The Conduit

NEWS FROM THE COLLEGE OF ENGINEERING AND SCIENCE

SPRING 2025

Inside this Issue

FLORIDA TECH

FLORIDA'S STEM UNIVERSITY®

Message From Dean John Harris

Welcome to the inaugural issue of *The Conduit: News from the College of Engineering and Science* at Florida Tech!

We spent considerable time choosing the right name for our new newsletter—something that would reflect both the spirit of our college and the purpose of this publication. *The Conduit* stood out. In science and engineering, a conduit is a channel through which energy, data or resources flow. That image resonated with us. This newsletter, too, is a channel—one that connects people and ideas, shares knowledge and sparks innovation.

The term "conduit" is used across many disciplines—electrical and civil engineering, computer science and even biology—making it a fitting symbol for a college that is proudly interdisciplinary. Like a conduit, this publication links our faculty, students, alumni and partners—bringing research to life and extending the reach of our discoveries into the broader community.

Other names we considered—*Connections, Communications, The Bridge* and even *The Causeway* (a nod to our beautiful Melbourne, Florida, location)—all shared a common theme of connection. That is the vital role of both this newsletter and the college itself: to connect, communicate and catalyze progress.

We believe this first issue of *The Conduit* reflects the energy and momentum building across the College of Engineering and Science. From student and alumni success stories to faculty breakthroughs, there is much to celebrate—and even more to look forward to.

Thank you for being part of our journey.

Respectfully,
John Harris, Ph.D.
Dean, College of Engineering and Science

Panthers on the Rise

1 ANDY GRECO '10

In July 2023, Andy Greco took on the role of lead engineer for the 15th expedition to the Mars Society's Flashline Mars Arctic Research Station in Devon Island, Nunavut, Canada. The mission's goal was to address the unique challenges of living and working in space by tackling those obstacles here, on Earth, before they arise on Mars.

When he's not working on space missions, Greco serves as the 737 Max liaison engineering team lead at Boeing Co. in Seattle. In this capacity, he manages a team of 22 members, supporting mechanics and quality inspectors as they work on the aircraft.

Greco's Panther Pride remains strong, as he continues his studies with Florida Tech, working toward a master's degree in space systems, with an expected graduation in spring 2025.

2 JOE BUSSENGER '13

Joe Bussenger was recognized with the Jerome P. Keuper Distinguished Alumni Award at the 2024 Annual Homecoming Alumni Awards Gala. This prestigious award—the highest honor a Panther can receive—celebrates alumni whose career achievements uphold Florida Tech's legacy of excellence.

Bussenger serves as the director of launch operations and Florida site director for the Terran R program at Relativity Space. His career in the space industry began with an internship at SpaceX during his junior year at Florida Tech, leading to a decade-long tenure with the company.

After graduating, Bussenger became a full-time engineer at SpaceX and made history as the first launch engineer dedicated to Falcon 9 landing operations. In a defining career moment, he proudly announced to the world, "The Falcon has landed," as millions watched the historic event.

Over the years, Bussenger's leadership expanded to include overseeing more than 100 Falcon 9 landings, managing astronaut and cargo recovery and directing teams across recovery and launch control operations. Now, at Relativity Space, he continues to push the boundaries of innovation in spaceflight.

3 PURVI JAIN-BAFNA '15 M.S.

Purvi Jain-Bafna '15 M.S. has been promoted to CEO of Sawai Fragrances USA, a leading name in the Indian fragrance market. With this new role, she has relocated to New York City to oversee the company's business operations.

Leading a team of 40 employees across the United States, India and the United Kingdom, Jain-Bafna manages social media, logistics, marketing, brand strategy and warehouse operations.

Sawai Fragrances has a rich legacy, having been founded in 1965 by her grandfather, Sawailal Jain, in Kannauj, India, a city renowned as the country's "perfume capital."

4 LUCY FREEMAN '21

Thanks to the connections she built at Florida Tech, after graduation, Lucy Freeman '21 landed a job at Piper Aircraft, where she serves as a liaison engineer II.

In her role, Freeman plays a key part in modernizing aircraft designs through CAD modeling, supports the construction of planes on the factory floor and conducts rigorous tests to ensure their structural integrity.

5 JOSHUA SHELDON

In September 2024, Joshua Sheldon (pictured far left), a computer science student, showcased his innovation at INIT FIU's ShellHacks 2024, Florida's largest hackathon, held in Miami. Collaborating with fellow engineers, Sheldon helped develop ESPER (Epileptic Seizure Prevention and Early Response)—a groundbreaking Google Chrome extension designed to dynamically adjust video brightness, reducing rapid changes that could trigger seizures.

ESPER's impact was widely recognized, earning first place from event sponsor Assurant and securing the Best Overall Project award out of 257 submissions.

6 ANNA WEBER

Anna Weber, a postdoctoral researcher in the Daly-Engel Shark Conservation Lab, has been awarded the Vembu Subramanian Ocean Scholars Award from the Southeast Coastal Ocean Observing Regional Association. This highly competitive grant has been awarded to an average of just two recipients per year since its inception in 2018.

With this funding, Weber will attend the 2025 Joint Meeting of Ichthyologists & Herpetologists, where she will present her research on using models to predict sharks' spatial responses to climate change.

A+ Accolades

Global Employability University Ranking and Survey

Times Higher Education

For the third consecutive year, Florida Tech has been ranked among the top 20 universities nationwide for graduate employability by *Times Higher Education*. This prestigious ranking highlights the institutions that employers at leading companies believe best prepare students for success in the workplace. The list is led by institutions such as M.I.T., Caltech and Stanford and includes many of the most respected universities in the country. Notably, Florida Tech is the highest-ranked university in Florida for graduate employability.

STARS Silver Rating for Sustainability

AASHE

Florida Tech has once again been recognized for its commitment to sustainability, earning a Sustainability Tracking, Assessment & Rating System (STARS) Silver rating from the Association for the Advancement of Sustainability in Higher Education (AASHE). STARS evaluates sustainability efforts across higher education institutions, and this three-year rating marks Florida Tech's second consecutive STARS Silver designation, following its 2021 recognition.

Top Scholars

ScholarGPS

ScholarGPS has named three Florida Tech faculty members "Top Scholars" for their outstanding contributions to academia over the past five years:

- Manasvi Lingam, an astrobiology researcher in the aerospace, physics and space sciences department, ranked No. 9,562 globally out of nearly 15 million scholars, placing him in the top 0.06% worldwide.
- Mirmilad Mirsayar, an aerospace engineering expert, was ranked No. 35,155, landing in the top 0.24% globally.
- Robert van Woesik, a coral reef ecologist, ranked No. 58,081, placing in the top 0.39% worldwide.

ALUMNI SPOTLIGHT ON

PEDRO BELTRAN

It's in his Genes

ALUMNUS TURNS PASSION FOR DNA RESEARCH INTO A CAREER

Pedro Beltran '92 is chief scientific officer at BridgeBio Oncology Therapeutics (BBOT), a clinical-stage biotechnology company that focuses on treating cancers by inhibiting driver oncogenes.

"This can be a very frustrating, time-consuming, 24/7 job. There's just no way around it," Beltran says. "But when you see somebody battling cancer with multiple lung tumors, even after six lines of therapy and no more options, and they take your medicine, which results in their tumors shrinking, or they disappear completely ... there's nothing more exciting, fulfilling and motivating than that!"

Beltran's passion for DNA has always been in his DNA, even at a young age growing up in Lima, Peru.

Inspired by the DNA revolution that started in the '60s, Beltran knew he needed to look outside of his home country to pursue his love of DNA and turn it into a career.

With the help of his father, Beltran discovered Florida Tech through its ELS Language Center.

"When I graduated from high school, I didn't speak any English because the school I attended in Lima was German," Beltran says. "My father's work had him traveling back and forth from Peru to Miami a lot, so he researched nearby language institutes to help me learn English and found Florida Tech."

After completing his education at Florida Tech and receiving a bachelor's degree in molecular biology, Beltran knew he wanted to make a difference with his education and pursue medicine creation.

Beltran started applying for grad schools and was selected to attend the University of Texas MD Anderson Cancer Center in Houston. There, he completed his Ph.D. in cancer biology in the laboratory of professor Isaiah J. Fidler, chairman of the cell biology department.

> "My goal was and still is to make medicines for people with serious diseases. So, everything that I do is based on that North Star."

Beltran then found himself back in Florida at the University of Miami, where he completed his postdoctoral fellowship, focusing on molecular and cellular pharmacology with John Bixby.

"My goal was and still is to make medicines for people with serious diseases," he says. "So, everything that I do is based on that North Star."

In his current role, Beltran manages a team of scientists who create, design and test molecules that will be turned into medicines and delivered to clinics that help cancer patients. This process, developing a new treatment from beginning to end, can take more than 10 years and cost upward of $1 billion, he says.

BBOT's main focus is driver oncogenes, genes that can drive tumor growth on their own. BBOT is focused on the most important oncogenes: RAS and PIK3CA. Because 35% of all cancers are driven by RAS, it is the most mutated oncogene in human cancer.

Beltran has authored more than 10 Investigational New Drug Applications and 40-plus peer-reviewed manuscripts and abstracts, has spoken at multiple national and international conferences and holds various patents that describe novel ways to treat malignant diseases.

In 2022, Beltran was honored with Florida Tech's Outstanding Alumni Award for Science from the College of Engineering and Science.

FLORIDA TECH CONNECTION:
'92 B.S. molecular biology

FAVORITE ACTIVITY TO RELAX: Running

NOSTALGIC DISH FROM YOUR HOME COUNTRY:
Lomo saltado (A stir-fry typically served with steak, rice, onions, tomatoes and French fries.)

BUCKET-LIST CONCERT:
Dire Straits

MANTRA: "Things don't do themselves. People get things done."

THREE THINGS THAT MAKE YOU HAPPY:
Watching my two daughters succeed, going home to Peru and seeing a drug approved.

And the Award Goes to ...

Carter Tomasky and Alina Janshon

2024 Farmer Scholars

For the first time, Florida Tech has bestowed its illustrious Farmer Scholarship upon two students in the same year. The 2024 recipients are Florida residents Carter Tomasky and Alina Janshon, who have demonstrated exceptional academic achievement and outstanding character. Tomasky, from Brooksville, is majoring in mechanical engineering and applied mathematics. Janshon, from New Port Richey, majors in applied mathematics.

Ranked among the highest in their respective graduating classes, both students completed high school with GPAs well over 4.0. As Farmer Scholars, Tomasky and Janshon will receive a full, four-year scholarship, along with additional benefits.


Carter Tomasky


Alina Janshon

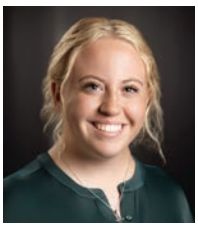
Elizabeth Beraducci and McKenna Taylor

2024 Astronaut Scholars

Aerospace engineering major Elizabeth Beraducci and McKenna Taylor, an astrobiology and astronomy & astrophysics double major, were named 2024 Astronaut Scholars, a prestigious recognition given to top students pursuing careers in STEM fields.

They are among 71 students from 48 U.S. universities selected for the Astronaut Scholarship Foundation's annual honor. The scholarship recognizes junior and senior students studying science, technology, engineering or mathematics (STEM) who demonstrate potential for advancing research and contributing to their field upon completing their degrees.


Elizabeth Beraducci


McKenna Taylor

Nasri Nesnas

Edward H. Kalajian Professor

Nasri Nesnas, a 22-year faculty member at Florida Tech, has been named the Edward H. Kalajian Professor. Nesnas is known for his pioneering research into light-responsive molecules for brain mapping and developing novel approaches to combating cancer.

The Edward H. Kalajian Endowed Professorship was established in 2017 to recognize faculty who demonstrate excellence in teaching, advising and student engagement. Nesnas is the second recipient of this prestigious title, for which he was selected by a Faculty Senate committee of his College of Engineering and Science peers. The award comes with an annual salary enhancement of 5 percent of the available endowment funds. Nesnas will serve in this role until June 2029.


Nasri Nesnas

Brice Smith and Dylan Gore

Dr. Kerry Bruce Clark Endowed Scholarship Recipients

Seniors Brice Smith and Dylan Gore have been named recipients of the 2024–2025 Dr. Kerry Bruce Clark Endowed Scholarships in Marine Biology. The scholarships are awarded to marine biology students who demonstrate exceptional academic achievement and a commitment to pursuing a career in the field.

The selection committee highlighted Gore's research in the Toby Daly-Engel Shark Conservation Lab and at the University of North Florida, where she studied scalloped hammerhead sharks. Smith was recognized for his work on the native Florida apple snail in Rich Aronson's Marine Paleoecology Lab.


Brice Smith


Dylan Gore

Happenings

FLORIDA TECH LAUNCHES APPLIED INNOVATION HUB

Vertex, Florida Tech's new applied innovation hub that officially launched in February, is bringing together industry, higher education, local and state governments, investors, community members and more to fuel transformative partnerships, connecting them with applied engineering technologies, customized workforce development programs and the unmatched talents and expertise of the Florida Tech community.

The hub is already making an impact, hosting clients in its business-in-residence program and developing new collaboration pathways and industry-focused initiatives.

Formerly the Center for Advanced Manufacturing and Innovative Design (CAMID), which is still a component of the hub, Vertex has been reimagined and retooled with a new mission, scope and executive director.

While it is housed in a robust 100,000-square-foot facility featuring labs, adaptable workspaces, manufacturing equipment and electronic resources, Vertex is more than brick and mortar.

"At Vertex, we're not just providing a physical space," says Samantha Miles, Vertex executive director. "We're cultivating a comprehensive ecosystem of support and unique value-added services that will contribute to the transformative growth of the Space Coast."

And the Space Coast, with its high-tech heritage and enterprising spirit, is the perfect place for Vertex to flourish.

"This region is uniquely positioned and ready for Vertex's mission with its rich industrial ecosystem and skilled workforce," said Hamid Rassoul, Florida Tech's chief research officer. "Vertex is more than an innovation hub—it is a catalyst for growth on the Space Coast."

ASHOK PANDIT RETIRES

Ashok Pandit has retired after an impressive 42 years at Florida Tech, leaving behind a remarkable legacy.

Pandit was the driving force behind several key firsts, including the first master's student to graduate in civil engineering, the first research grant for the department and the creation of the first doctoral program in water resources engineering, along with its first graduate. He also spearheaded the department's first published conference and peer-reviewed papers in civil engineering.

In addition to these academic accomplishments, Pandit played a crucial role in establishing six endowments and organizing Florida Tech's engineering summer camp for 10 years.

Hired as the fourth faculty member in the civil engineering program by then-department head Edward Kalajian, Pandit later succeeded Kalajian as department head, continuing to shape the program's growth and success.

COES ALUMNI TRAVEL TO ECUADOR

In January, 16 Florida Tech alumni and friends embarked on an eight-day expedition through Ecuador, guided by professors Richard Aronson and Mark Bush and College of Engineering and Science Dean John Harris.

The journey began with two days in the Andean cloud forest, renowned for its rich wildlife, followed by five days at Sacha Lodge on the shores of Pilchicocha, a lake in the most biodiverse part of Amazonia.

Throughout the trip, participants encountered an incredible array of wildlife, including toucans, monkeys, macaws, army ants, birds of prey, anacondas and towering kapok trees.

KACHOUIE LANDS $344K GRANT FROM DESANTIS FLORIDA CANCER INNOVATION FUND

Nezamoddin N. Kachouie, associate professor of mathematics and systems engineering, has been awarded a $344,422 grant from the Florida Department of Health's Casey DeSantis Florida Cancer Innovation Fund to develop a cutting-edge AI-powered cancer treatment recommender system.

Titled "A Shared Geospatial Artificial Intelligence Cancer Treatment Recommender System for Optimal Outcome," the project aims to enhance data sharing, transparency and dissemination in cancer care and better share best practices. By integrating AI-driven insights, the system will help improve clinical trial implementation and research outcomes, ultimately leading to better patient care and treatment strategies.

AUXILIARY UNIVERSITY PROGRAM OFFERS U.S. COAST GUARD TRAINING

The Coast Guard Auxiliary University Program (AUP) offers a clear pathway for Florida Tech students aiming for officer commissioning in the U.S. Coast Guard (USCG) or the National Oceanographic and Atmospheric Administration (NOAA) Commissioned Officer Corps.

Launched at the start of the 2024–2025 academic year, the Florida Tech AUP is based at the Mertens Marine Center. The inaugural class of 12 undergraduates represents a diverse range of majors, including ocean engineering, marine sciences, computer science and aviation.

The program starts by developing students' boating, emergency management and related maritime skills. The basic curriculum covers navigation, search and rescue, boat handling, seamanship, mission planning and FEMA incident management. After two years, students focus on gaining real-world experience supporting Coast Guard missions before finally pursuing a commission.

According to William Cox, Florida Tech AUP's U.S. Coast Guard Auxiliary liaison, the university's proximity to USCG Station Port Canaveral enables students to participate in a broad range of local Coast Guard projects.

UNIVERSITY PARTNERS WITH KSC VISITOR COMPLEX FOR SPACE EDUCATION, COMMUNITY IMPACT

On July 15, 2024, Florida Tech President John Nicklow and Kennedy Space Center Visitor Complex (KSCVC) chief operating officer Therrin Protze signed an agreement solidifying a partnership, led by the university's Ortega Observatory, to create new and expand existing educational opportunities on space sciences for researchers, students and the general public.

The partnership includes two key outcomes:

- Educational program coordination: The Ortega Observatory team will lead the educational program for observational astronomy at KSCVC, organizing observational events and scientific talks in the new Gateway building at the complex.
- Portable observatory: Florida Tech will operate a portable robotic observatory, enhancing research, educational and outreach opportunities for Florida Tech students and the Space Coast community.

"This partnership demonstrates the trust in Florida Tech and the Ortega Observatory team to coordinate an educational program that will impact thousands of people in the future who visit the Kennedy Space Center Visitor Complex," Nicklow said at the signing.

FLORIDA UNIVERSITIES TEAM UP TO BOOST SPACE MANUFACTURING

Researchers from Florida Tech, the University of Florida, Florida A&M University and Embry-Riddle Aeronautical University have teamed up to launch the Center for Science, Technology, and Advanced Research in Space (C-STARS), which will work alongside industry partners to advance in-space production of medicines, electronics and bioenergy systems.

The multisite center, which includes a location at Florida Tech, will also play a key role in workforce development, training the next generation of specialists in space technologies, sciences and exploration. Additionally, the universities will partner with Oak Ridge Associated Universities in Tennessee to expand outreach efforts.

"C-STARS is a multidisciplinary hub that will support and serve the rapidly growing sector of space manufacturing," said biomedical engineering professor Kunal Mitra, who is involved in the effort. "It will bring academic researchers from the four Florida universities together with spaceflight providers to help industries transition to the space manufacturing sector and improve the production of unique medicines, therapeutics, electronics and materials that can benefit the people of Earth."

C-STARS will address six space manufacturing areas where the four universities have intersecting experience and expertise: cell and tissue tools, bioenergy systems, advance material electronics, artificial intelligence (AI) and machine learning, lab-on-a-chip systems and recycling and sustainability.

Florida Tech's team will work on elements of at least three areas, including cell harvesting and organoids; disease modeling and cubesat systems; and real-time biomonitoring and autonomous bioprinting.

FLORIDA TECH WINS $2.3M AWARD TO SUPPORT AI.PANTHER

Florida Tech has been awarded $2.3 million in federal funding to enhance its AI.Panther high-performance computing cluster, strengthening the university's role in artificial intelligence, cybersecurity and aerospace innovation.

The funding, provided by the National Institute of Standards and Technology (NIST), supports Florida Tech's project, "Leveraging High-Performance Computing and Artificial Intelligence for Enhanced Cybersecurity, Resilience, and Innovation in the Aerospace and Defense Industry."

This initiative complements the university's cutting-edge Aerospace Cybersecurity Engineering Development (ASCEND) program and other AI-driven research efforts.

"The expansion of our AI.Panther cluster will provide state-of-the-art computational infrastructure to promote interdisciplinary projects within Florida Tech, facilitate workforce training and foster university-industry and university-government collaborations, enabling Florida Tech to serve as an intellectual and innovation hub for AI research," said Munevver Mine Subasi, associate provost for academic affairs and principal investigator on the NIST project.

NSF GRANT FUNDS NEW SCANNING ELECTRON MICROSCOPE

After winning a $488,373 grant under the National Science Foundation's Major Research Instrumentation Program, Florida Tech purchased a new scanning electron microscope (SEM) that will be installed in the High-Resolution Microscopy & Advanced Imaging Center this year.

In an electron microscope, far smaller electrons replace the light waves used in a traditional optical microscope and allow for a much closer surface examination. The powerful tool will allow researchers to examine materials, from analog Martian regolith and biomaterials to thermal coatings, bacteria and even ship hull corrosion, at an incredibly detailed level.

"It really gets down onto the surface of things," said associate professor Andrew Palmer, principal investigator on the grant alongside associate professor Chris Bashur, co-PI. "The surface of a leaf might look smooth under a regular microscope, but under an electron microscope, we see it's not smooth at all, but features caverns and hills and mountains, comparatively to what we see."

The new microscope, a JSM-IT710HR SEM from JEOL, will also include a cryostage specimen platform.

SCALED MODEL OF NAVAL RESEARCH VESSEL TO FURTHER EDUCATION ON HYDROMECHANICS

A new vessel is set to dock at Florida Tech's Mertens Marine Center: a 1/23rd-scale, self-propelled model of the U.S. Navy's R/V Melville, a research ship originally built in 1969. Acquired through an agreement with the Naval Surface Warfare Center Carderock Division, the model will serve as a valuable research tool for students and faculty.

Travis Hunsucker '11 M.S., '16 Ph.D., assistant professor of ocean engineering, said he plans to use the model for both research and class, where he'll use it to teach his students experimental ship dynamics and hydromechanics.

Weighing 530 pounds and measuring 12 feet long, the model is radio-controlled and equipped with accelerometers and GPS sensors to track its movements through the water.

Collecting data on a large ship at sea would cost thousands of dollars, Hunsucker said. Using the model ship, they can scale the waves in the Indian River Lagoon to the model to gather similar real-world data.

"We teach students various ... hand calculations and software tools, but now we can actually go out and get real data with this ship," Hunsucker said.

RYAN WHITE

Artificial Intelligence: Math, Not Magic

Artificial intelligence (AI) has permeated our lives. Our phones unlock at the sight of our faces. We can have entire text and voice conversations with ChatGPT. Amazon knows what I am looking for, and my email finishes my sentences with uncanny accuracy.

AI may seem magical, but these solutions are based on deep learning and neural networks (NNs), which only require a little calculus—and lots of data and computing power!

The first NNs, proposed in the 1960s, aimed to emulate human brains by perceiving stimuli (inputs), processing them with interconnected layers of "artificial neurons" and producing responses (outputs). For example, facial recognition on phones is trained to accept an input image and answers, "Is this person my owner?" If yes, it unlocks.

Inside an NN, each pair of neurons has a "knob" controlling how strongly a signal is passed from one to the next. "Training" an NN involves tweaking these knobs until the NN consistently maps a large training dataset of inputs to their desired outputs. This tweaking of millions or billions of knobs is guided by calculus to minimize errors in the outputs. Effective NNs learn to produce desired training outputs but also generalize to work with new inputs they encounter.

At Florida Tech's NEural TransmissionS (NETS) Lab, we study deep learning and develop our own NNs. Concerningly, NNs make mistakes for unknown reasons, which makes high-stakes deployments risky. Much of our work focuses on these failure modes, assessing why they occur and what we can do about them.

Led by Ph.D. student Mackenzie Meni, we developed a technique called PEEK that "peeks" into the inner workings of NNs to visualize what details they are focusing on. PEEK explains NN decisions and reveals data biases. Excitingly, PEEK can frequently discern the correct outputs from the inner workings, even when the NN fails to produce them. Ongoing work, funded by the U.S. Army Engineer Research and Development Center (ERDC), aims to use these "corrected" outputs as a fail-safe to catch and correct errors on the fly.

> "AI may seem magical, but these solutions are based on deep learning and neural networks (NNs), which only require a little calculus—and lots of data and computing power."

Ryan White
Assistant Professor, Department of Mathematics and Systems Engineering

The versatility of NNs allows us to collaborate across disciplines. We work regularly with aerospace and biomedical engineers.

With Ph.D. student Trupti Mahendrakar '21 M.S. of the Autonomy Lab, we developed vision and guidance algorithms for autonomous satellite swarms for the Air Force Research Laboratory (AFRL), with ongoing work on human guided vision algorithms.

Ph.D. student Nehru Attzs '16, '19 M.S., is developing an algorithm to track satellite components in real time.

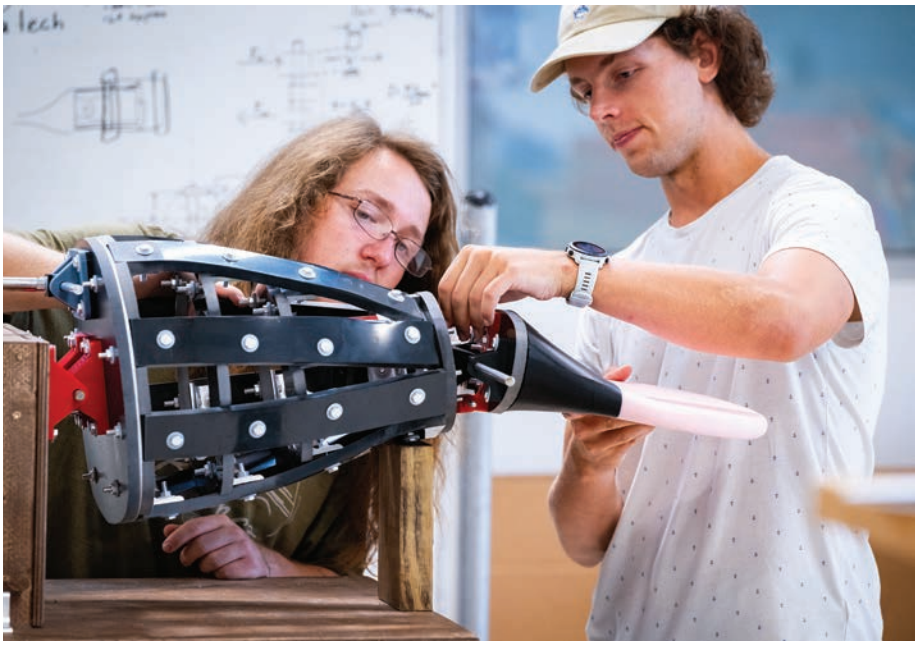
Ph.D. student Arianna Issitt '23 and I spent last summer as faculty/graduate fellows at the AFRL, working on a project to send chaser satellites on inspection orbits around spacecraft, capturing images to build 3D reconstructions. We designed optimal inspection orbits and deployed them on spaceflight computers.

Additionally, we collaborate with the Multiscale Cardiovascular Fluids Laboratory to develop NNs estimating blood flow dynamics within patient blood vessels noninvasively in real time. This can enable medical teams to make rapid diagnoses and treatment plans for cardiovascular disease patients.

The efforts of the NETS Lab aim to provide a deeper understanding of AI broadly speaking and design effective solutions for safety-critical applications in spaceflight and medicine.

Ryan White '11 M.S., '15 Ph.D., is an assistant professor in the department of mathematics and systems engineering and director of the NEural TransmissionS (NETS) Lab. He joined the Florida Tech faculty shortly after earning his Ph.D. in applied mathematics from the university.

Research Highlights



ROBOTIC SEA CREATURES

A team of ocean engineering seniors is working on an innovative way to study wild manatees: "Mechantee." A remotely operated vehicle (ROV), Mechanatee is designed to mimic the anatomy and movement of a real manatee, starting with its tail and flippers, to create more realistic motion than traditional robotic designs.

The team hopes Mechanatee will be accepted by wild manatees, allowing researchers to observe their behavior in a noninvasive way. The ROV, inspired by the West Indian manatee, will measure 5 feet long with a 3.5-foot tail and fluke and will be equipped with embedded sensors to collect environmental data, such as water salinity, temperature and depth. The students also plan to install a live underwater camera and a hydrophone to record manatee vocalizations, potentially helping researchers interpret and replicate manatee communication.

The Mechanatee project, led by Cannon Bogar, Aidan Calenda, Jackson Clendenin, Laura Mace, Eden Stroman and Jacob Warner, runs parallel to another initiative by ocean engineering professor Stephen Wood: a robotic whale, led by graduate student Haylie Garman.

RESEARCH SEEKS TO IMPROVE RAINFALL PREDICTION ACCURACY

Pallav Ray, associate professor of ocean engineering and marine sciences, is helping refine climate models with research inspired by his childhood in India's hot climate.

His latest paper, "Rain-Induced Surface Sensible Heat Flux Reduces Monsoonal Rainfall Over India," was published in *Geophysical Research Letters* and highlights a key variable that is often overlooked in climate models but could improve the accuracy of rainfall predictions.

Ray's research, funded by the National Oceanic and Atmospheric Administration (NOAA), introduces the variable Qp, representing precipitation-induced sensible heat flux, which is a component of surface energy that influences precipitation. It essentially accounts for how precipitation cools land surface temperatures.

This variable is important, Ray explained, because the temperature of raindrops is typically cooler than the temperature of the surface, so when it rains, the surface cools down.

In testing Qp, Ray and his team of researchers ran simulations investigating the variable's role on precipitation. They found that when incorporating it, not only is anticipated precipitation reduced by up to 5 percent—which he said is a significant reduction—but the models also reflect changes in the spatial distribution of precipitation.

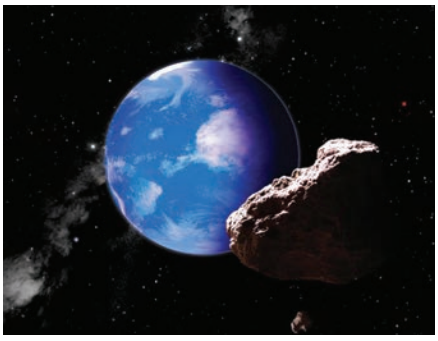
Ray's results generated predictions that were much closer to observed rainfall in India. He said that inclusion of this variable in common climate models could influence India's regional agriculture and irrigation strategies.

RESEARCH SHOWS IMPACT OF 'SUPER-EARTH' ON SOLAR SYSTEM

Icarus, a leading journal in solar system research, recently published "How might a planet between Mars and Jupiter influence the inner solar system? Effects on orbital motion, obliquity, and eccentricity," a paper Emily Simpson '24 co-authored with her advisor, assistant professor Howard Chen.

Simpson and Chen developed a 3D model simulating how the solar system's orbital architecture might have evolved differently had a planet at least twice the size of Earth's mass—a "super-Earth"—formed in place of an asteroid belt.

In the study, Simpson proposed five potential planet masses ranging from 1 percent of the Earth's mass to 10 Earth masses. With each mass, she modeled 2 million years of orbit to find what kind of architectural impact each mass would have on our solar system. Specifically, she tracked changes to the other planets' obliquities—how much a planet tilts on its axis—and eccentricities—how much a planet's orbit deviates from a true circle.



Their findings revealed that lower-massed simulations (up to two Earth masses) had less of an impact on the habitability of the inner planets—Mercury, Venus, Earth and Mars. They found some changes in obliquity—Mars "wobbled" a bit more, Simpson said—but overall, the inner solar system remained habitable.

However, when simulating a planet 10 times the size of Earth's mass, inner planets experienced high obliquity and high eccentricity, leading to dangerous temperature differences between seasons. The mass may have even pushed Earth's orbit closer to Venus and beyond the habitable zone it exists in currently.

While hypothetical, these observations can help astrobiologists predict how and where life may have a shot of surviving in a planetary system.

DARPA FUNDS BHATTACHARYYA'S RESEARCH ON PREVENTING CYBERSICKNESS

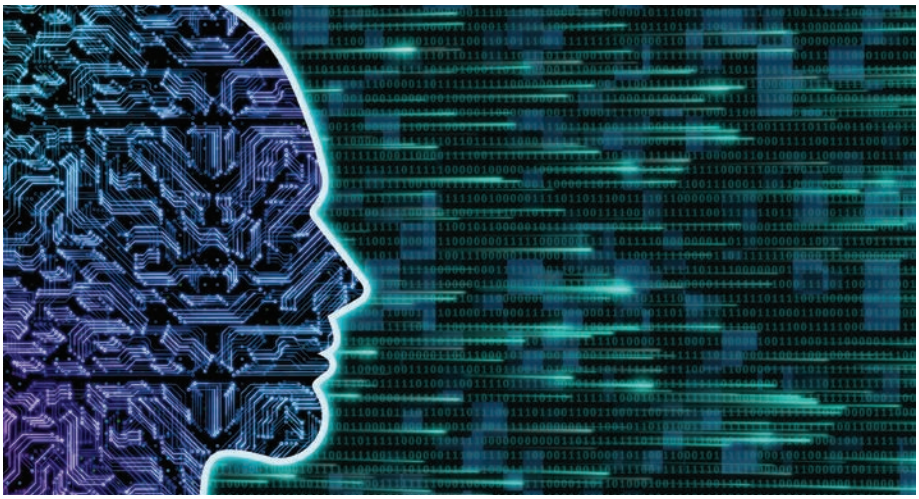
A research team led by Florida Tech computer scientist Siddhartha Bhattacharyya has secured funding from the Defense Advanced Research Projects Agency (DARPA) to help prevent cybersickness in soldiers using mixed reality (MR) systems during cognitive attacks.

The project, part of DARPA's Intrinsic Cognitive Security (ICS) program, falls under the Modeling and Analysis Toolkit for Realizable Intrinsic Cognitive Security (MATRICS) initiative—an $8 million research collaboration. Bhattacharyya's team will receive $304,000 for their work.

The goal of MATRICS is to ensure MR system designs are secure against cognitive attacks before military personnel become heavily reliant on them. Bhattacharyya, alongside Ph.D. students Parth Ganeriwala and Candice Chambers, will focus on developing formal models and cognitive architectures that can detect and prevent cybersickness—a condition causing dizziness, nausea, headaches and fatigue.

"If we know the range of values for mixed reality systems such as frame rate, latency and optical flow that work well for normal people, we will be able to detect when the values are out of range and may cause cybersickness," Bhattacharyya said. "Florida Tech is modeling and verifying the detection and then prevention of physiology-based attacks."

The research will involve analyzing physiological data and operational context to create formal models that can both detect and prevent cognitive attacks leading to cybersickness.

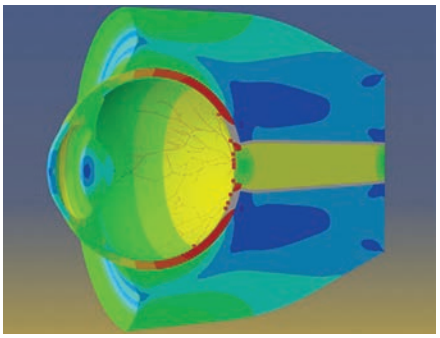


RESEARCHERS DESIGN SIMULATION TO BETTER UNDERSTAND NEWBORN RETINAL HEMORRHAGING

Florida Tech Ph.D. candidate Jose Colmenarez and Linxia Gu, professor of biomedical engineering, are working to shed new light on why many infants experience retinal hemorrhaging during childbirth.

Their latest research, published in *Scientific Reports*, found that the condition is caused by pressure exerted during labor—which challenges existing theories for its cause—using a detailed computer model they developed to map the condition's mechanics.

In their paper, "Vascular insult in neonatal retinal hemorrhage: computational analysis of a fundus-segmented blood vessel network," Colmenarez and Gu, along with a team from the University of California-Irvine, revealed that up to half of newborns experience physiologic retinal hemorrhaging, a natural bleeding in the retina. The highest percentage of cases was found in births requiring instruments, such as a vacuum suction, to assist in delivery.



Because the injury happens during childbirth and involves infants, Colmenarez said testing can be invasive or unethical. So, the team turned to a computer model.

Colmenarez's model directly simulated a fetus's eye, optic nerve, eye socket and retinal vessels during labor. The results showed that the stress and strain from labor contractions, which compress the fetus's head, deform the eye. When tiny retinal vessels are subjected to prolonged tension, they can rupture, leading to hemorrhaging.

PINELLI LAB CONDUCTS CATASTROPHIC RISK MODELING TO PROTECT PEOPLE AND PROPERTY

Major storms and hurricanes have proven to be increasingly expensive for Florida residents and businesses. They're also economically challenging for insurance companies covering the structures damaged by these events—as well as the state itself. But how might we make changes that leave everyone in this equation better off?

That's a question that Jean-Paul Pinelli and his Wind and Hurricane Impact Research Laboratory (WHIRL) team help address. He and his team of engineers, scientists and business experts do catastrophic risk modeling to understand how to keep more people and property safe while providing guidance to help insurance companies and the state set appropriate premiums.

While most Florida homeowners would benefit from putting shutters on their windows, not all protective measures are cost-effective.

"We could eliminate losses if we built every house like a bunker, but that's not realistic," Pinelli said.

Insurers, meanwhile, must set premiums in ways that reward homeowners who take the right steps to protect their homes and that also ensure that companies have funding to pay out for catastrophic losses.

The state, which regulates the insurance industry (and is also a participant in it), can offer tax incentives to support specific preventative measures, as well. To come up with fair solutions, Pinelli and his team do on-the-ground measurements with sensors during extreme weather events and post-event reconnaissance to build accurate models, then pair those with sophisticated stochastic analyses that can run more than 50,000 "hypothetical hurricanes" to come up with damage estimates. These, in turn, translate into annual expected losses for insurance companies.

"It's a complex interaction among different actors, but we want to help create win-win situations for everyone: protecting the homes so that they have less damage, which leads to fewer claims to pay out for insurance and the government, and a community that is safe and resilient," Pinelli said. "That's the ultimate objective."

College of Engineering and Science

Florida Institute of Technology
150 W. University Blvd.
Melbourne, FL 32901-6975

STEMPOWER DAY

More than 1,000 students from Brevard County and beyond participated in Florida Tech's STEMPower Day Sept. 14, 2024. University students, faculty and local leaders representing some of the Space Coast's top STEM employers hosted several engaging and interactive sessions covering topics such as space, aviation, engineering, psychology, cybersecurity, biology, earth science and innovation. Participants built towers out of playing cards, taught a robot how to swim, made "bristle bots"—or robots with toothbrush heads—built an anemometer, extracted strawberry DNA, and more, hopefully building talent and affinity for STEM fields at a young age.