the overall mechanical structure integration and the thrust system, and SATLASS recently concluded its first design iteration with a finalized structural configuration.

Embry-Riddle Search and Rescue Technologies (SARTEC)

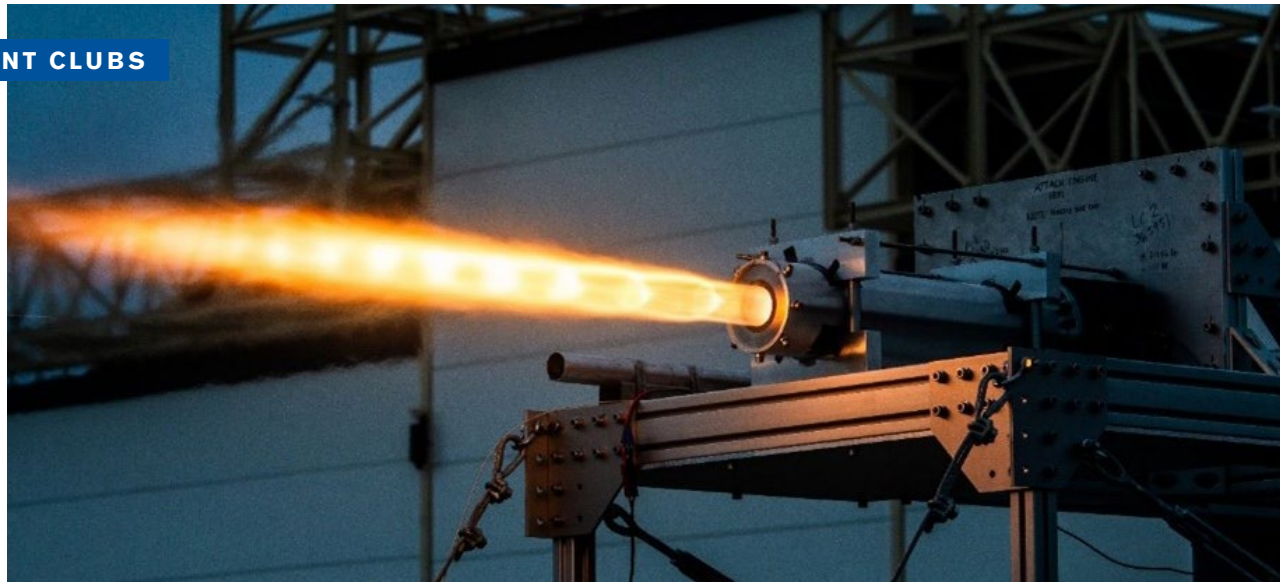
Advised by Professor Kimberly Heinzer

SARTEC is dedicated to designing and constructing specialized UAVs for search and rescue missions. Since its inception in 2022, SARTEC has grown to over 100 members. Employing a multidisciplinary approach to the engineering design process, members engage in conceptualizing, designing, analyzing, manufacturing and testing aircraft designs, leveraging their unique skill sets to enhance the collective experience. They extend their ethos of learning and sharing by volunteering at local schools and forging connections with seasoned aircraft industry professionals.

SARTEC's flagship initiative, Project Yellow Tail, focuses on developing a fixed-wing UAV capable of prolonged flight and rapid response in challenging conditions.

Equipped with thermal imaging, object recognition and sensors, this system aims to swiftly locate survivors and assess environmental conditions. Additionally, SARTEC is working on Project Sky-Drop, which aims to deliver relief supply packages for disaster response efforts.

SARTEC envisions Project Yellow Tail and Project Sky-Drop as pivotal tools for various search and rescue operations, encompassing tasks from locating missing individuals to providing essential assistance in the aftermath of natural disasters.



Embry-Riddle Future Space Explorers and Developers Society (ERFSEDS) and the Experimental Rocket Propulsion Lab (ERPL)

Advised by Dr. Rick Perrell

ERFSEDS' Project Prometheus has successfully performed four consecutive test firings over the past year. Each firing has involved a rocket motor burning the team's own formulation of solid propellant, with the tests designed to demonstrate repeatability and reliability. The tests produced around 100 pounds of thrust for three seconds and were completed in collaboration with Embry-Riddle's Aviation Maintenance Science Department in one of their jet engine test cells.

Samuel Haas, Project Prometheus' team leader, said, "These validation firings are necessary before we scale up the motors for a flight test. This will be our first launch of an 'in-house' motor since before the pandemic."

This summer, ERFSEDS will travel to Spaceport America, New Mexico to compete in the Intercollegiate Rocket Engineering Competition with their Artemis two-stage rocket.

The Experimental Rocket Propulsion Lab also completed the first successful test firing of their Odyssey 500-pound thrust hybrid rocket engine, which burns nitrous oxide with a solid fuel. The 10-second burn was conducted at Cecil Spaceport in Jacksonville, Florida.

ERPL has subsequently entered Project Odyssey in the Collegiate Lander Challenge, where teams compete to achieve a series of technical milestones for cash rewards. Student team leader, Alex Clay, noted, "The next competition phase is to develop a throttling system, which coincidentally we have been doing for the past year."

In a second test, the engine briefly achieved 600 pounds of thrust before a leak during throttling resulted in the loss of the engine. "We anticipate these things way ahead of time," stated Clay, in discussing rocket project safety. "And we'll learn more than we already know from analyzing the failure."

Embry-Riddle ERPL Club

Embry-Riddle ERFSEDS Club

Aerospace Engineering Student Wins Astronaut Scholarship

Being an Eagle and studying engineering runs in the family for Vikas Patel.

“My brother Kushan is about 10 years older than me and he graduated from Embry-Riddle in 2014 as an aerospace engineer,” said Patel. “He’s more the aero guy and I’m the astro guy — we say that together we kind of take over the skies.”

Now, after being chosen as a 2023 Astronaut Scholar, Patel is closer than ever to his ultimate dream of becoming an astronaut and conducting space research.

“I’ve always wanted to be an astronaut and I realized Aerospace Engineering was a way to combine my love for space with problem-solving and critical thinking,” he said.

The Astronaut Scholarship Foundation awards scholarships up to $15,000, membership in the Astronaut Scholar Honor Society, an invitation to the Innovators Gala and various mentoring opportunities from astronauts, scholar alumni and space industry executives. In 2023, the Astronaut Scholar Foundation awarded 68 scholarships to students from 46 different universities across the nation.

“It’s a huge help financially but also encourages me to keep doing what I am doing,” said Patel. “This award is also a recognition of everyone around me who has helped make me what I am today.”

A Standout Student

Patel has excelled both on and off of Embry-Riddle’s Daytona Beach Campus. In summer 2023, he was a flight simulation intern at Lockheed Martin in Sunnyvale, California, while in summer 2022, he was an engineering intern at the U.S. Navy at Cape Canaveral, Florida.

On campus, he served as the lead flight test engineer for the AIAA Design/Build/Fly international engineering competition, helping the team win top honors.

Patel is also conducting research in the Space Technologies Lab at Embry-Riddle. He is leading battery testing for the LLAMAS project, which is a camera system that aims to capture images and video of the first commercial spacewalk planned for the Polaris Dawn mission.

“Vikas has been dedicated to the testing of the spaceflight hardware, and his efforts are essential to ensuring the safety of the payload for the crewed Polaris Dawn mission,” said Dr. Troy Henderson, associate professor of Aerospace Engineering and director of the Space Technologies Lab. Henderson is also the faculty member who nominated Patel for the scholarship.

After graduating with his bachelor’s degree in December 2024, Patel plans to continue to graduate school and focus his research in the areas of guidance navigation control or launch operations. He also has his student pilot’s license and hopes to continue his flight training part-time, while in school.

“I feel like Embry-Riddle has been the best fit for what I want to do,” said Patel. “A lot of people here have really given me the resources and support to guide me and teach me what it means to be a good engineer.”

This story was originally written by Melanie Azam with Embry-Riddle’s News Team.

Aerospace Engineering Student Wins USRA Scholarship

Ashley Tirado-Pujols wasn't always comfortable being the only female in her high school robotics club, but she eventually became club president anyway.

"I think that putting yourself in uncomfortable positions is important for personal growth," said Pujols, an Aerospace Engineering senior. "At first … I felt like I had to prove myself to my team. But as I put that mindset behind me and began to focus on the passion I held, I was able to work with them and lead the team to first place at regionals during our senior year."

Pujols' hard work and determination continued in college and led to her being chosen as one of only five women in the nation to win a Women in Aerospace Foundation scholarship. The merit-based award recognizes promising young women poised to become the next generation of female leaders in the aerospace industry.

"Ashley is taking on challenging research, and she is flourishing... because of her strengths in collaborating with others and her motivation to achieve success," said Dr. Seetha Raghavan, professor of Aerospace Engineering and associate dean for research & graduate studies.

Pujols is the first Embry-Riddle student to win one of the foundation's scholarships in many years.

"I was in absolute shock that I was selected but beyond proud that I can continue to represent Latinas in aerospace," said Pujols. "I want other young girls and women to know that they can do it and not to doubt themselves for even a second. I hope to be someone who can represent them while being a role model."

Pujols has racked up a long list of accomplishments during her time at Embry-Riddle. This year, she was named a NASA M-STAR (Minorities in Space Technology Artemis Research) Fellow and spent the summer interning at NASA Langley Research Center. Her research focused on finding ways to mitigate the effects of lunar dust on ceramic-coated materials used for the Artemis missions.

She has also been awarded the Universities Space Research Association (USRA) Distinguished Undergraduate for 2023. Earlier this year, she was named Outstanding Undergraduate Researcher in Fundamentals of Engineering by the College of Engineering. Pujols is also a project editor for the university's Eagle Heritage Project, reviewing and editing podcasts, interviews and other historical recordings from Embry-Riddle alumni.

After graduation, Pujols wants to work in the aerospace industry, but she says she also aspires to eventually earn her doctorate degree and become a professor herself.

"I love teaching and helping students because I used to be in their shoes, and a little support can go a long way," she said.

This story was originally written by Melanie Azam with Embry-Riddle's News Team.

Embry-Riddle Students Secure Highest Number of Patti Grace Smith Fellowships

For the third consecutive year, Embry-Riddle and the College of Engineering led the field in securing Patti Grace Smith Fellowships.

This year's class includes five Eagles, four of whom call the Aerospace Engineering Department home. Nationally, 31 undergraduate students were named Fellows, a distinction that includes professional mentoring, grants to partially cover school expenses and a paid summer internship at an aerospace engineering firm.

The Patti Grace Smith Fellowship was established in 2020 and aims "to provide a meaningful, effective pathway into successful aerospace careers and future aerospace industry leadership to people whose race and ethnicity has made them the subject of systemic bias." Embry-Riddle has been the best-represented institution in every fellowship cohort since.

The 2023 cohort includes the following engineering students:

- Emily Burrus — Emily is also the recipient of the Patti Grace Smith Memorial Scholarship, which is offered in partnership with the Commercial Spaceflight Federation. She interned at Blue Origin.
- Xavier Goewey — Xavier interned at Sierra Nevada Corporation.
- Janae Jordan — Janae interned at BryceTech.
- Andrew Pierre-Antoine — Andrew interned at Airbus.

This story was originally written by Ginger Pinholster with Embry-Riddle's News Team.

Three Eagles Earn Fellowships to Contribute to NASA's Artemis Mission

NASA's Artemis program will land the first woman and the first person of color onto the lunar surface, equipping them with innovative technologies to explore and discover more than any astronaut has before. But NASA won't do it alone.

This summer, three students from Embry-Riddle contributed to the mission, conducting Artemis-related research at NASA facilities. They earned this once-in-a-lifetime opportunity as part of being named NASA M-STAR Fellows. Two hailed from the Department of Aerospace Engineering.

Ashley Tirado-Pujols, for instance, interned at NASA Langley Research Center, where she worked on ways to mitigate the effects of lunar dust on ceramic-coated materials used by astronauts.

"If we can understand how dust adheres to different surfaces, we are one step closer to developing prominent methods to mitigate its adhesion on aerospace structures and spacesuits," said Pujols.

John Yonkauske also interned at NASA Langley. As a research intern at NASA, Yonkauske investigated the electromechanical properties and space applications of nanotube-polymer composite materials.

This story was originally written by Mike Cavaliere with Embry-Riddle's News Team.

Embry-Riddle Ph.D. Student Brings Top-Notch Experience to Space Research

When Kyle Vernyi started his Ph.D. program at Embry-Riddle this past fall, he had already completed two internships at NASA's Glenn Research Center (GRC), where he worked closely with one of his undergraduate professors, who is also a NASA engineer, from The University of Akron.

"The projects and labs at NASA GRC span the whole engineering gamut," said Vernyi. "Getting to tour those places and meet the engineers, mathematicians, pilots and technicians was fantastic."

For his Ph.D., Vernyi chose Embry-Riddle, he said, because of its emphasis on aerospace.

"Other big-name engineering schools also have strong programs in aerospace, but at Embry-Riddle, you are totally immersed in the aerospace world, which is a unique experience," he said, adding that the university's aerospace controls faculty also attracted him.

Working in the Foundational Autonomous Systems and Technologies (FAST) lab with Dr. Merve Dogan, assistant professor in the Department of Aerospace Engineering, has been "an amazing experience," Vernyi added.

"I have learned more in a single semester of graduate school than I ever thought possible," he said. "My classwork has directly applied to my research on robotic manipulator control, and my research has likewise strengthened my understanding of the academic topics. The professors are fantastic, and I look forward to every lecture."

From Dogan's perspective, Vernyi demonstrates huge talent and potential.

"Kyle brings an unparalleled level of dedication, technical expertise and innovative thinking to the FAST lab. His experience at NASA's Glenn Research Center, coupled with his contributions to our research on experimental testbed development and control of space vehicles with robotic arms, underscores his ability to seamlessly integrate theoretical excellence with practical innovation," Dogan said. "His commitment to addressing critical challenges in autonomous space systems, aerial systems and robotics is evident in his pioneering efforts, and I am confident that his groundbreaking work will significantly contribute to the advancement of aerospace technology."

The project Vernyi worked on during his two Space Communications and Navigation (SCaN) internships at NASA — as part of the High-Rate Delay Tolerant Networking (HDTN) team — aimed to create a satellite network that would speed the delivery of information from the surface of the moon back to Earth. As he explains, the footage that was broadcast to the world during the Apollo missions was of poor visual quality. With the Artemis return to the moon, the goal is to stream 4K video. The HDTN project was launched in November 2023 on a SpaceX Falcon 9 rocket to the International Space Station, where it will be tested.

Vernyi's research at Embry-Riddle is focused on control theory, a field that is distinct from but closely related to space communications, he said.

"I really enjoy both, so I am looking to combine them in my research," Vernyi said. "For example, a multiagent system such as a drone swarm or satellite constellation uses both communication and control theory."

In March 2024, Vernyi was also awarded a SMART Scholarship.

This story was originally written by Melanie Azam with Embry-Riddle's News Team.

10 Years

In 2023, the Aerospace Engineering Ph.D. program celebrated its 10th anniversary. The department looks forward to educating future Aerospace Engineering Ph.D. students!

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

Richard Anderson, Ph.D.
Professor
University of Central Florida

Magdy Attia, Ph.D.
Professor
Texas A&M University

Mark Balas, Ph.D.
Visiting Distinguished Professor
University of Denver

Riccardo Bevilacqua, Ph.D.
Professor
Universita degli Studi di Roma La Sapienza

David Canales-Garcia, Ph.D.
Assistant Professor
Purdue University

Hancheol Cho, Ph.D.
Visiting Assistant Professor
University of Southern California

Kyle Collins, Ph.D.
Research Assistant Professor &
Director of Eagle Flight Research Center
Georgia Institute of Technology

K. Merve Dogan, Ph.D.
Assistant Professor
University of South Florida

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

William Engblom, Ph.D.
Professor
University of Texas

Habib Eslami, Ph.D.
Professor
Old Dominion University

Luis Estefano
Ferrer-Vidal Espana-Heredia, Ph.D.
Associate Professor
Ph.D., Cranfield University

Ebenezer Gnanamanickam, Ph.D.
Associate Professor
Purdue University

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

James Gregory, Ph.D.
Professor & Dean of the College of Engineering
Purdue University

Glenn Greiner, M.S.
Associate Professor
Embry-Riddle Aeronautical University

Kimberly Heinzer, M.S.
Associate Professor
Embry-Riddle Aeronautical University

Troy Henderson, Ph.D.
Associate Professor
& Honors Program Coordinator
Texas A&M University

Yizhou Jiang, Ph.D.
Assistant Professor
University of Illinois-Chicago

Daewon Kim, Ph.D.
Professor
Virginia Polytechnic Institute
& State University

Mandar Kulkarni, Ph.D.
Assistant Professor
Virginia Polytechnic Institute
& State University

J. Gordon Leishman, Ph.D.
Distinguished Professor
Glasgow University

T. Alan Lovell, Ph.D.
Professor
Auburn University

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

Reda Mankbadi, Ph.D.
Distinguished Professor
Brown University

Scott Martin, Ph.D.
Professor
University of Washington

Alberto Mello, Ph.D.
Associate Professor
University of Texas at Austin

Hever Moncayo, Ph.D.
Professor & M.S. Program Coordinator
West Virginia University

Sirish Namilae, Ph.D.
Professor & Ph.D. Program Coordinator
Florida State University

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

Morad Nazari, Ph.D.
Assistant Professor
New Mexico State University

Hao Peng, Ph.D.
Assistant Professor
Beihang University

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

Richard Prazenica, Ph.D.
Professor & Associate Chair
University of Florida

Frank Radosta, Ph.D.
Professor
University of Florida

Mark Ricklick, Ph.D.
Associate Professor
University of Central Florida

Dongeun Seo, Ph.D.
Associate Professor
& BSAE Program Coordinator
University of Texas

Surabhi Singh, Ph.D.
Assistant Professor
University of Florida

Jennifer Smith, Ph.D.
Professor
Utah State University

David Sypeck, Ph.D.
Professor
University of Virginia

Ali Yeilaghi Tamijani, Ph.D.
Professor
Virginia Polytechnic Institute
& State University

Yi Zhao, Ph.D.
Professor
Louisiana State University

Yue Zhou, Ph.D.
Assistant Professor
Binghamton University

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