#8 Aerospace Engineering
Bachelor's Program
U.S. News & World Report

AERONEWS

Department of Aerospace Engineering | Daytona Beach, Florida Campus

STUDENTS PREPARE FOR MOON MISSION

2020 ISSUE

EMBRY-RIDDLE
Aeronautical University

Message from the Chair

There is no doubt that 2020 was a turbulent year for us, but we also saw many successes come to fruition. In response to COVID-19, we moved courses online and offered a combination of face-to-face and online classes. Overall, due to our faculty efforts, students responded positively in their teaching evaluations.

The Department of Aerospace Engineering (AE) continues to grow and be the largest in the country with 1,626 bachelor's, 125 master's, and 35 doctoral students as of Fall 2020, which proved to be another record year for enrollment. It should be noted that about 12.7% of our undergraduates are honors students, while the rest of the Daytona Beach Campus has 5.5% honors students. In addition, our new master's degree in Air Worthiness is the first program of its kind and enrolled 25 in its inaugural semester last year.

I am also proud to report the undergraduate AE program continues to rank very highly at No. 8 in the nation, according to U.S. News and World Report rankings (September 2020). This is a significant accomplishment and demonstrates the program quality. Our program offers unique experiential learning through various competitions throughout the year and yields excellent results, including a second place win in the AIAA Gas Turbine Design Competition in August 2020.

The graduate program continues to thrive, ranking No. 33 (tied) in March 2020 and second in Florida. Thanks to the Graduate Assistance in Areas of National Need (GAANN) grant from the Department of Education, we are able to support 8 to10 Ph.D. students (U.S. citizens) per year.

Researchers and students at the Eagle Flight Research Center (EFRC) are continuing to work on electric and hybrid-electric propulsion systems for aviation. Under a $2.5 million dollar project in 2020, the EFRC designed, built and tested a 100+ KW hybrid-electric power generation prototype. To continue to push the envelope, another hybrid-electric power generation system using higher power to weight subsystems has been designed and the component parts are being assembled with plans to complete and run in Fall 2021.

The EFRC is also continuing to explore eVTOL vehicles as a part of the industry wide focus on UAM. The vehicle research interests include control law development, redundant flight controls, and vehicle certification of unconventional concepts.

Research expenditures also continue to increase. Sample grants that were active in 2020 include: "A Self-sustaining Wind Energy Extraction Technique (SWEET) Using Multi-level Control Design Methods," (NSF, PIs: MacKunis, Golubev, Mankbadi); "Improving Image Processing for Orbit Estimation," (Air Force, PI: Henderson); "Multiscale Optimization of Additively Manufacturable Spatially Varying Cellular Microstructures," (NSF CAREER, PI: Tamijani); "Investigation of Load Path Based Topology Optimization," (AFOSR Young Investigator Program, PI: Tamijani); "Nanoscale Design of Interfacial Kinematics in Composite Manufacturing," (NSF, PIs: Namilae, Al-Haik); "Cyberinfrastructure for Pedestrian Dynamics-Based Analysis of Infection Propagation Through Air Travel" (NSF, PIs: Srinivasan, UWF, Namilae, and Scotch, ASUI).

Many of these research endeavors are detailed in the forthcoming pages. Please enjoy this newly redesigned edition of the AE Department newsletter.

Best Regards,

A Lyrintzis

Dr. Tasos Lyrintzis
Distinguished Professor, Department Chair

Department of Aerospace Engineering | College of Engineering | Embry-Riddle Aeronautical University
1 Aerospace Boulevard | Daytona Beach FL, 32114 | **db.erau.edu/aerospace**

Eagles to Land First Student Project on Moon, Aiming to Photograph Spacecraft Landing

Dr. Troy Henderson

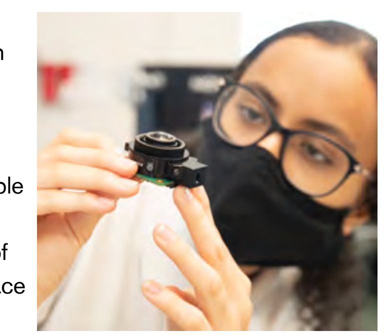
A team of Embry-Riddle students and faculty are building a CubeSat camera system that will travel to the lunar surface and capture, for the first time, a third-person view of a spacecraft landing.

Intuitive Machines, the company developing the Nova-C Lunar Lander, offered engineering students the opportunity to design and build a camera system that will deploy from the Nova-C to capture the landing and, in the process, become the first university student project ever to land on the moon.

Named in honor of the university's mascot, the EagleCam project is expected to launch on the Nova-C in the fourth quarter of 2021. It is fast becoming a valuable experience for the students, who range from sophomore through Ph.D. levels. The team, led by Dr. Troy Henderson, Associate Professor of Aerospace Engineering, consists of three faculty and 25 students.

"Students are at the center of this historic mission, getting invaluable hands-on experience and taking on lead roles in a groundbreaking project," said an aerospace engineering student Jana Alaslani.

The project began as a challenge from aeronautical engineering alumnus and Intuitive Machines President and CEO **Steve Altemus (BSAE '87)** to take the ultimate selfie. It soon evolved with the team taking on challenges in communications, dust plume effects, and the radiation environment. The mission lists multiple historic firsts, which includes the first use of WiFi on the lunar surface to transmit images. The mission also will provide data sets that will be analyzed by future students and scientists for future missions in support of the Artemis Program, NASA's return of humans to the Moon.



The team has already presented two technical reviews to government and industry volunteers who are interested in the project's technology and success. EagleCam's design is a 1.5U CubeSat (10 x 10 x 15 centimeters), which deploys from the Nova-C lander at about 30 meters in altitude. The multiple, wide field-of-view cameras will provide a 360-degree image set from deployment to a few minutes after landing. Along with the imagery, corresponding inertial measurement unit data will be used (after the mission) to reconstruct the trajectory of EagleCam and generate high-resolution 3D maps of the local terrain.

The team will test an electrodynamic dust removal system, a technology developed by NASA Kennedy Space Center, on one of the cameras. This technology will verify what NASA researchers have seen in the lab, but have yet to see on the Moon — that the fine lunar regolith can be removed from surfaces.

CONTINUED ON NEXT PAGE

In order to ensure that the system survives the free-fall landing, the EagleCam team has performed a series of drop tests. A testbed was built, with partial funding from the Air Force Research Lab, which replicates the lunar surface. The 4- x 3-foot test area is enclosed on the sides and instrumented with multiple cameras, including a camera capable of 1,000 frames per second, for analysis of the impact. So far, the structure has survived landing speeds expected on the Moon. More tests, inclusive of WiFi data streaming, are planned for Spring 2021.

Questions (or offers to volunteer your experience) may be directed to Dr. Troy Henderson at **hendert5@erau.edu**.

Embry-Riddle to Demonstrate Dust Shield on Lunar Surface

Dr. Troy Henderson (Funded by NASA Kennedy Space Center)

As part of the EagleCam project, Embry-Riddle has teamed with the NASA Kennedy Space Center to demonstrate an electrodynamic dust shield (EDS). Dr. Troy Henderson, Associate Professor of Aerospace Engineering, is leading the funded research.

Since the Apollo missions, the fine lunar regolith has demonstrated an ability to electrostatically stick to space suits, camera lenses, and other hardware. The NASA-developed EDS system will be integrated into two of the camera lenses of EagleCam by Embry-Riddle faculty and students. Upon landing on the surface, lunar regolith will degrade the image from the camera by coating the lens.

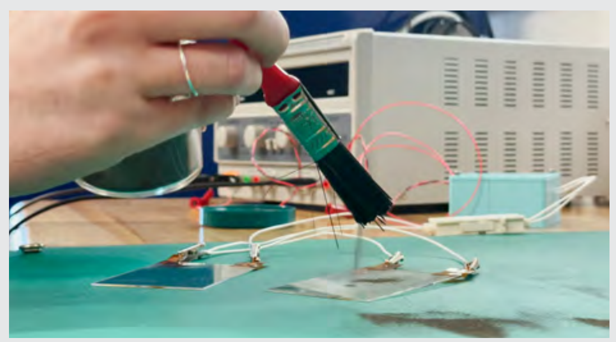
The EDS uses an electric field to remove the dust. The experiment, which will be the first ever demonstration of the EDS technology on the lunar surface, will include images from before and after the EDS operation to determine the efficiency of dust removal.

"It's exciting to be working with Embry-Riddle students to demonstrate the EDS on the lunar surface.

The data from a successful test could impact future space missions, including the return of humans to the Moon," said alumnus **Dr. Charles Buhler ('95)**, Senior Research Scientist at NASA Kennedy Space Center's Electrostatics and Surface Physics Laboratory.

NASA Senior Research Scientist Charles Buhler (left) talks with EagleCam lead engineer and Ph.D. student Christopher Hays about the project.

Buhler and a team of NASA engineers delivered a laboratory unit to a group of excited students and faculty in the Embry-Riddle Space Technologies Laboratory on Jan. 29. During his visit, Buhler an engineering physics alumnus, trained the EagleCam team on how to use the lab unit to test dust removal in air, and under vacuum, and discussed the unit's ability to remove dust on images. Continued experiments will help finalize the EDS that will operate as part of EagleCam.



A student applies a dust simulant to the Electrodynamic Dust Shield in preparation for a test.

Doctoral student **Christopher Hays (BSAE '19, MSAE '20)** was among the EagleCam team members taking receipt of the EDS. Hays, a lead engineer, is researching image processing methods for space systems to address lens degradation due to dust or radiation effects.

"This is a great experience for ERAU students to interact with NASA engineers who are experts in dust mitigation," said Hays, who earned a bachelor's and master's in Aerospace Engineering.

RESEARCH NEWS

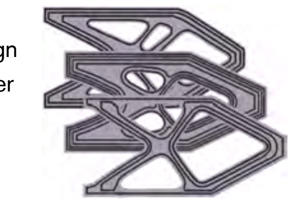
Topology and Fiber Path Optimization of 3D Printed Continuous Fiber Composites

Dr. Ali Tamijani (Funded by the Office of Naval Research)

Additively manufactured (AM) fiber-reinforced polymer composites have shown great potential for functional end-use applications.

This technology can distinguish itself from conventional composite manufacturing methods by enabling a variety of complex geometries, eliminating the need for molds/tooling, out-of-autoclave processing, and a reduction of material waste. Accompanying these improvements is the ability to tailor the placement and orientation of fiber reinforcement within each composite lamina to improve part performance for a given state of loading. AM is inherently well-suited for integration with optimization schemes as the geometrically complex models produced through optimization can be sent directly to a 3D printer.

In the research supported by ONR, Embry-Riddle is collaborating with the University of Texas at Austin to create and experimentally validate an innovative framework for design optimization of continuous fiber paths and geometric shape and layout in order to achieve unprecedented mechanical performance in multi-layer 3D printed composite structures. The optimized designs will be manufactured on an in-house built continuous fiber fused filament fabrication printer, and the mechanical properties and failure mechanics of 3D printed continuous fiber composites will be studied through computational analysis and experimental testing.



Multi-layer continuous fiber composites with optimized topology and fiber paths developed by Dr. Ali Tamijani's research group in collaboration with UT Austin.

The proposed framework will allow a paradigm shift from conventional unidirectional fiber designs to manufacturable continuous fiber 3D printed composites.

Thermo-mechanical Optimization for Optical Instruments

Dr. Ali Tamijani (Funded by the NASA Center Innovation Fund)

Optimized space optical mount developed by Dr. Tamijani's research group in collaboration with NASA JPL.

The NASA Jet Propulsion Laboratory (JPL) recently developed a gradient-additive manufacturing technique that melds multiple metals into a single part.

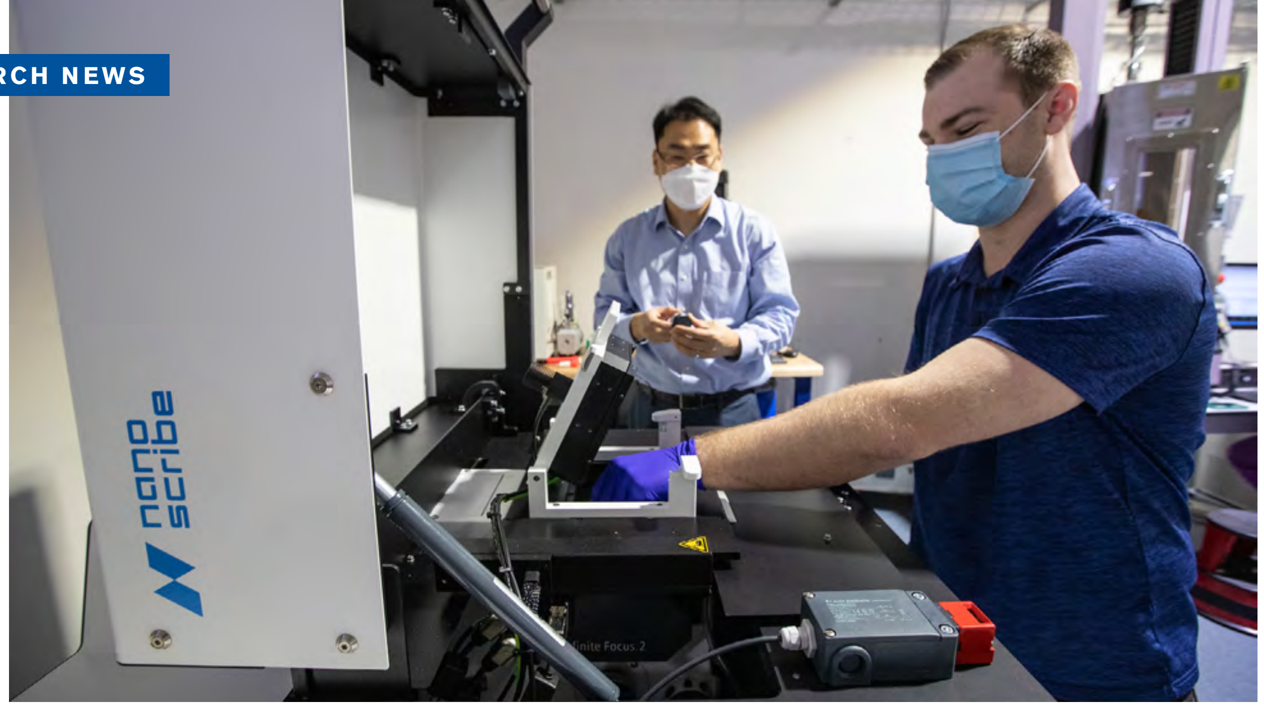
Multi-material additive manufacturing is particularly useful in aerospace applications where structures are subjected to large mechanical and thermal loads.

In general, a single material will not simultaneously have optimal strength, stiffness, and thermal expansion characteristics for a given application. By using multiple materials, where each individual material has some unique advantage, parts can be tailored to have specific mechanical and thermal characteristics that would otherwise be impossible using just one of those materials.

In the research supported by the NASA Center Innovation Fund, Embry-Riddle is collaborating with JPL to integrate fabrication and characterization techniques with novel computational methods to design, analyze, and experimentally validate graded structures for a space optical mount. Such graded structures will be lightweight, strong, and stiff, while performing under high temperatures and in harsh environments.

The design methodology developed under this project will provide a precise control over graded composition and will lead to designs that can eliminate unwanted thermal expansion, cancel out the expansion of neighboring materials, and eliminate thermal expansion mismatch.

The computational analysis and design will be accompanied by experimental tests in order to derive the material models, analyze the homogeneity of the 3D printed samples, and compare the modeled and printed material compositions.



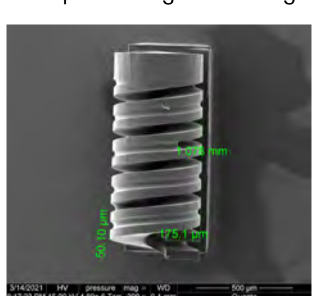
Machine Capable of 3D Printing Nanoscale Objects to Revolutionize Embry-Riddle Research

Dr. Daewon Kim, Dr. Marwan Al-Haik, Dr. Ali Tamijani, Dr. Foram Madiyar & Dr. Eduardo Rojas
(Funded by the National Science Foundation Major Research Instrumentation Grant)

Fabricating objects from their smallest components up is the work of nanoscale 3D printers, traditionally rare devices for scientists to acquire given their cost and sophistication. These machines can potentially be the key to breakthroughs in healthcare and manufacturing, however, offering researchers the ability to build and study objects at the nanoscale level.

That is exactly the hope of researchers at Embry-Riddle, who won a $524,000 grant from the National Science Foundation to bring a nanoscale 3D printer to the Daytona Beach Campus.

For context, a single strand of human hair is anywhere from 50,000 to 100,000 nanometers wide. A red blood cell has a width of 7,000 nanometers. With the ability to create objects this small, Eagle researchers like Daewon Kim, Associate Professor of Aerospace Engineering and Principal Investigator of the grant project, are hoping to not only unlock secrets about the material world, but also greatly expand collaboration opportunities for graduate, undergraduate and even K-12 students throughout the region.



Test print of a helical actuator.

"Here is a 3D printer with features as small as 160 nanometers," Kim said. "Questions we only imagined before, such as what if we can make micro-channels to advance our understanding of breast or colon cancers, or what if we can fabricate artificial muscles that behave similarly to real muscles, could be answered through various investigations we can do using this instrument."

The new equipment will enable Embry-Riddle researchers to fabricate nano to microsize materials and structures with smart actuation and sensing, optimize metamaterial structures and polymer curing, and fabricate micromechanical and microfluidic devices to study biochemical processes and cancer.

As Embry-Riddle enhances its research in aerospace structures and materials, sensing, aerospace biology and physiology, the sophisticated 3D fabricator will help to connect the university with other institutions, Kim said. By enabling "a regional hub for nano-fabrication research," the instrument should also attract partnerships with corporations at Kennedy Space Center and companies located in Embry-Riddle's John Mica Engineering and Aerospace Innovation Complex (MicaPlex).

"As a major regional resource, this state-of-the-art 3D nano/micro fabrication system will propel a broad range of new aerospace research," Kim said.

RESEARCH NEWS

Grant Enables Breakthroughs in Nondestructive Evaluation of Engineering Materials

Dr. Marwan Al-Haik, Dr. Eduardo Divo, Dr. Sirish Namilae, Dr. Eduardo Rojas & Dr. Foram Madiyar
(Funded by the National Science Foundation, Major Research Instrumentation Grant)

Thanks to a recent National Science Foundation award, a team of Embry-Riddle researchers will soon acquire a state-of-the-art TriboIndenter (TI-980, Bruker™) nanoscale characterization system to empower research in aerospace materials, thin films, and biomaterials.

Funded through the Major Research Instrumentation program grant, the TI-980 system provides unique mapping of the mechanical, electrical and microstructural facets of materials in a number of fields such as nanocomposites, smart materials, inkjet-printed conductive films, coatings for nuclear fuel cladding, phase-changing materials and biomaterials. The system enables mechanical testing under static and dynamic loads, mapping electrical resistivity with deformation, tribology and adhesion characterization of surfaces and interfaces and elucidating the mechanical behavior of materials at elevated temperatures as high as 800 °C. The system also furnishes imaging capabilities using optical microscopy, atomic force microscopy, scanning probe microscopy and florescence microscopy.

The instrumentation will help enable researchers to:

- Map the properties of heterogeneous biomaterials, 3D printed smart materials, and nanocomposite materials to their microstructure.
- Facilitate unprecedented simultaneous characterization and imaging of phase-changing materials at the onset of their transition temperatures.
- Integrate (in collaboration with national labs and researchers at other universities) the high temperature measurements with simulation to advance fundamental knowledge of thin films' structural stability.
- Lay the foundation for needed microstructure properties' additive manufacturing processing correlations to establish the durability of 3D printed thick-film dielectrics and electric conductors for antennas and electronics under harsh environments.
- Help establish the elastic and viscoelastic properties of novel synthetic arterial grafts and shunts to ensure structural compatibility, achieve optimal compliance, and prevent cardiovascular malfunction.
- Provide crucial tribological insights of 3D printed dielectric metal-elastomers composites and establish their deformation-electric current constitutive behavior.
- Enrich research collaborations both within the university and other schools and with R&D small businesses.

This specialized equipment will also create a new pipeline of skilled nano-characterization researchers from a large and ethnically diverse pool of graduate and undergraduate students. The acquisition of the TI-980 system is crucial to ensure that both Ph.D. and master's students at Embry-Riddle have access to state-of-the-art facilities to improve the quality of their research.

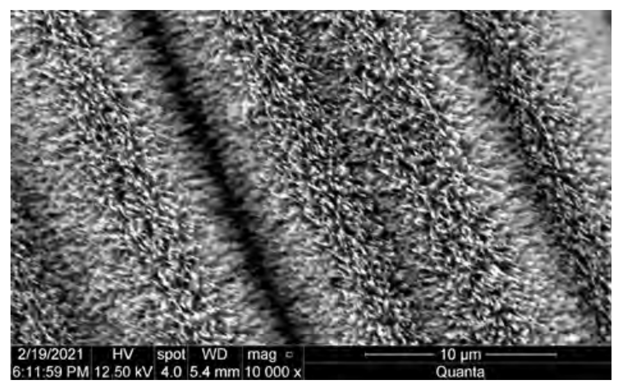
It's reach will also extend into the community. Nanotechnology will be introduced to K-12 students through STEM programs including Girls in Engineering Math and Science summer camp programming at Embry-Riddle. Public understanding of nanotechnology will be heightened through an exhibit at the Daytona Beach Museum of Arts and Sciences.

This exhibit will introduce some aspects of nano-biotechnology to the museum visitors by displaying enlarged scanning probe microscopy, scanning electron microscope images and results of nanoindentation and nanoscratch tests performed on human teeth and on local Florida species (e.g., alligators and sharks) and fossils provided. The exhibit will also draw interest in STEM-related topics especially from local youth participating in museum summer camps.

Building Stronger Composite Parts

Dr. Sirish Namilae & Dr. Marwan Al-Haik (Funded by National Science Foundation)

Embry-Riddle is leading an initiative to improve the performance and manufacturing capability of materials used to produce aircraft and other aerospace equipment, and including students as young as high school-level in the hands-on operation, thanks to a National Science Foundation grant of $392,000.



Images from the electron microscope depict the carbon fibers before and after growing the zinc oxide (ZnO) nanowires. The ZnO nanowires strengthen the interface between the carbon fiber laminates — which is the weakest zone in structural composites — through a mechanism identical to Velcro.

The Eagle researchers who received the three-year grant — Aerospace Engineering Associate Professor Sirish Namilae and Professor Marwan Al-Haik — are developing new methods to investigate and improve the manufacturing of composite materials, which make up more than 50% of the construction of newer aircraft, such as the Boeing 787.

According to Namilae, the research is pioneering because it explores how composite materials react while they are being cured, which is when they are susceptible to defects.

"The key innovation is we're doing this during processing," said Namilae, adding that the project involves a custom-built autoclave similar to ones used by manufacturers, but with viewports, or windows. The viewports allow the researchers to use an observation technique known as digital image correlation to watch deformations develop that can lead to defects in the final product.

Composite defects can require redesigns, not only of aircraft but also of the civil infrastructure in which they are used. Wrinkles in composite materials, for example, Namilae said, can reduce a material's strength by up to 30%.

The research will help produce "optimum curing cycles," Namilae said, or recipes for making better, stronger composites.

Once the researchers have perfected in situ diagnostic techniques for manufacturing composite materials, they will experiment with using nanoscale components such as zinc oxide (ZnO) nanowires between the composite layers.

The ZnO nanowires strengthen the interface between the carbon fiber laminates — which is the weakest zone in structural composites — through a mechanism identical to Velcro. Basically, the ZnO nanowires will mechanically interlock with the adjacent carbon fibers, providing more resistance against mechanical loads.

In addition, ZnO can convert mechanical deformations into electrical energy, which allows the developed composites to have added functionalities such as sensors that monitor their structural health.

The research will involve Embry-Riddle graduate students, undergraduates and even interns from local high schools, who will be paired with the graduate students. Studies have shown that exposing younger students to hands-on lab work can draw them into STEM fields, Namilae said.

RESEARCH NEWS

Pedestrian Movement, Disease-Spread Modeling Helps Fight COVID-19

Dr. Sirish Namilae (Funded by the National Science Foundation)

How people move through a given space may offer clues to how infectious diseases, like COVID-19, spread. Dr. Sirish Namilae, an Associate Professor of Aerospace Engineering at Embry-Riddle, is refining research he conducted on pedestrian movement — amplifying it with new data and disease-spread modeling — to help develop social distancing strategies as the world confronts the COVID-19 pandemic.

"We want to get an aggregate idea of how people are moving," Namilae said. "For this COVID problem, the research is even more relevant."

Namilae started researching pedestrian movement during the 2014 Ebola epidemic in Africa. Last year he was awarded a $600,000 National Science Foundation (NSF) grant to develop a cyberinfrastructure for this problem. He was recently awarded another $200,000 NSF RAPID grant, to incorporate new streams of data — from video footage from worldwide public-domain webcams, as well as from cellphone location systems — into pedestrian dynamics modeling. The mathematical models of pedestrian movement are based on the movement of particles, such as molecules, and were originally developed in materials science.

"All of this comes together so we can look at pedestrian data more comprehensively," Namilae said, adding that he will be working with colleagues from the University of West Florida, Purdue University and Arizona State University, as well as with students from Embry-Riddle.

The result of their research will be a cyberinfrastructure, or software system, useful to such decision-makers as civil engineers, aviation workers and public health professionals as they work to design the most efficient social distancing guidelines. The modeling could then be used to inform policies designed to mitigate local outbreaks of infectious diseases.

"[The software] will help determine the best tactics, for example, in an airport," Namilae said. "How should the security queue be designed? How should a building be designed?"

Theme parks are another example of a venue where crowds mix intensely. Additions to traditional serpentine lines that reduce mixing, such as temporary walls between the lanes of customers, can reduce infection rates to 25% of what they would otherwise be, Namilae said. Single-file lines represent an even more drastic reduction.

By simulating many variations of different kinds of situations with pedestrian modeling and combining them with infection modeling, Namilae said it is possible to identify and quantify vulnerabilities, and determine crowd management strategies that may lead to lower infection rates.

BY MICHAELA JARVIS

Modeling for COVID-19

To reduce the spread of illness, some airlines have been keeping middle seats open, which is effective in reducing infection risk. Preliminary research based on computer simulations, however, suggests that random boarding of aircraft, rather than back-to-front boarding – a procedural response to the COVID-19 pandemic – may have an even greater impact, reducing exposure rates by about 50 percent.

These findings are still in the process of being peer reviewed, but if confirmed they suggest that airlines should either revert to their earlier boarding process or adopt the better random process. This study is part of a body of work co-authored by Dr. Sirish Namiliae, Associate Professor of Aerospace Engineering, and collaborators from the University of West Florida, Florida State University, and Arizona State University.

NEW ASSISTANT PROFESSOR: DR. K. MERVE DOGAN

The Aerospace Engineering Department welcomed Assistant Professor Dr. K. Merve Dogan to Embry-Riddle in August 2020. She received her Ph.D. from the University of South Florida (USF) in 2020. She is a recipient of the 2020 Outstanding Thesis and Dissertation Award (USF), 2019 Student Best Paper Award (Adaptive and Learning Control Systems, IFAC, Winchester, UK), and 2019 Best Session Presentation (in AIAA Guidance, Navigation, and Control Conference, San Diego, California). Her co-authored paper titled "Learning control of robot manipulators in task space" is listed in the 2019 Top 20 Most Read Papers (Asian Journal of Control). Dogan's research specializations include adaptive systems and learning, autonomy, flight dynamics and control. She has co-authored more than 45 peer-reviewed papers in top internationally recognized journals and conferences in these research areas.

DR. VLADIMIR GOLUBEV RECEIVES FULBRIGHT SCHOLARSHIP

Thanks to a Fulbright U.S. Scholarship award, Aerospace Engineering Professor Dr. Vladimir Golubev is advancing alternative wind energy initiatives with faculty engaged in similar research at Nazarbayev University in Kazakhstan. Several projects will be investigated with the host institution in order to share complementary expertise in theoretical, experimental and numerical research in unsteady aerodynamics, aeroacoustics, aeroelasticity, and flow and flight control.

DR. ALI TAMIJANI RECEIVES ERAU OUTSTANDING RESEARCHER OF THE YEAR

Associate Professor of Aerospace Engineering Dr. Ali Tamijani has been once again recognized for his excellence in research. He is the recipient of the 2020 Professor Abas Sivjee Outstanding Researcher of the Year Award. The Embry-Riddle award, bestowed by the faculty senate, recognizes and honors the full scope of research and associated scholarly contributions produced by Tamijani.

In 2019, Tamijani won the coveted National Science Foundation Career Award for research that could lead to more lightweight, efficient aircraft wings, orthopedic implants and other consumer technologies. He is also recipient of the Air Force Office of Scientific Research's Young Investigator Award, Air Force Summer Faculty Fellowships, and a NASA Jet Propulsion Laboratory Faculty Fellowship. His research focuses on the heterogeneous design for additive manufacturing and multi-scale and multi-disciplinary optimization with applications in aeroelastic tailoring, biomedical devices, and space optical instruments. Tamijani is the Associate Editor of the Journal of Aerospace Science and Technology.

Aerospace Engineering Faculty Make Top 2% Scholarly Impact List

A Stanford University study has created an international list of the world's top 2% of scientists recognized for their scholarly impact (excluding self-citations): **https://journals.plos.org/plosbiology/article?id=10.1371/journal.pbio.3000384**

There are 979 names in the Aerospace Engineering discipline. The following Embry-RIddle Distinguished Professors are recognized in this list:

Dr. Gordon Leishman #35, Dr. Mark Balas #39 (visiting), Dr. John Ekaterinaris #210, Dr. Tasos Lyrintzis #523, and Dr. Reda Mankbadi #667.

Graduate Program News

The Aerospace Engineering Department is proud to highlight the following Ph.D. students.

ELIAS WILSON (BSAE '18, MSAE '19) was awarded the Department of Defense Science, Mathematics, and Research for Transformation (SMART) Scholarship-for-Service Program. Wilson is advised by Dr. Richard Prazenica and conducting research on model predictive control algorithms with online learning for complex nonlinear dynamical systems. Wilson has applied these methods to develop autonomous control algorithms for rotorcraft autorotation under power loss conditions and is now extending this research to explore the decision-making capabilities of these algorithms within stochastic aerospace systems, such as missile defense systems and aerial cargo delivery vehicles.

NICHOLAS PETERS (BSAE '18, MSAE '20) joined the NASA Ames Aeromechanics Branch Pathways Program over the summer of 2020. He assisted with NASA's Revolutionary Vertical Lift Technology program with a role in assisting with the development of an acoustic model for rotor blades, which can be used to provide high-fidelity results in the early conceptual design phase of vehicle development. For his Ph.D. research Peters is working with Dr. John Ekaterinaris on reduced order models for store separation.

FREDERICK T. SCHILL (BSAE '20, BSCM '20) received the Drs. Charles and Elizabeth Duva Endowed Fellowship in Aerospace Engineering. Schill is working with Dr. Hever Moncayo and investigating machine-learning techniques to increase aviation safety. He is specifically studying how deep reinforcement learning combined with other bio-inspired techniques can be used to estimate the interactions between pilot-human and machine-vehicle, and to determine potential solution mechanisms to predict undesired dynamics that can lead to accidents. The solution he is proposing can be extended to other domains such as cybersecurity, fault tolerance, or even increasing autonomy of cyber-physical systems with self-learning, self-accommodation, adaptation and self-healing characteristics.

PH.D. PROGRAM UPDATE

In 2013, the department added the Ph.D. to its degree program offerings, bringing comprehensive aerospace engineering to central Florida. The program started with two Ph.D. students and its progression has been steady and strategic. As of Spring 2021, 41 Ph.D. students are enrolled and 18 students have graduated.

The department is proud of its 2020 doctoral graduates: Sam Salehian (advisor Dr. Reda Mankbadi; currently Assistant Professor at Tuskegee University), Dhuree Seth (advisor Dr. Gordon Leishman; currently post doc at Ohio State), Naveen Uddanti (advisor Dr. Yechiel Crispin, currently at Mathworks).

In 2018, the Aerospace Engineering Ph.D. program received a grant from the U.S. Department of Education, as part of the Graduate Assistance in Areas on National Need (GAANN) program. This government program provides fellowships, through academic departments and programs, to assist graduate students with excellent records who demonstrate financial need and plan to pursue the highest degree available in their course study at the institution in a field designated as an area of national need. In 2020, three students received the GAANN fellowships program: Kaela Barrett, Christopher Hays, and John Zelina. This brings the total number of the GAANN fellowship recipients to 11.

Aerospace Engineering undergraduate student Joseph Thiemer is part of the team converting a Diamond HK-36 for electric propulsion.

It's Electric! Diamond HK-36 Project Reaches Milestone

Dr. Pat Anderson, Dr. Kyle Collins, & Dr. Jianhua Liu

After nearly four years of perseverance, the Eagle Flight Research Center (EFRC) team celebrated a milestone in its electric propulsion research: its Diamond HK-36 completed a successful taxi test exclusively on electrical power at the Daytona Beach International Airport.

The fully electric propulsion system for the eSpirit of St. Louis brings aviation a step closer to cleaner and quieter flight — objectives that could revolutionize commercial aviation.

Dr. Richard "Pat" Anderson, Professor of Aerospace Engineering and director of the EFRC, piloted the experimental aircraft with student Joseph Thiemer as co-pilot. During the taxi session, Thiemer programmed and monitored parameters in the motor inverter/speed controller and monitored the battery management system.

In total, the eSpirit taxied about a quarter mile during its initial test on Nov. 16, 2020.

Faculty provide oversight as three aerospace engineering students (Thiemer, Sanay Satam and Roberto Muntaner Whitley) work on overall implementation, project planning and management, test procedures and execution.

While the technology employed for the eSpirit's electric motor and inverter is currently used in the automotive industry, the EFRC designed its own battery packs for the aircraft. Unlike other electric aircraft that have dedicated spaces for battery packs, the EFRC design allows the packs to conform to irregular and small spaces.

"Battery weight is the critical factor when it comes to designing electric aircraft battery packs. To achieve this, the batteries operate near maximum performance and, as a result, generate heat. Care must be taken to design battery packs that can be cooled," said Dr. Kyle Collins, Research Assistant Professor at the EFRC.

The packs used for the taxi test are a first generation design. New equipment and research performed over the past year enabled the EFRC to bond the battery cells together, which has led to a more advanced, liquid-cooled pack design.

The new second-generation battery pack technology will power the eSpirit's flight — relying solely on electric propulsion — in mid 2021.

EAGLE FLIGHT RESEARCH CENTER

The center studies four key areas of aviation technology: propulsion, unmanned autonomous vehicles, manned flight control and certification. This includes projects related to electric and hybrid electric flights, novel UAVs and unleaded aviation fuels.

RESEARCH NEWS

Dr. Kyle Collins compares the PAV-ER rendering to the urban air mobility (UAM) vehicle taking shape.

Distributed Electric Propulsion is Highlight of New Air Vehicle

Dr. Pat Anderson & Dr. Kyle Collins

Embry-Riddle's new personal air vehicle, known as PAV-ER, combines a decade of electrified propulsion progress, innovative control laws and autonomy research into a proof of concept that could propel the future of urban transportation.

As more than 250 companies around the world race to become UAM vehicle manufacturers, Embry-Riddle is demonstrating its leadership in the field by building a manned experimental aircraft with distributed electrical propulsion and helicopter rotor blades.

For researchers, the PAV-ER project is the next logical step to merge 10 years of technology development with an 8-rotor eVTOL aircraft that employs cyclic propeller pitch for transition between vertical to horizontal flight modes.

"We developed all the underpinnings of UAM technology here and all that was remaining was to merge them into a technology demonstrator vehicle," said Richard "Pat" Anderson, director of the University's Eagle Flight Research Center (EFRC), one of the nation's leading researchers in alternative propulsion.

Valuable lessons learned and experiences gained through previous projects at the EFRC culminated in late 2019 with the development of PAV-ER, a 500-pound technology demonstrator.

Working alongside faculty researchers, aerospace and mechanical engineering students are regularly testing the capabilities of PAV-ER's eight distributed electric propulsion units, which can change thrust by employing three different strategies. Inspired by their in-house UAV's propulsion system of pods, they successfully demonstrated the scalability of the models on the PAV-ER. The vehicle is able to create thrust, or control, or a combination of thrust and control through its ability to control each hingeless prop-rotor independently or in unison, in addition to its ability to change motor RPM.

"Being able to switch across these three control strategies makes the PAV-ER testbed an invaluable tool in understanding how these types of aerospace vehicles should be certified depending on the thrust, lift, and control strategy used," Anderson said.

Control is possible through the ability to generate longitudinal and lateral moments creating significant control authority in nominal and even degraded situations. Following propulsion simulations in MATLAB and Simulink, researchers developed the fly-by-wire flight control laws for a full vehicle simulation in preparation for the actual flight tests.

The student-centered project also gave the future engineers an opportunity to experiment first-hand with initial autonomous flight testing. Most of the research has focused on increasing reliability and the vehicle's ability to accommodate in-flight failure, such as the loss of a rotor head.

"We have been able to demonstrate that PAV-ER's distributed propulsion architecture and the high control authority of each pod allows the vehicle to continue flight with at least one failed rotor," Anderson said. "This begins to align with airline-type safety requirements, which makes the vehicle safer than standard helicopters."

Researchers plan to continue to test and refine flight control algorithms and systems to be used in eVTOL vehicles of the future.

Design Build Fly Team Steps Up to AIAA Challenges

In light of the pandemic, the Design Build Fly student team had a successful 2020 season and has continued to see success in the current 2021 season.

In the 2020 season, students working under Distinguished Professor Gordon Leishman were challenged by AIAA to design a banner-towing and passenger service capable aircraft. More than 100 student teams from around the world participate in the fly-off competition where Embry-Riddle often places within the top 10.

The 2020 season was judged solely on report scores, with Embry-Riddle placing No. 23 out of 100-plus teams and scoring four points higher than their 2019 report score.

The current 2021 AIAA design challenge is to create an aerial sensor-towing aircraft that is additionally capable of transporting sensors to deployment locations. This season

Aerospace Engineering students pose for a photo during the January 2020 AIAA SciTech meeting in Orlando, FL.

has seen the Design Build Fly team expand its precision manufacturing capabilities tenfold along with a promising prototype aircraft already undergoing regular flight testing.

Rocket Club Changes Gears, Enjoys Busy Year

Embry-Riddle's rigorous COVID-19 risk mitigation protocols have challenged, but not slowed work by the Aerospace Engineering Department's rocket engineering student clubs.

Embry-Riddle Future Space Explorers and Developers Society (ERFSEDS)

ERFSEDS team members have completed their Preliminary Design Review for Project Artemis, their entry in the 2021 Spaceport America Cup, scheduled for June 2021 in Las Cruces, NM. The Spaceport America Cup engages more than 100 university student teams around the world in a rocket engineering competition. ERFSEDS is a two-time past winner.

Artemis is a 91-pound, 18-foot, two-stage rocket with a target altitude of 25,000 feet. For the first time, Artemis will feature a solid propellant motor designed, built, and tested by the student team. The student team leader is Aerospace Engineering Senior Brian Danaher. The team's certified high-power flyers this year are Justin Nauman and Kaitlyn Bridge. They are advised by Professor Eric Perrell.

Experimental Rocket Propulsion Laboratory

The past year's challenges have dictated that most of the club's efforts focus on computational modelling for Projects Spectre, and Harpy, their liquid and hybrid engine RDT&E projects, respectively.

They were, however, able to complete design and construction of a new larger rocket engine test stand and perform a series of experiments on single element, impinging, and bi-swirl liquid propellant injectors.

Engineering procedures and safety protocols have been written for further uses of the stand and injectors in the engine programs. Aerospace Engineering graduate student Ben Malczewski is the Experimental Rocket Propulsion Laboratory's lead engineer.

CubeSat to Help Study Solar Behavior

In 2020, the AIAA student chapter's astronautics team developed a 12U CubeSat payload proposed for use in a constellation of spacecraft in heliocentric orbits that will provide multiple data points for solar behavior.

As American and international space agencies are planning to establish a long-term human presence in deep space, it is crucial to understand risk associated with solar activity. The Solar and Coronal Observation of Radiation and Catastrophic events to Humans (SCORCH) CubeSat is a response to NASA Strategic Knowledge Gap II-A, which is the need to "Define active regions that are potential Solar Energetic Particles/Coronal Mass Ejection sites over the 1/2 of a solar rotation."

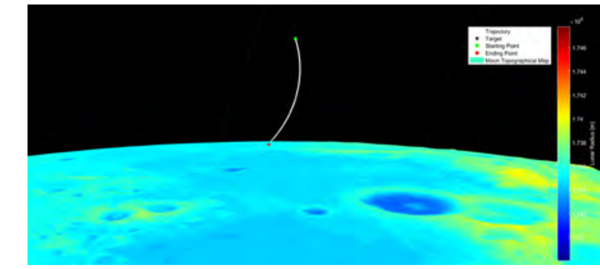
This project earned the team first place honors from the Embry-Riddle Student Research Symposium in December 2020.

Topology Data Improves Spacecraft Lunar Landing, According to Student's Award-Winning Research

Aerospace engineering student Brennan McCann (BSAE '19, MSAE '20) took first place in AIAA's master's category of the 2020 Regional Student Conference. His paper, "Utilizing Topology Data to Facilitate Geometric Control of a Spacecraft During Lunar Landing," identifies a method to ensure spacecraft can orient properly upon landing by modeling the landing at the Apollo 11 site, known as Mare Tranquilitatis.

According to his research under Assistant Professor Morad Nazari, geometric mechanics considers that both translational and rotational motion occur simultaneously. Most landing spacecraft have a main engine or set of engines in a fixed orientation, requiring the entire vehicle to rotate to point the main engines to control translational motion, thus making it susceptible to landing problems.

By using topology data to help with motion planning, McCann found that the final position and orientation of the spacecraft could be planned so that not only could the spacecraft land in the target location, it would land flush



against the surface and in the correct orientation.

McCann, who envisions a career in mission planning or guidance navigation and control for robotic spacecraft, focuses his research on constrained motion analysis and trajectory optimization, both within the framework of geometric mechanics. He found the student competition to be a good way to prepare for his career and look ahead at the state of the field.

"Seeing other people's research gives a good context for what work has and hasn't been done," said McCann, now a Ph.D. student. "It helps you understand where developments can be made and spurs more research."

Students Take 2nd place in AIAA Engine Design Competition

Aerospace Engineering students recently designed a jet engine for a supersonic business jet with the capability of producing a maximum flight speed of Mach 3 and cruise speed of Mach 0.95.

Similar to the engine in the Lockheed SR-71 Blackbird — known as the world's fastest non-rocket powered aircraft — students were inspired by the engine's architecture and performance for their design. Working under advisor and Associate Professor Mark Ricklick, their engine design achieved fuel efficiency targets at both subsonic and supersonic speeds.

The novel design earned the five undergraduate students second place from the AIAA Gas Turbine (Engine) Design Competition. The students, who are enrolled in the Aerospace Engineering propulsion track, include Bruno Aranda, Jorge Clares, Jesus Ferrand, Michael Scott, and Fahad Vavdiwala

Aranda, the team lead, said the competition offered the group a unique experience that pushed them beyond conventional classroom lessons. "It gave us opportunities to network with industry and academic leaders as well as learn from other university competitors around the world."

A cut-away view of the jet engine design displays the integration of the components designed by the Aerospace Engineering student team. The design earned the students second placed from the AIAA Gas Turbine (Engine) Design Competition.

Students were required to respond to AIAA's Request for Proposal. They determined a hypothetical solution, tested the hypothesis, evaluated its effectiveness and prepared a report for review by experts in the field.

Much like the rest of the world's office workers, students found themselves contending with a temporary pivot to online classes in March 2020. Teammates were suddenly split up and living in the U.S., Mexico, and Pakistan.

"There is no doubt that COVID-19 played a big part on how we completed this design," Aranda said. "Trust and time management was the key to our success."

Student Earns AIAA Diversity Award

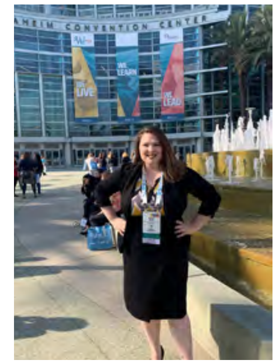
An active student leader, Natalie Hahn helps cultivate an atmosphere to equip underrepresented students for success. Her dedication to diversity and inclusion earned her an award from the AIAA Diversity Scholars Program.

The program provides opportunities for underrepresented students who are pursuing a degree in aerospace to attend an AIAA forum or event. Thanks to the initiative, Hahn attended the AIAA Ascend conference in November 2020, an online event designed to accelerate space commerce, exploration and new discovery.

"This award means so much to me," Hahn said. "It showcases that the aerospace community celebrates diversity and is willing to demonstrate that there is a place for diverse members in the community itself."

Hahn's own personal experience motivated her to help others. Inspired by her brother, who was born with a disability, she has been an activist for extending STEM programs to youth of varying abilities.

"As an aerospace engineering student, I fall into many diverse groups myself. From being a first generation college student, a member of the LGBTQIA+ community, and a woman in STEM, I have organizations and networks that allow me to speak freely without fear of being my true self," she said.



Natalie Hahn is an active member of the Society of Women Engineers and is pictured at an event in 2019.

As the founder and president of Valkyrie, Hahn established the campus organization to give women and other marginalized genders the tools they need to excel professionally, academically and socially. She has also served as past president for the Society of Women Engineering and as COO of Reinvented Magazine — the nation's first print magazine for women in STEM, and participated in Out 4 Undergrad Engineering Scholars, an LGBTQIA+ organization.

BY KELLY PRATT

Autonomous Robot Harvests Microplastics From Sand

In January 2019, first-year student Grace Robertson was involved in a beach cleanup, when she noticed tiny pieces of plastic in the sand that were too small to pick up and that tended to break into smaller pieces. She started doing research and found out that these bits of plastic pollution, called microplastics, are in the air we breathe, the food we eat and the water we drink.

"I knew there was an engineered solution that, if we worked hard enough, we could find," Robertson says.

She embarked on a project to design a method to extract the microplastics from beach sand. Now a junior studying aerospace engineering, Robertson says her goal is to decrease the number of particles that "end up in the ocean, consumed by wildlife, in freshwater systems, or in the atmosphere."

Supported by a grant from the Embry-Riddle Office of Undergraduate Research, Robertson is the team lead and works with three other undergraduates, Emma Bucey, Jackson Schuler and Matt Liepke.

Student Grace Robertson is working to develop a "beach Roomba" that will clean microplastics from the sand at beaches.

Using a custom designed 3D-printed setup paired with parts commonly used in drones, the plastic extraction method has proven to have a 93% average efficacy rate when separating particles at the density found to be present on beaches in the Daytona Beach area. This extraction method is meant to be used autonomously and on board a robot, as designed by the team.

"Engineering a solution like this is not necessarily in our immediate field of work, but it makes us better engineers," Robertson said. "Interdisciplinary research can teach you things well beyond the classroom experience."

Alumna Named to Forbes 30 Under 30 List

An Embry-Riddle alumna with aspirations of becoming an astronaut has been recognized as one of the nation's best and boldest young leaders by the Forbes 30 Under 30 science list for 2021.

The honor places Aerospace Engineering bachelor's graduate **Naia Butler-Craig (BSAE '19)** among a global community of innovative young leaders who are changing the course and face of business and society.

"I am so honored to share this list with so many incredible scientists from this class and the many classes before this one," said the 23-year-old.

Butler-Craig, a native of Orlando, is now working toward her Ph.D. in Aerospace Engineering and is a NASA Space Technology Graduate Research fellow at the Georgia Institute of Technology.

Her research involves characterizing the electron energy distribution function at the inner front pole cover of a magnetically shielded Hall-Effect Thruster with a centrally mounted cathode using Laser Thomson Scattering.

In between her pressing academic schedule, Butler-Craig also works to advocate for diversity in STEAM disciplines (Science Technology Engineering Arts and Mathematics).

She engages in public speaking events, volunteers with STEAM organizations, and virtually mentors students.

Butler-Craig has also built a large following online through her social media profiles and website. These outlets bring her advocacy work to life by offering a window into the life of a doctoral student in a laboratory, testimony and Q&A videos from her living room, and quick demonstration videos on a variety of aerospace engineering topics.

Naia Butler-Craig is also the recipient of the 2020 Modern-Day Technology Leader Award for her outstanding performance in STEM. To learn more about her work, visit linktr.ee/astronaia

BY KELLY PRATT

Systems Engineer Earns NASA Award for Work on Rocket Mission

Boeing Company systems engineer Nathalie Quintero (BSAE '15) recently earned NASA's Space Flight Awareness Trailblazer Award for her work on NASA's Space Launch System (SLS), the world's most powerful rocket that will land the first woman and next man on the moon.

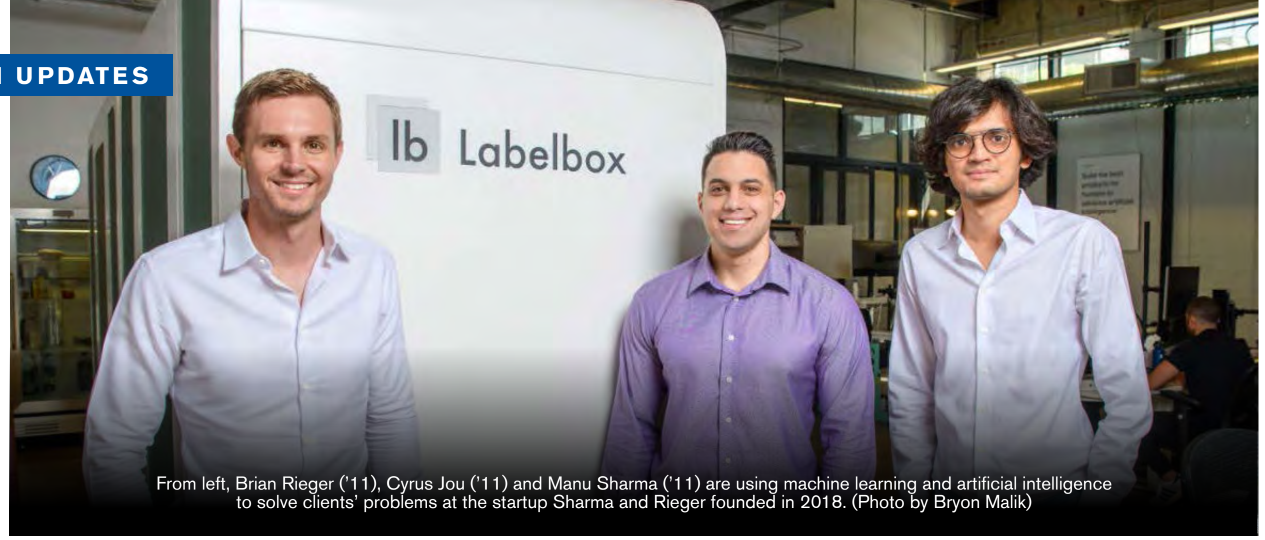
Quintero, who came to the United States from Caracas, Venezuela, as a dual citizen, earned a Bachelor of Science in Aerospace Engineering degree, with a double minor in Aerospace Life Sciences and Computer Aided Design/Computer Aided Manufacturing, from Embry-Riddle, and then a master's in Systems Engineering from Cornell University while working full-time.

Specifically, Quintero was recognized for her development and implementation of new procedures for work authorization document reviews, as she integrated the Boeing Design Center with Kennedy Space Center operations personnel. She also directs the technical review of SLS ground operations procedures, coordinating Boeing's feedback with NASA personnel, and she serves as the Boeing Launch Operations team focal for Integrated Test Checkouts. Additionally, she recently completed her Green Run Electrical Power System console certification as part of the Green Run Avionics Test Team.

Quintero started at Boeing as an intern and had two stints at Commercial Airplanes before SLS. Despite a challenging schedule, she is active with early-career and other Boeing diversity groups, engineering societies and community outreach.

"Boeing has provided me with opportunities to be involved and engaged since I was an intern, and in return I try to bring new perspectives, the incorporation of new technologies, and adaptability," said Quintero.

Learn about her advocacy work via @STEMforAerospace on Instagram.



From left, Brian Rieger ('11), Cyrus Jou ('11) and Manu Sharma ('11) are using machine learning and artificial intelligence to solve clients' problems at the startup Sharma and Rieger founded in 2018. (Photo by Bryon Malik)

What's in a Label? THREE ALUMNI LOOK 'INSIDE THE BOX' TO DEVELOP THE LATEST MACHINE LEARNING INNOVATIONS

Manu Sharma (BSAE '11), Brian Rieger (BSAE '11) and Cyrus Jou (BSAE '11) met during their senior year capstone course at Embry-Riddle in Professor Snorri Gudmundsson's aircraft design class.

"We were on three different teams, and we were all competing with each other on designing the best airplane," Sharma explained. "We were all very, very competitive and very excited to explore the boundaries of what was possible with the limited knowledge that we had."

That exploration continued well beyond their days at Embry-Riddle as they joined forces for several innovative ventures. Their latest innovation, ironically enough, has them thinking "inside the box." Together they have developed a tool that uses machine learning to help data scientists find meaningful patterns in very large amounts of visual information.

The tool, and the company they formed, is called Labelbox. A web-based platform, Labelbox allows users to identify and label items portrayed in an image, so that these items can be parsed, via a proprietary machine learning algorithm, to extract meaningful insights. The platform also allows users to coordinate the activities of individual labelers, whether it's a handful or thousands.

The applications are endless, Brian Rieger said. "When you look at all of the different sectors of the economy today, there's a lot of visual decision-making going on. Machine learning, and AI [artificial intelligence] more generally, is good at doing visual analysis; it's good at finding patterns in visual information." Companies across industries — from dentistry to agriculture, fashion to finance — are using machine learning to build the next generation of products and help make informed decisions, he said.

The idea that ultimately gave birth to Labelbox started forming in Manu Sharma's mind when he worked for Planet Labs, a provider of global satellite imagery data.

"We were able to scan the earth every single day," Sharma recalled. "And my job was to build an analytics platform to extract insights from this imagery that we were collecting."

Sharma said Planet Labs was using AI to process its image data to answer questions, such as: What does deforestation look like on planet earth? And, how much deforestation is happening?

"[But] if you want the AI to detect cars from satellite or drone imagery, or to detect where deforestation is happening, you need humans to tag lots of examples of cars and give it to this model, and the model will be trained to detect these cars eventually." People have to look at and tag millions of images — label them — before feeding these tagged images through an algorithm, which then learns to identify what is shown in these images on its own, Sharma explained.

Recognizing the common need for labeled data and for an analytics platform to manage it was an epiphany for Sharma. By 2018 Rieger and Sharma had founded their own company and appointed Cyrus Jou as the director of customer success.

The three aerospace engineering alumni agree that their college experience created a lasting bond and a drive to innovate. "It has been the most transformational experience of all our lives, meeting there [at Embry-Riddle]," Sharma said.

ALUMNI UPDATES

Powering Investment in Clean Energy Projects

David Rogers' (BSAE '89) degree in aeronautical engineering didn't lead him to a career in aviation; instead, the chief technology officer at Ziyen Energy used his structural software expertise to develop a start-up project designed to help a new era of renewable energy take flight.

"Originally I was going to become a pilot, but I discovered that I was more intrigued with the engineering program," Rogers explained. "It was an era of great change — as students we started out on drafting tables, but by the time we graduated we were using CAD."

Adapting to change became a theme in Rogers' career: What started as a climb toward a management position morphed into a series of career choices that placed him at the leading edge of developing digital tokens for renewable energy projects.

Around 2016, the company where Rogers served as director of software quality assurance moved into a different business sector, leaving Rogers, then 50, to hustle contract gigs, mostly in the med/tech industry. "One day, I met this gregarious Scotsman on a driving range who was looking for someone to manage the software side of his startup business," he recalled.

At that point, Ziyen's focus was industry-specific government and private contracts for bid.

Ziyen founder and CEO Alastair Caithness had noticed that many contracts crossing his desk involved abandoned oil wells. Originally, Caithness suggested acquiring the wells in terms of interest — taking advantage of existing wells — and using wind turbines to power the oil production.

"Because of this boutique idea, Ziyen began to be invited to join conferences with some big energy players [e.g.: Shell, BP and Exxon]," Rogers said. "As part of those interactions we heard that many companies had begun looking toward blockchain for their secure contracts."

That's when Caithness' original concept began to evolve. Instead of a small scale, well-by-well approach, Ziyen could use blockchain as the catalyst to help transform the global energy sector from fossil-based to zero-carbon.

With blockchain — a shared, decentralized information record that can pass information from one entity to another in an automated, secure manner — one party initiates a transaction by creating a block, which must be verified by a chain of network computers before the next step begins. The best-known users of blockchain, such as Bitcoin, use it

David Rogers ('89) helped develop a digital currency that makes it possible for users to invest in renewable energy projects alongside oil and gas projects. (Photo by Frank Rogozienski)

for monetary transactions because blockchain requires no transaction or currency conversion charges from banks or credit card companies.

Unlike the unregulated Bitcoin, however, Ziyen created a new digital currency, called ZiyenCoin, which is backed by energy assets and reports to the U.S. Securities and Exchange Commission.

Information about each new project, including geological and financial statements and tax distributions, will be made available on the Ziyen's "Energy Tokens" platform, giving the public the opportunity to invest in its equity through "tokens," or digital shares. Blockchain tokens representing the asset will be tradable on secondary markets, just like traditional securities.

"Everyone says we need to move from traditional to renewable energy," Rogers said. "Any way we can help leverage our technology to do this is hugely exciting."

Bell Nexus air taxi rendering.

Alumnus Joins Transportation Revolution at Bell

At Bell, Donovan Curry (BSAE '10, MSME '13) is part of a team pushing the limits of technology to reimagine the future of transportation and autonomous flight.

"Everything we are working on now — from the avionics, the flight controls, the control law, autonomous navigation, to the battery and electric motor technology — will be used to set the foundation for a transportation revolution," he said.

As an engineer specializing in control law development, Curry is part of an innovation group conducting R&D for military and commercial projects, such as the Bell Nexus air taxi and the Autonomous Pod Transport. He is proud to be a part of a new and growing field.

"Almost every major aircraft and car OEM is placing a horse in this race, not to mention the various startups that have entered the field as well," he said. "OEMS are in an advantageous position because they already harness the knowledge and capability to certify and mass produce aircraft, so it excites me that Bell has taken on this challenge and plans to develop and build a demonstrator in the near future."

While most of his experience prior to joining Bell in 2019 involved larger business aircraft for Cessna and Gulfstream Aerospace — Curry found his work in static loads, flight dynamics, and control laws easily complements Bell's specialty.

"The key to making UAM (urban air mobility) energy efficient is to design a VTOL that flies an aircraft in forward flight," he said. "I think my background in airplane control law design and Bell's history of helicopter design match well in bringing the two philosophies together."

A native of the Bahamas, Curry's passion for aviation began with plane spotting from his grandparents' home located near the final approach at the Lynden Pindling International Airport.

"I recall watching these airplanes pass by day after day," he said. "I was fascinated by them and their command of the skies."

Early interactions with pilots and crew as an intern for SkyBahamas Airlines introduced him to aerodynamics and controls.

"This reinforced my childhood passions I developed at my grandparents' house," he said.

At Embry-Riddle, Curry went on to earn his bachelor's degree in Aerospace Engineering and master's in Mechanical Engineering. The theories he learned in class were applied at the Eagle Flight Research Center, where among memorable projects, a team designed a control law algorithm for a RC SkyWalker.

In autonomous flight, using classical controls, the Skywalker could navigate to three-dimensional desired waypoints.

It was his first introduction to drone work and developing an autopilot system using a microprocessor.

"There were hardware limitations and we burned out a few boards with bad wiring," he recalled. "But sometimes the simpler ideas worked best. The airplane did eventually fly and navigate to waypoints, but there were hard lessons to learn, lots of compromises and lots of iterations."

Now on the cusp of helping UAM become a reality, those early design lessons still ring true today in real-world applications, he said.

First Aerospace Engineering Ph.D. Graduate Finds Success in Urban Air Mobility

For Alfonso Noriega (BSAE '11, MSAE '13, PHDAE '16), the agile and hands-on environment at startups give him the ability to break new ground in dynamics and controls engineering.

"It's extremely satisfying knowing that you're solving problems that haven't been solved before. Watching an aircraft take off autonomously, fly around, and come back with code that we programmed is very rewarding," he said, recalling his time at Acubed, an Airbus venture that produced Vahana, a self-piloted electric urban air mobility (UAM) technology demonstrator vehicle in Sunnyvale, Calif.

Noriega — the university's first Aerospace Engineering Ph.D. graduate — gained his initial experience in this type of bold testing environment at the Embry-Riddle Eagle Flight Research Center, where he was involved in dynamics and controls research. By the time he completed his doctorate degree, he had instrumented a Cessna 182 with sensors and a computer that allowed him to tap into the aircraft's autopilot and feed it guidance commands to essentially "fly itself."

"We also had it integrated into an iPad display with sliders. When we rolled the sliders, the airplane could turn right or left," he said.

The research the center experience helped prepare him for a career with several startups.

"It's not just the work itself. It's the environment. We may not always know exactly how to accomplish the task at hand, but we work together to figure it out because it has to be done," he said. "I feel like that coincides a lot with the startup mentality of learning to do things that you don't necessarily know how to do and trying to come up with new solutions within specifications."

For his first job out of college — under the wing of two alumni who own Flight Level Engineering in Daytona Beach Fla. — Noriega wrote flight control software for a rare Ryan Navion, a variable response aircraft that exposes pilots and engineers to different flying characteristics and control systems.

"The Navion was already instrumented. We connected it for that acquisition system, programmed the computer and conducted many flight tests on it," said Noriega, a native of Guatemala, whose father inspired him to become a private pilot.

Now working as a guidance, navigation, and controls engineer at Archer, a UAM startup, he is part of a team developing an eVTOL. The Palo Alto-based company aims to provide a sustainable and safe alternative to traditional surface transportation.

Since joining in January 2020, Noriega has participated in developing Archer's flight control system and is involved in testing and feedback discussions related to its design.

Embarking into a new technology sector means there isn't always a blueprint for a way forward, Noriega said. But that's where a problem-solver mindset and the engineering basics he learned at Embry-Riddle continue to serve him well.

"If you know how the theory works, you can apply it to make something fly in a different way. I think that's the key when you're trying to build something that doesn't exist yet," he said.

We Make A Difference

For the past seven years, our department has reached 100% participation in our annual university Faculty & Staff Giving Campaign. Join our dedicated faculty and staff to help make a difference!

2014, 2015, 2016, 2017, 2018, 2019 & 2020

As we continue to enhance the quality of our programs, we'll need your support to improve the facilities and sponsor worthy students to maintain our reputation as the leader of Aerospace Engineering education and research.

To help make a difference, please donate at: **givingto.erau edu**

Click on 'Make a Gift'
Select Aerospace Engineering

EMBRY-RIDDLE FACULTY & STAFF GIVING ONE COMMUNITY

Aerospace Engineering Alumni Share How Their Careers Have Taken Flight

- Several alumni employed at the Sikorsky Aircraft Company are working on the U.S. Air Force's Combat Rescue Helicopter program. They include **Mike Bornemann (BSAE '04)**, lead flight test engineer, **Rachel Garza (BSAE '04)**, lead propulsion flight test engineer, and **Scott Wilkinson (BSAE '05)**, special projects flight test engineer.
- U.S. Air Force Major Gen. **DeAnna M. Burt (BSAE '91)** became the multinational Combined Force Space Component Command's first female commanding officer during a Nov. 16 change of command ceremony at Vandenberg Air Force Base, California. Burt's most recent assignment was at Peterson Air Force Base, where she served as the director of operations and communications for the Space Force.
- **Nathan Crane (BSAE '18)**, who is currently an aerospace technologist at NASA Langley Research Center, has won the Zarem Graduate Student Awards for Distinguished Achievement from AIAA. Crane, who graduated in 2020 with his M.S. in Aerospace Engineering from the Georgia Institute of Technology, won the aeronautics award for "Preliminary Active Subspace Investigation of a Commercial Supersonic Design Space."
- **Jan Jansen (BSAE '81)** was promoted to F-22 chief structures engineer at The Boeing Company in Missouri.
- **Claude Joyner (BSAE '80)** is a Fellow for Advanced Propulsion Development at Aerojet Rocketdyne in West Palm Beach, Florida.
- **Timothy Marge (BSAE '09)**, who leads the F-35 HMS Queen Elizabeth Class test team, was recognized with his team for their outstanding accomplishments at the 2019 Naval Air Warfare Center Aircraft Division Commander's Award Ceremony. Other Embry-Riddle alumni on the test team include **Seth Dion (BSAE '03, MSAE '06)** and **Seth Shaw (BSAE '07)**.
- **Alec Subero (BSAE '03)**, who is head of engineering and design at Virgin Galactic and The Spaceship Company, spoke about his experiences Oct. 15 at World Space Week in the Dominican Republic.

Marwan Al-Haik
Professor, Associate Chair, Ph.D. & M.S. Coordinator
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 and M.S. Program Coordinator
Ph.D., Texas A&M University

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

Shibani Bhatt
Visiting Assistant Professor
Ph.D., Embry-Riddle Aeronautical University

Kyle Collins
Research Assistant Professor
Ph.D., Georgia Institute of Technology

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

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

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

Bill Engblom
Professor
Ph.D., University of Texas

Habib Eslami
Professor
Ph.D., Old Dominion University

Ebenezer Gnanamanickam
Associate Professor
Ph.D., Purdue University

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

Glenn Greiner
Associate Professor & BSAE Program
Embry-Riddle Aeronautical University

Snorri Gudmundsson
Associate Professor
Ph.D., Embry-Riddle Aeronautical University

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

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

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

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

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

Reda Mankbadi
Distinguished Professor
Ph.D., Brown University

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

Hever Moncayo
Associate Professor
Ph.D., West Virginia University

Sirish Namilae
Associate Professor
Ph.D., Florida State University

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

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

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

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

Frank Radosta
Professor
Ph.D., University of Florida

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

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

Virginie Rollin
Associate Professor
Ph.D., University of Vermont

Dongeun Seo
Associate Professor
Ph.D., University of Texas

David Sypeck
Professor
Ph.D., University of Virginia

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

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

Advancing aerospace engineering through collaborative research.

Department of Aerospace Engineering
College of Engineering | Embry-Riddle Aeronautical University
1 Aerospace Boulevard | Daytona Beach FL, 32114 | **db.erau.edu/aerospace**

EMBRY-RIDDLE
Aeronautical University