



AEROSPACE ENGINEERING 2025

UPDATE

Elevate society. Create wonder.



Two teams finish sky high



An illustration of the 1st place winner, "Chipmunk" by Team Hummingbird.



An illustration of the 3rd place winner, "Gravibus" by Team Kinglet.

In AIAA's Undergraduate Team Aircraft Design Competition, Illinois teams took first and third place. Although both teams addressed the identical requirements laid out in the competition RFP, the resulting aircraft designs couldn't be more different—first place went to a traditional tube and wing design and third place to a blended wing body design.

In his senior design class, **Jason Merret** uses the first semester to build the skills his students need to design an airplane. He incorporates some of the specific knowledge and tools they'll need for AIAA's annual design parameters into some of the class assignments.

First-place team lead **Colin Kinsey** said their biggest challenge was integrating the aerodynamics and engine decisions into the overall aircraft design and allowing for the three different payload configurations.

"It took a long time to get that nailed down so we could move forward with some other disciplines that were reliant on those

decisions. We had to work in parallel as much as we could, because so much of it relies on previous information. As team lead, I had to make sure everyone had something they could work on while waiting for new calculations or new design characteristics."

Kinsey's team included: **Avery Beinhauer, Anna Marie Buss, Aryan Dawra, Jakub Mitka, Divyansh Ojha and Zachary Werth.**

Matt Brotnow led the team that placed third. "We knew from the onset that a BWB design might mean a little more work, but we were willing to do it to create a unique, innovative design that still satisfied the RFP," Brotnow said. "It meant starting from scratch on a lot of the nitty-gritty design work."

He said the large cargo bay requirements led to a few unique challenges. The existing weight estimations and structural layouts for BWB designs typically don't allow for such a large opening.

Brotnow's team included: **Eduardo Martinez, Vincent Ma, Jackson Long, Lucas Smerica, Cynthia Sigamony, Yesung Jeon and Daniel Zapata.**

Student honored as one of 20 Twenties



Aviation Week Network's 2025 Class of 20 Twenties includes **Yair Guerrero**, BS '25. He was selected from 90 nominees at 46 colleges and universities worldwide.

"Among the undergraduate students I have mentored during my first year at Illinois, Yair stands out," said **Matthew Clarke**.

Clarke said Guerrero expressed an interest in pursuing a PhD and approached him to do an independent study that would allow him to apply what he learned in his classes. Clarke was impressed with his initiative and took him on as a research assistant on a project exploring the effects of helicopter surveillance noise on urban communities.

Outside of his courses and research with Clarke, Guerrero is a leader in the campus Society of Hispanic Professional Engineers, serving first as outreach chair, then treasurer and president.

Matthew Clarke, left, with Yair Guerrero, right

Greetings

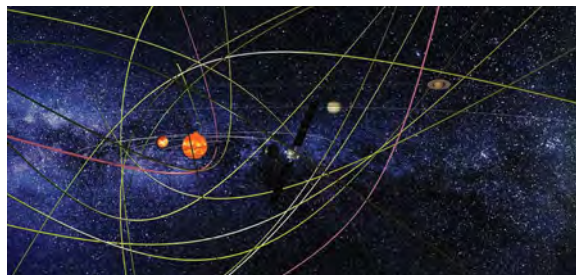


Space is more interesting and more accessible than ever, so we chose to devote the center section of this *UPDate* to our efforts in space exploration and design. There are stories about in-space servicing and repair missions, stress in re-entry parachutes, flexible electronics, and new ultra-efficient propulsion technologies, to list a few.

I hope you'll also enjoy reading stories about some of our outstanding alumni, our students who go above and beyond, and our faculty, all of whom have updates on their achievements from this past year at the back. Our undergraduate student teams have celebrated successes in competitions. We have new equipment that expands our capabilities and new faculty.

See what we are doing to **elevate society** and **create wonder**.

Jonathan B. Freund
Donald Biggar Willett Professor and Head



Cover images: From research conducted by Hiroyasu Tsukamoto, the background image uses visualized neural-rendezvous trajectories for interstellar object exploration--the pink trajectories are of 1I/' Oumuamua and 2I/Borisov. Additional images include Matthew Clarke and students Yair Guerreiro, Zoe Surles, Gabriela Zabiegaj, Alana Falter, Tiana Foreman, Ryan Smith, Emma Held, Anabelle Stevenson, Avanti Singh and Risa Bhaumik.

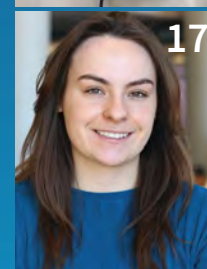
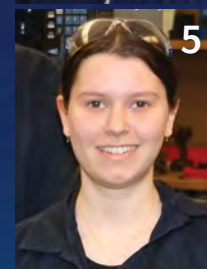
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Contents

- 2** Two teams finish sky high
Student honored as one of 20 Twenties
- 4** Students using ChatGPT may pass the course,
but with a cost
- 5** Satellite swarm images cloud's insides
She knows her way around a machine shop
- 6** Blending a career in engineering and medicine
Barton's aviation career a steady climb
- 8** Eliminating space trash
The fate of telescopes in space is looking up
- 9-16** Special section: Space Exploration & Design
at Illinois
- 17** Two summers at Kirtland built plasma
knowledge
Grad student's journey from art to aerospace
- 18** Christopher D'Souza: Distinguished Alumni
award
Robyn Macdonald: Outstanding Recent Alumni
David Riley: Harry Hilton Service award
- 20** Faculty highlights
- 23** New faculty: Ehrhardt, Gonzalez, Hausman,
Kearney and Wijayatunga
Faculty research areas



Department Head Jonathan Freund
Department Administration Kristen Reifsteck
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Graduate Advising Dung Quach-Wisdom and Siggie Schroth
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Students using ChatGPT may pass the course, but with a cost



Melkior Ornik lecturing in an AE 353: Aerospace Control Systems class

Melkior Ornik and his PhD student **Gokul Puthumanaillam** began with the assumption that students are going to use artificial intelligence and large language models such as ChatGPT to do their homework. Then they set out to learn how well the free version of ChatGPT would compare with human students in a semester-long undergraduate control systems course.



Gokul Puthumanaillam

The results: On straightforward math homework, ChatGPT got an A, but with some quirky answers. However, on higher-level problems that require reasoning, it got a D.

“On open-ended questions it got a 62, bringing ChatGPT’s semester grade down to an 82, a low B,” said Puthumanaillam. “The class average for human students was 84.85 percent because they could handle the more complex problems.”

They concluded that a student who puts in minimal effort could use ChatGPT exclusively, get a B and pass the course. However, the passing grade might be the combination of A+ in simple math and D- in analysis, so they probably haven’t learned much.

“Like calculators in math classes, ChatGPT is a tool that’s here to stay and that students will use,” Ornik said. “The results showed me that I need to adjust as an educator. I plan to consider how I design my courses so that, over time, I include more higher-level questions, perhaps including project-based assignments. Students will still use programs like ChatGPT to do the simpler math problems, but by adding more open-ended questions, they’ll also reach a higher level of critical thinking and truly learn the material.”

Puthumanaillam said although ChatGPT is fast and mostly correct on structured questions, it’s wise to use it with caution.

“A student might take 20 minutes to answer a question. ChatGPT solves it in less than 20 seconds, but the correctness is sometimes questionable.”

He also described examples of strange behavior from ChatGPT’s homework such as using inappropriate technical jargon and saying things that were simply not true.

“Despite the fact that we provided all of the course material needed to ChatGPT, it still hallucinated, using words like quasi periodic oscillations that were never used in the class, in the lectures or course materials.”

Did ChatGPT learn from its mistakes?

“When we told ChatGPT it was wrong on a multiple-choice question, gave it the correct option, then a variation of the same question, yes, it did better,” Puthumanaillam said. “In a sense, it was learning but overall, it was stagnant. If it scored 90 percent in homework, it ended up scoring 90 or 92 at the conclusion of the semester.”

“The Lazy Student’s Dream: ChatGPT Passing an Engineering Course on Its Own,” a collaboration between Ornik, Puthumanaillam and **Tim Bretl**, was presented at the 14th International Federation of Automatic Control Symposium on Advances in Control Education.

Bretl and PhD students **Grayson Schaer** and **Pranay Thangeda**, created the project environments, developed course materials and the PrairieLearn infrastructure.

Ornik was awarded a grant to lead a team of 12 researchers, including **Siegfried Eggl**, to extend this work to multiple courses and consider its impact on teaching practices and choice of material.

Satellite swarm images cloud's insides



David Stanley's

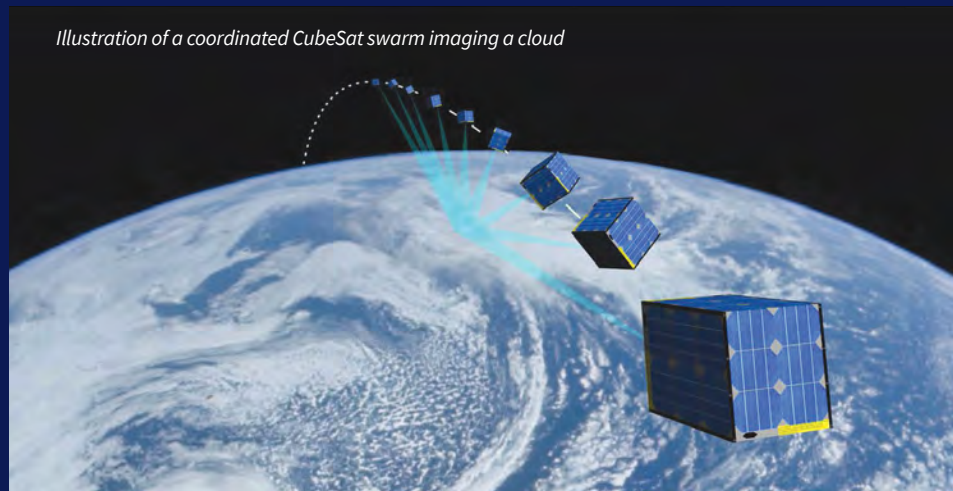
interest in climate change led him to develop a program to improve how we gather data to study the inside of a cloud.

"Computed cloud tomography is like a CT scan," Stanley said. "Instead of X-rays, the simulation of multiple satellites takes images of the cloud from as many angles and in as short a period of time as possible."

Stanley said one of the unknowns in climate modeling is how much convective transport affects regrowth of new clouds. Convection is about the movement of heat and moisture in the atmosphere, especially up- and down-drafts in unstable conditions.

"By generating multiple time passes on the center of the same cloud, you can see how the convection changes over time, how that is affecting the growth of other clouds in the future and how cloud growth can increase greenhouse effect."

Stanley, MS '21, said his advisor, **Robyn Woollands**, developed a method for a constellation of satellites orbiting Mars to collect as many observations of dust devils on Mars as possible, where, instead of subdividing the whole earth, they subdivided sections below the satellites which allowed them to only need a few indexes at a time.



"I realized I could use just the clouds as the index," Stanley said. "It worked well and went down from millions of indexes to about a few 100 at a time, which is much more solvable."

Stanley stressed that this is simulated data.

"The important thing is that we have developed a new method that has the potential to significantly improve how 3D cloud data is collected which could lead to an improvement in our understanding of the dynamics inside a cloud and hence long-term climate effects."

"Enabling Space-Based Computed Cloud Tomography with a Mixed Integer Linear Programming Scheduler," by David Stanley and Robyn Woollands is published in the *Journal of Spacecraft and Rockets*.

She knows her way around a machine shop



Ana Bojinov, BS '25, worked in the Talbot Machine Shop since her sophomore year, but the work wasn't new to her. Bojinov's family owns a machine shop in Chicago where she was first introduced to the line of work.

"I spent a lot of summers and weekends hanging around, watching my father fix stuff for people," Bojinov said. She said, that's what got her interested in engineering.

Bojinov said, working with the shop supervisor, **Dustin Taylor Burns**, she was first assigned to small tasks.

"As I learned more about the details of machining, I got trained on the machines to make parts as well," she said.

Her hands-on experience is also a conversation starter.

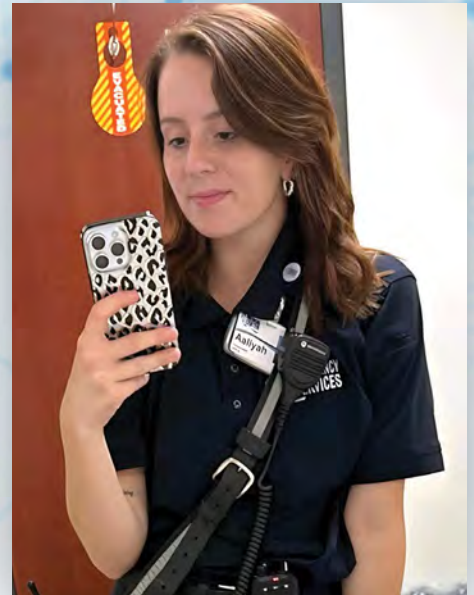
"When I've had interviews for internships, I've talked about my experience in the machine shop," she said. "It's something that a lot of people find interesting —because it's something not a lot of people do and because it shows I understand the process that goes into making things."

In the Talbot Laboratory Machine Shop, left to right: Rex Krumwiede, Dustin Burns, Ana Bojinov and Greg Milner

Blending a career in **engineering and medicine**



*Above: Aaliyah Gaffey at NASA's Johnson Space Center with the xEMU space suit.
Right: Gaffey takes a selfie wearing her EMT uniform.*



For information about scholarships and other ways you can support the department, contact Tim Cochran at tcochran@illinois.edu or 217-333-1149.

Aaliyah Gaffey used a gap year to develop new skills, leading her to a career path that blends her passions for aerospace engineering and medicine.

"That year off before college, I took patient information for COVID vaccinations at a clinic and got my EMT certification and license, but I also served as a mentor for my high school's FIRST robotics team, which gave me continuous exposure to engineering. I fell in love with both fields and wanted to combine them."

Gaffey said she saw an overlap. As medicine becomes more quantitative, there will be a bigger push for more engineers to go into healthcare and that will be the perfect balance of her passions.

"My goal is to get an MD/PhD," she said. "My dream job would be as an astronaut, but I think I'd be just as happy as a flight surgeon."

She already passed the squeamish test, having observed surgery up close while shadowing at the CGH Medical Center in her hometown of Sterling, Illinois and from her

hands-on experience as an EMT with the local ambulance service.

"I liked the fast-paced environment and critical thinking required and being able to walk into a house and see a medical problem, then within a minute plan how to treat and stabilize the patient."

Since then, Gaffey has continued to find herself at the intersection of engineering and medicine. On a co-op at NASA's Marshall Space Flight Center, she worked on a human exploration rover challenge. In an internship at NASA's Johnson Space Center, Gaffey created test procedures for thermal vacuum chamber testing of the xEMU spacesuit and assisted with space suit tests at the Neutral Buoyancy Lab.

At yet another internship, this time on the space medicine team at SpaceX, she developed the medical subsystems on future lunar missions that use engineering principles to guide medical device selection.

Gaffey's mentor at SpaceX challenged her to look at a medical case, then think about the physics behind it. "For example,

something like IV tubing. In space, you'd have to hang it six times as high to combat lunar gravity. I'd never thought of that until I did the internship."

About the varied opportunities and scholarships she's received while at Illinois such as one from the Aerospace Medicine Association and another from the Illinois Space Grant Consortium, Gaffey repeatedly says she's grateful.

"I remember seeing the email notification that I'd received the Scott R. White Scholarship. I was shocked. I'm honored to have been awarded this one as it's related to my undergrad research. Also, the scholarship amount really helped lighten my financial burden. I did EMT work to help pay for rent, gas, food and other essentials. Receiving the award greatly reduced my financial stress."

Barton's aviation career a steady climb



Barton donated his retirement gift to the department—one of 22 blades for a GE90-115B turbofan engine.



Craig Barton, wife Bethany, and their children CJ and Izzy while on a ski trip to Snowmass, Colorado in December 2006—the trip on which Barton received the first of two ski trip promotion offers.



Fresh out of college, **Craig Barton**, BS '88, got his first job as an “experimental aerodynamics guy” at Rockwell.

“I was doing wind tunnel testing, but across a lot of different products. It was super exciting because everything I worked on was the next generation of its kind.”

After earning an MS in aerodynamics and propulsion at Cal Poly Pomona, he relocated for a job in Tulsa, Oklahoma which was a better fit for him and his family.

That move became a 27-year career with American Airlines, beginning as a power plant engineer working on engines for the MD 80 and 727s. After being promoted to lead engineer on the V2500, he experienced a series of steppingstone job changes leading to top management.

He then made a dramatic move from engineering to operations. His soft skills

were recognized. He had the ability to manage upwards as well as relate to the skilled labor force in the unionized environment of an airline. He did well and was asked to lead the operations side of the business.

Barton described the “crazy” promotion offer.

“I was up on a chairlift on a skiing trip with my family when my phone rang. I didn't want to answer it because I knew my phone would end up in the snow drift. It was my boss who was at the time the vice president of maintenance. I skied down to the bottom and called him. He basically said, ‘this is your new job’ and off I went.

“Crazy enough, but two years later the exact same thing happened. A new boss called me while skiing and asked me about moving from the engine side of the business to the airframe side. I decided I would never go skiing again unless I wanted a new job.”

Moving to the operation side of the business led to larger and more expansive roles.

Then, when American Airlines and US Airways merged, Barton volunteered to take on the task to integrate the technical operations within the two companies.

“That was probably the biggest one-off challenges of my career.”

After that success, Barton was promoted to vice president, overseeing all of American's supply chain, planning and heavy maintenance. With a fleet of about 1,000 airplanes, his shops were doing maintenance on 50 aircraft and 100 engines at a time, some partial repairs and others in their heavy overhaul.

In his last role before retirement, Barton was the vice president of technical operations for maintenance execution around the globe and about 14,000 mechanics and managers reporting to him.

“I learned that the things you do previously in your career will always be with you and may help you 10 years later doing something completely different.”

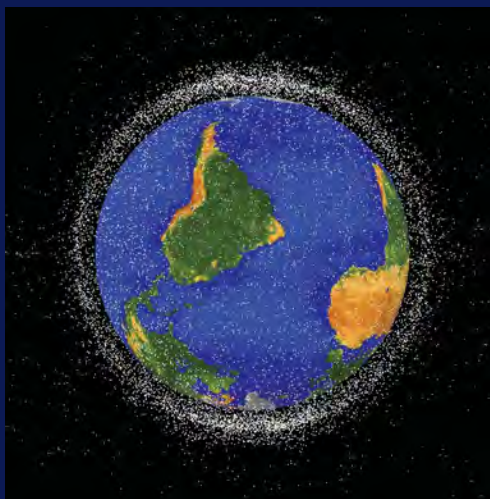
Eliminating space trash

Siegfried Eggl is an author on a chapter in *The Zero Debris Technical booklet*, an international reference to curb the pollution of near-Earth space including the protection of the dark and quiet sky from interference through space objects.

In the past, astronomers and those in the space industry worked hand in hand when designing and operating space telescopes. With the advent of satellite constellations in low Earth orbit, Eggl said they sometimes find themselves at odds with one another.

He hopes the booklet will become a guiding star for both the space industry and space agencies.

"We cannot continue with business as usual," Eggl said. "We have to be much more conscientious about space as a limited resource that needs cooperation between all stakeholders. Having translated policy into technical terms will help clarify what needs to be done. Long term, I can see this becoming the first major step in a continued effort to ensure and maintain access to space for all."



In the region within 2,000 km or 1,242 miles of Earth's orbit is the most concentrated area of orbital debris. Credit: NASA ODPO

The fate of telescopes in space is looking up

Traveling about a million miles from Earth for a service call on Gaia or James Webb Telescopes is a challenge. But according to **Siegfried Eggl**, it's worth the trek.

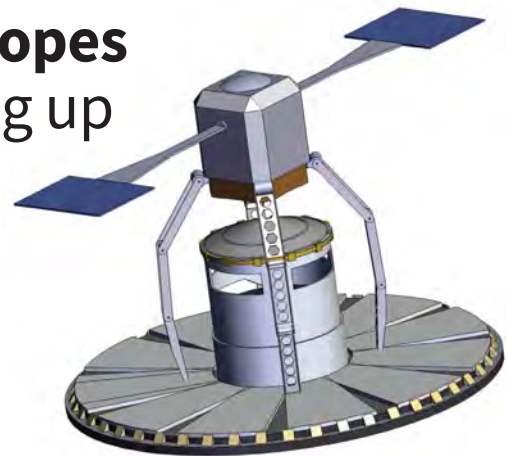
"Many space telescopes such as Gaia aren't really damaged when they are decommissioned, but they are simply running out of fuel for cooling, station keeping or attitude control. It's buying an expensive sports car, then throwing it away when it runs out of gas. PhD student **Ruthvik Bommenna** designed a novel concept to add a spider-looking attachment that can extend the life of Gaia-like satellites without impeding data collection."

Eggl also said, it would be great if we were able to repair James Webb's mirror that was hit by a micrometeorite in 2022 before the end of its mission lifetime.

"Ruthvik uses thrusters to maneuver multi-agent spacecraft teams sent to repair a telescope and avoid colliding. The challenge lies in developing optimal guidance and control strategies that not only prevent collisions between spacecraft but also ensure that thruster exhaust does not damage the telescope."

Robyn Woollands said one of the main goals they achieved was finding a trajectory to get there cheaply, without reliance on large, cost-prohibitive rockets.

"Fortunately, getting there is doable because of some hidden highways in our solar system," she said. "We have a trajectory that is optimal for the size of spacecraft needed to repair the JWST."



CAD model of the Gaia spacecraft with service vehicle, post-docking configuration.

PhD student **Alex Pascarella** brought together two approaches to trajectory design to develop a novel technique for quick sampling of the solution space that can shorten the computation time.

"Trying to rendezvous with a target spacecraft at a specific location in space/time is challenging," he said. "We first investigate the solution space by propagating a sample of solutions—either without any thrust or with a very simple thrust control law—and we take note of how close they pass to our desired destination," Pascarella said.

Eggl said, "We're trying to stay a step ahead so there is a plan when we need to replace mirrors, for example. Understanding how to do this cost effectively will be even more important for the next generation of space telescopes, which will be designed with serviceability in mind."

"Mission design for space telescope servicing at Sun-Earth L2," is published in the journal *Acta Astronautica*.



Siegfried Eggl



Ruthvik Bommenna



Robyn Woollands



Alex Pascarella



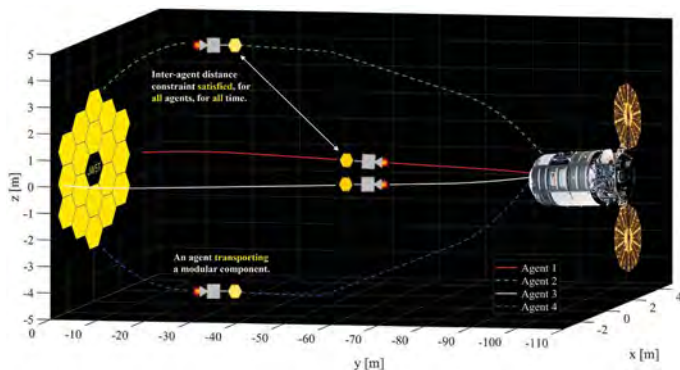
SPACE EXPLORATION AND DESIGN AT ILLINOIS

The department is setting the future of space exploration and design. We are prolonging the life of spacecraft, inventing both new fuels and propulsion systems, and creating innovative materials and structures, some of which will even be manufactured in space. We are designing better entry parachutes and heat shields, using deep learning to find fast-moving interstellar objects, and planning how spacecraft can operate autonomously far from Earth.

Our hands-on, teamwork-focused education in space, and all aerospace engineering, is equipping the next generation of aerospace engineers for careers in space systems, and maybe in space itself.

The hollow cathode Hall thruster shown here is just one example of University of Illinois Urbana-Champaign research. In addition to being visually stunning, it is also state-of-the-art technology for space propulsion.

Follow us as we continue to work with our students to advance space science, space technology and space exploration, continuing a tradition of elevating society and creating wonder.



Fuel-optimal trajectories of four servicing agents transporting modular components between the service vehicle and the target spacecraft, while satisfying anti-collision constraints.

Multiple CubeSats for in-space servicing and repair missions

Illinois researchers developed a method so multiple CubeSats can act as servicing agents to assemble or repair a space telescope. It minimizes fuel consumption, guarantees that servicing agents never come closer to each other than 5 meters, and can be used to solve pathway guidance problems that aren't space related.

Robyn Woollands and PhD student **Ruthvik Bommenna** simulated two, three or four vehicle swarms simultaneously transporting modular components between a service vehicle and a space telescope undergoing in-space servicing.

The most difficult aspect is the scale of the distances. The James Webb Space Telescope's orbit is about 1.5 million kilometers away, where the gravitational force of the Sun and Earth balance each other, making it the perfect place in space for deep-space observation satellites to maintain orbit while facing away from the Sun.

"We used indirect optimization methods to guarantee that the output solution is fuel optimal," Bommenna said. "Direct methods do not guarantee that. And we incorporated the anti-collision path inequality constraints into the optimal control formulation as a hard constraint, so spacecraft do not violate the constraint at any point during the trajectory."

Bommenna said although the application for this work is to make in-space servicing and assembly safer and more efficient, the methodology they developed is very versatile and can be used in other trajectory optimization scenarios with different constraints.

"Indirect Trajectory Optimization with Path Constraints for Multi-Agent Proximity Operations," is published in *The Journal of the Astronautical Sciences*.



Robyn Woollands with Ruthvik Bommenna when he received the 2025 John V. Breakwell Best Student Paper Award.

Flexible electronics integrated with paper-thin structure for use in space

It's essential that space structures are lightweight and multifunctional. To address these characteristics in a new way, **Xin Ning** and PhD student **Yao Yao** integrated flexible electronics with a three-ply, self-deployable boom that weighs only about 20 grams.

Ning said, Juan Fernandez from NASA Langley Research Center approached Ning to collaborate.

"He was making a boom structure for a Virginia Tech CubeSat project and saw the opportunity to add multifunctional devices to the boom instead of just a pure structure," Ning said.

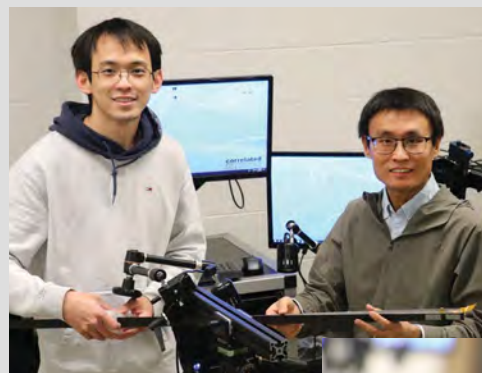
The boom, created at Langley, is a three-ply carbon fiber and epoxy composite material designed to be extremely thin—about as thick as a sheet of paper. It's rolled up like a tape measure with stored energy in its coils until it unfurls on its own in space.

"Virginia Tech's specific requirements were to have power and data lines over a meter in length embedded in a paper-thin composite material," Ning said. "We tried different materials and different technologies.

"Eventually, we went with thin commercial wires coated with insulation and it worked. We tried fancier approaches, but they failed. This was a simple and reliable solution using off-the-shelf, readily available wires."

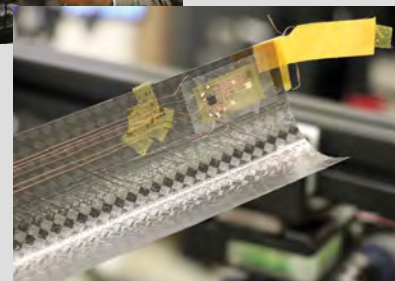
Another key component is a lightweight, flexible electronics patch with a motion sensor, a temperature sensor and a blue LED, all mounted on the boom tip. The electronics needed to endure the harsh thermal-vacuum conditions of space while remaining flexible enough to withstand the sudden unfurling of the coiled boom.

"Multifunctional bistable ultrathin composite booms with flexible electronics," by Yao and Ning, Juan Fernandez at Langley and Sven Bilén at Penn State, is published in *Extreme Mechanics Letters*.



Left: PhD student Yao Yao and his advisor Xin Ning

Right: The extended boom showing a lightweight, flexible electronics patch with a motion sensor, and a temperature sensor mounted on the boom tip





Laura Villafañe Roca and Cutler Phillippe work with the micro-CT scanner at the Beckman Institute for Advanced Science and Technology. Story and Photo Credit: Lauren Otolski, Beckman Communications Office.

A micro-scale look at how parachute textiles act under stress

Regardless of what a parachute is slowing down, it must withstand large amounts of force and ensure the safety of its cargo. **Francesco Panerai**, **Laura Villafañe Roca** and PhD student **Cutler Phillippe** used computed tomography scans to study the fiber-scale properties of parachute textiles and link them to larger-scale behavior.

The researchers used a micro-CT scanner at Beckman Institute to image two parachute textiles under increasing stress levels. Like a hospital CT scanner, micro-CT scanners use X-rays to image 2D slices of a material. The slices visualize the material's 3D structure when put together.

A tensile tester allowed them to incrementally increase the force on their samples. At each new level of force, micro-CT scans were taken while the samples were kept under stress.

The researchers expected the fibers would respond the same when pulled in each direction of the weave—warp and weft—but they observed the opposite: the textiles had different properties in different directions. Specifically, the fabric is more resistant to being stretched in the direction of the warp fibers.

Because parachutes are made of different textile pieces attached to each other, the orientation of these pieces influence the properties of the overall parachute.

This research informs models to identify promising candidate textiles. And, according to Phillippe, this work can be applied to parachutes in other settings: for instance, use in relief efforts or in recreation.

"In Situ Imaging of Parachute Textile Micromechanics Under Tensile Load," is published in the *American Institute of Aeronautics and Astronautics Journal*.

New instrument uses radar to measure what the eye can't see

Laura Villafañe Roca, PhD student **Nicolas Rasmont** and close collaborators at Illinois developed a new instrument to measure the density of the dust kicked up when spacecraft thrusters interact with planetary surfaces during landing. Because cameras and other optical equipment are blinded by dense dust clouds, the new instrument uses millimeter-wave radar in a new way to accurately measure the dust and debris.

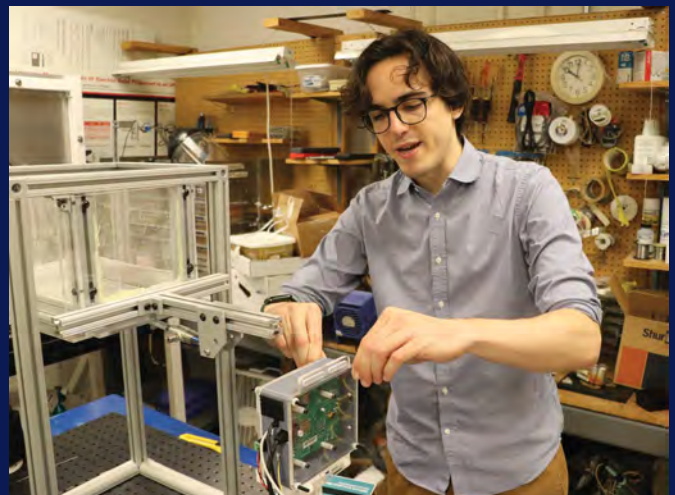
The instrument uses a radar to generate waves with a wavelength of 3.8 mm, just over an eighth of an inch. The wave travels through a cloud of particles, reflects, and is captured back to the instrument to detect the presence of the particles.

"With the radar emitter and receiver, we can time the light traveling between two points with high accuracy," Rasmont said. "The particles slow the millimeter-waves slightly, which means that there is a small difference in time-of-flight between a wave traveling through a cloud of particles against a wave traveling in vacuum. That small difference in time-of-flight can be measured by comparing the two waves together."

Rasmont said the instrument has a wide range of applications outside of lunar landings.

"Many industrial processes involve mixing or carrying powders, like flour, grain, catalysts, coal, or other chemicals, with a fluid. To control and understand those processes, you want to measure the particle concentration of the mixture, which is exactly what our instrument provides."

"Millimeter-Wave Interferometry for Opaque Particle-Laden Flows," by Rasmont, Hussein Tatal Al-Rashdan, Gregory Elliott, Joshua Rovey and Villafañe Roca, is published in *IEEE Transactions on Microwave Theory and Techniques*.



Nicolas Rasmont assembling his radar interferometry instrument in the lab.



Victoria Coverstone A woman of many firsts

When **Victoria Coverstone** was an undergrad at Illinois in the mid-'80s, she was usually the only female in her aerospace classes. Just seven years later, Coverstone found herself teaching those classes. She went on to establish herself in academia with an impressive list of firsts. Recently retired, she's back sharing her expertise in the department.

Coverstone earned her BS in '85 and MS in '86. While working on her PhD, she was asked to teach the introductory controls course on short notice.

"I was terrified. I had taken the course but had no teaching experience. I didn't have a mentor. It wasn't a thing back then. I had the syllabus and my lecture notes,"

That sink-or-swim experience convinced her to apply for the job. She got it, becoming the first female faculty member in the department.

Over the next 26 years, she worked to redesign courses, held college leadership positions and championed new programs such as the MEng professional master's degree.

She started the CubeSat program because she wanted students to build something that goes into space. Full circle: she and **Joshua Rovey** received funding with the Air Force University Nanosatellite Program.

As campus director of the NASA Illinois Space Grant Consortium, Coverstone co-founded the Undergraduate Research Opportunities Program, now in its 23rd year.

Coverstone also works with CU Aerospace, a company she co-founded in 1999 with her first husband, **David Carroll**, BS '85, MS '86, PhD '92, and faculty members **Rodney Burton**, **Michael Bragg**, **Wayne Solomon**, and **Scott White**.

She served for several years as professor and head of the Department of Mechanical and Aerospace Engineering at the University of Miami in Coral Gables, Florida, then moved back to Illinois.

"I'm grateful to be back. Like Dorothy said, 'there's no place like home.'"



Top: Victoria Coverstone
Bottom: Coverstone accepting the award for the AIAA Teacher of the Year in 2001 from AE senior Matt Hausman, who joined the faculty in 2024.

Astronaut tool gets underwater testing, simulating use in space

Illinois was once again among the teams selected to have their creation tested at the Johnson Space Center in Houston, Texas. Their tool carrier descended into NASA's 40-foot-deep Neutral Buoyancy Lab pool. From topside, one of the students communicated with the diver, giving them live, detailed instructions on how to operate the tool.

Sophomore **Alana Falter** served as the research and testing lead on the project and was behind the microphone for the testing.

"The diver commented that he liked the design of the top handle," Falter said. "He liked that the ridges were designed to fit fingers."

The NASA program, called Micro-g NEXT, is a challenge, not a competition. Every year, the challenge is different so teams can't build on knowledge from previous years.

Team lead **Emma Held** said "It's a unique project because you do the entire design process from brainstorming an idea to building the final product in one year. This carrier is the biggest tool the team has ever had to create, so that was a challenge in itself—fabricating something that large on campus.



Left to right: Zoe Surles, Gabriela Zabiegaj, Alana Falter, Tiana Foreman, Ryan Smith and Emma Held. Not pictured: Drew Eimer, AJ Bernardo, Niharika Navin, Kate Pactol, Theodore Prama Raditya, Ryan Souka, Mythri Subash, Aditi Badde and Vincent Ma.

Illinois rocket team breaks 7-year altitude record

After a long history with the Intercollegiate Rocket Engineering Competition, **Navya Meka**, BS '25, said the time was right for Illinois Space Society's Spaceshot team to go higher. The decision paid off. The team traveled to the Mojave Desert to participate in the unlimited altitude division of the Friends of Amateur Rocketry competition.

"We'd already won in the 30K category at IREC. With FAR, we could go as high as we want."

Their two-stage rocket Kairos II reached 44,165 feet or approximately 8.3 miles—taking second place and breaking the previous Illinois record set in 2016.

ISS's rocketry program is its largest technical project. Its main goal is Spaceshot, a multi-year project dedicated to developing a rocket capable of reaching the Kármán line, defined as 100 km or 62 miles.

Meka said their road to success was not without bumps. The year prior, their rocket hit lockout—a safety measure to make sure the rocket doesn't ignite horizontally. "Our sustainer was not at the right angle, so it didn't ignite."

This year, the team relaunched it to prove they could do a two-stage rocket and test the staging mechanisms before scaling it up to full size. After a second failed attempt, they rebuilt everything with a design closer to Intrepid—the rocket that took second at IREC—but this time as a two-stage rocket.

She said the team did more in-depth simulations for stability, designed better fin jigs to load and test the fins, scaled back from carbon fiber to fiberglass, and emphasized better engineering overall.



Team members at competition left to right: Ishaan Bansal, Shikhar Kesarwani, Cliff Sun, advisor Nicolas Rasmont, Aparna Kamath, Adam Pawlik, Krisha Mahajan, Ethan Kooper, and Sahilkrishna Vazhathodiyil.

Team takes 2nd place in human lander challenge

A team of undergrads in aerospace, mechanical and physics took second place in NASA's Human Lander Challenge with a system-level solution to mitigate plume-surface interactions during final descent and landing on the moon.

Over an intense two days at the Marshall Space Flight Center in Huntsville, Alabama, the Illinois team competed against 11 other university teams. Their project, HINDER: Holistic Integration of Navigational Dynamics for Erosion Reduction, uses a three-phase approach to select landing sites with reduced plume-surface interaction in the absence of dedicated infrastructure.

AE junior and project manager **Shikhar Kesarwani** said a major hurdle was the complexity of plume surface interaction, a field that demands extensive research to understand, let alone to devise solutions that mitigate its adverse effects on lunar lander safety.

"We consulted with our advisors to verify our understanding of PSI and validate our solutions. We also had team members who had participated in NASA's RASC-AL competition previously. Their experience was instrumental in guiding the design process and teaching newer members how to navigate a system engineering solution."

In addition to Kesarwani, the team's aerospace students included Brody Lauer, Chen Li, Ishaan Bansal, Galen Sieck, Benjamin Ochs and Sahilkrishna Vazhatodhyil.

"This is a great achievement by a team of our finest and more fearless students," said **Laura Villafañe Roca**, faculty advisor along with her PhD student **Nicolas Rasmont**. "I am extremely proud of what they achieved in one year of hard, independent work. They did an excellent job, gave a spotless presentation, and a gracious performance in answering the difficult jury questions."



Front, left to right: Amber Parker, Ashley Sawa, Zyun Lam, Quinn Athas, James Lippert, Navya Meka, Alex Gomez, Peter Giannetos, Liam Nelson and Cameron Steelberg.

Back: Thomas McManamen, Evan Yu, Charlie Plater, Aidan Costello, John Williams, Luke Leddy, Nikita Kovalov, Michael Karpov, Aaditya Voruganti, Mihir Shevade and Ethan Massey.

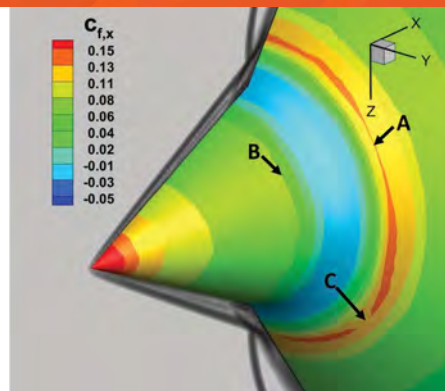
New disturbances exposed in 3D hypersonic simulation

At hypersonic speeds, complexities occur when the gases interact with the surface of the vehicle such as boundary layers and shock waves. **Deborah Levin** and her PhD student **Irmak Taylan Karpuzcu** observed new disturbances in simulations conducted for the first time in 3D.

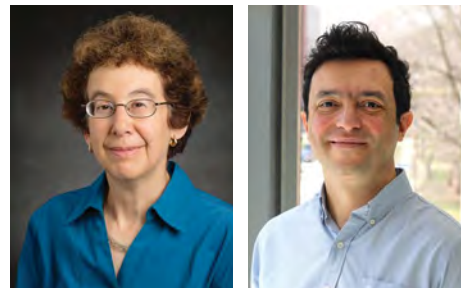
“Early experiments didn’t provide enough data to determine any 3D effects or unsteadiness because there weren’t enough sensors all around the cone-shaped model,” Karpuzcu said. “Having the full picture now in 3D, it’s different. You would expect the flow around the cone to be concentric ribbons, but we noticed breaks in the flow within shock layers both in the single and double cone shapes.”

Karpuzcu said the most difficult part of the work was in analyzing why the break in the flow was happening.

“The flow should be going in all directions, but uniformly. We needed to justify what we were seeing. We developed a code to numerically simulate the problem again. Running the 3D direct simulation Monte Carlo simulation is hard, but we set up a second computer program to make sure everything works and is within the limits for our flow conditions. When we did that, we saw the break in two big chunks in 180-degree periodicity around the cone.”



View of the cone junction of a simulated flow field. In the image labeled as A, B and C are the locations of the conical shock, wavy separation line and the discontinuity in the circular shape.



Deborah Levin, left and Irmak Taylan Karpuzcu right

Karpuzcu said the cone geometry represents a simplified version of many hypersonic vehicles and understanding how the flow affects surface properties can help lead to design considerations.

“Loss of axial symmetry in hypersonic flows over conical shapes,” is published in the journal *Physical Review Fluids*.

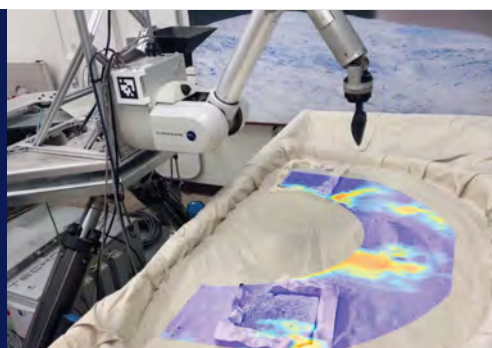


AI model masters new terrain at NASA facility

Extraterrestrial landers sent to gather samples from the surface of distant moons and planets have limited time and battery power to complete their mission. Illinois researchers trained a model to autonomously assess and scoop quickly, then watched it demonstrate its skill on a robot at a NASA facility.

Melkior Ornik’s PhD student **Pranay Thangeda** said they trained their robotic lander arm to collect scooping data on a variety of materials, from sand to rocks, resulting in a database of 6,700 points of knowledge. The two terrains in NASA’s Ocean World Lander Autonomy Testbed at the Jet Propulsion Laboratory were brand new to the model that operated the JPL robotic arm remotely.

“We just had a network link over the internet,” Thangeda said. “I connected to the test bed at JPL and got an image from their robotic arm’s camera. I ran it through my model in real time. The model chose to



Left: Melior Ornik and Pranay Thangeda

Right: A snapshot of scooping preferences during testing on NASA Ocean World Lander Autonomy Testbed at the Jet Propulsion Laboratory.

start with the rock-like material and learned on its first try that it was an unscoopable material.”

Based on what it learned, the robotic arm moved to another more likely area and successfully scooped the other terrain, a finer grain material. Because one of the mission requirements is that the robot scoop a specific volume of material, the JPL team measured the volume of each scoop until the robot accomplished scooping the full amount.

Thangeda said that although this work was originally motivated by exploration of ocean worlds, their model can be used on any surface.

“Learning and Autonomy for Extraterrestrial Terrain Sampling: An Experience Report from OWLAT Deployment,” by Pranay Thangeda, Yifan Zhu, Kris Hauser and Melkior Ornik from Illinois; Ashish Goel, Erica L. Tevere, Adriana Daca, Hari D. Nayar and Erik Kramer from NASA JPL, is published in the AIAA Scitech Forum.

Experiment validates electric ion thruster simulations



Huck Beng Chew

Researchers in several aerospace disciplines simulated ion activity in an electric ion thruster, then validated it in a unique experiment to help predict the lifespan of electric thrusters.

“We can simulate the damage to the engine caused by sputtering, but because both the engine and chamber walls are both coated with impact-resistant carbon, we didn’t know whether the damage was from accelerated ions directly hitting the engine or by carbon bombardment off of the chamber walls,” said **Huck Beng Chew**.

Joshua Rovey and his grad students conducted an experiment proving where the carbon fragments originated by testing two different carbon-coated plates in the vacuum chamber—one with ^{12}C and the other with ^{13}C —making the identification clear. **Deborah Levin**, developed a code to calculate the amount of carbon atoms displaced.

Huy Tran, Chew’s former PhD student, created a scale bridging model to look at the sputtered species surfaces.

“From that work, we found the type of carbon didn’t matter, which simplifies the analysis,” Chew said.

Another significant finding from the research concerned surface roughness.

“When the surface was impacted with a sharper, oblique ion incident angle, the material shaved off in a zigzag profile and a rougher surface. The question was: Are the simulation results real? Josh Rovey’s experiment verified the answer to be yes.”

The study, “Carbon Transport in Electric Propulsion Testing – I: Multiscale Computations for Carbon Sputtering by Low Energy Ion Bombardment,” by Tran, Sean Clark, Reed Thompson, Levin, Rovey and Chew, is published in the *American Institute of Aeronautics and Astronautics*.

Using multimode propulsion for more efficient trips in space

NASA provided four real lunar mission scenarios to explore how a multimode propulsion system that integrates both a chemical high-thrust mode and an electric low-thrust mode—while using the same propellant—can succeed.

“We showed for the first time the feasibility of using multimode propulsion in NASA-relevant lunar missions, particularly with CubeSats,” said PhD student **Bryan Cline**. “Other studies used arbitrary problems, which is a great starting point. Ours is the first high-fidelity analysis.”

After demonstrating the feasibility of multimode transfers to the moon, Cline developed an optimal control technique for multimode propulsion mission design. Cline first solved a simple two-dimensional transfer between Earth and Mars that decides the optimal times to use high-thrust, low-thrust, or just coast. He then solved a three-dimensional transfer to geostationary orbit that minimizes fuel consumption.

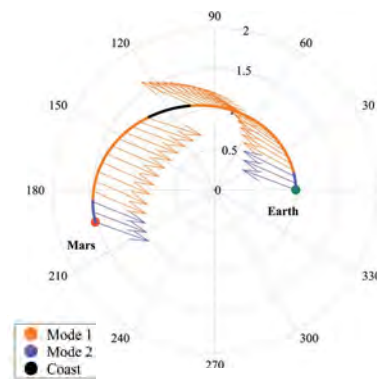
“The method can be used to solve all kinds of mission design problems,” Cline said. “The math is agnostic to the specific mission. And because the method utilizes variational calculus, what we call an indirect optimal control technique, it guarantees that you’ll get at least a locally optimal solution.”

“Lunar SmallSat Missions with Chemical-Electrospray Multimode Propulsion,” by Cline and **Joshua Rovey** from Illinois, Khary Parker and José J. Rosales from NASA’s Goddard

Space Flight Center and Stephen West from Space Exploration Engineering, is published in the *Journal of Spacecraft and Rockets*.

“Indirect optimal control techniques for multimode propulsion mission design,” by PhD students Cline and **Alex Pascarella**, and advisors, **Robyn Woollands** and Joshua Rovey, is published in *Acta Astronautica*.

Earth–Mars minimum-fuel trajectory when the spacecraft is coasting, as well as in mode 1: low-thrust and mode 2: high-thrust.



New equipment



A new space simulation chamber is now operating in the Electric Propulsion Lab. The larger size will allow researchers to test higher-powered, larger electric thrusters inside it as well as new propellants. At the installation, Joshua Rovey and David Attig are pictured center, with staff from Creative Thermal Solutions.

Concept for interstellar object encounters developed, then simulated using a spacecraft swarm



Hiroyasu Tsukamoto

Interstellar objects are among the last unexplored classes of solar system objects, holding tantalizing information about primitive materials from exoplanetary star systems. They pass through our solar system only once in their lifetime at speeds of tens of kilometers per second, making them elusive. **Hiroyasu Tsukamoto** developed Neural-Rendezvous—a deep learning-driven guidance and control framework to autonomously encounter these extremely fast-moving objects.

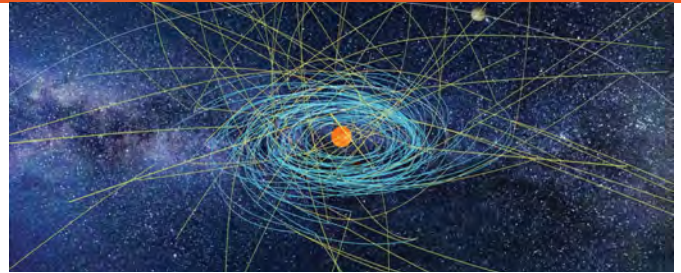
“Neural-Rendezvous learns all the information it needs to encounter an interstellar object, while also considering the safety-critical, high-cost nature of space exploration,” Tsukamoto said.

Tsukamoto said Neural-Rendezvous is based on contraction theory for data-driven nonlinear control systems, which he developed for his PhD at Caltech, while this project was a collaboration with NASA’s Jet Propulsion Laboratory, where he spent his time as a post-doctoral research affiliate.

In space, Neural-Rendezvous autonomously predicts a spacecraft’s best action, based on data, but with a formal probabilistic bound on its distance to the target ISO.

“We’re trying to encounter an astronomical object that streaks through our solar system just once and we don’t want to miss the opportunity. Even though we can approximate the dynamics of ISOs ahead of time, they still come with large state uncertainty because we cannot predict the timing of their visit. That’s a challenge.”

The speed and uncertainty of ISO encounters are also why the spacecraft must be able to think on its own.



Visualized Neural-Rendezvous trajectories for ISO exploration, where yellow curves represent ISO trajectories and blue curves represent spacecraft trajectories.

“Unlike traditional approaches in which you design almost everything before you launch a spacecraft, to encounter an ISO, a spacecraft has to have something like a human brain, specifically designed for this mission, to fully respond to data onboard in real time.”

Tsukamoto demonstrated Neural-Rendezvous using multi-spacecraft simulators called M-STAR and tiny drones called Crazyflies. While he was still at JPL, two Illinois aerospace undergrads approached him to show through research how it could benefit from a multi-spacecraft concept.

Arna Bhardwaj and **Shishir Bhatta** looked at how to mathematically maximize the information gathered from the ISO encounter using a spacecraft swarm. Their solution was to distribute the spacecraft to visually cover the highly probable region of the ISO’s position, which is driven by Neural-Rendezvous.

“Arna and Shishir worked hard,” he said. “I was surprised to see them publish a paper, given this field was entirely new to them. And while the Neural-Rendezvous is more of a theoretical concept, their work is our first attempt to make it much more useful, more practical.”

“Neural-Rendezvous: Provably Robust Guidance and Control to Encounter Interstellar Objects,” by Tsukamoto, Soon-Jo Chung at Caltech, Yashwanth Kumar Nakka at Georgia Tech and Benjamin Donitz, Declan Mages, and Michel Ingham at NASA JPL, is published in the *Journal of Guidance, Control, and Dynamics*.

“Information-Optimal Multi-Spacecraft Positioning for Interstellar Object Exploration,” by Bhardwaj, Bhatta, and Tsukamoto, is available on *arXiv*.

New research capabilities



A new two-stage light gas gun for hypervelocity impact experiments, which can propel projectiles to velocities exceeding 7 km/s, as seen in the ballistic impact photo, is now operational in Ioannis Chasiotis' lab. It will be used to design materials for lightweight space shields to protect space vehicles against micrometeoroid and orbital debris impact.



At the conclusion of her second summer, Timm was awarded the 2024 Outstanding Scholar Award for the Directed Energy Directorate, presented to her by Colonel Jeremy A. Raley.

Two summers at Kirtland built **plasma knowledge**

Even most non-scientists have a good understanding of how solids, liquids, and gases behave. But plasma, the fourth state of matter, holds mysteries even for scientists whose life's work is to study it. Over the past two summers, **Joshua Rovey's** PhD student **Allison Timm** got a crash course in generating and measuring plasma, with an emphasis on plasma diagnostic development and implementation at the Air Force Research Laboratory in Albuquerque, New Mexico.

"I received a National Defense Science and Engineering Graduate Fellowship to design, develop and characterize an engineering payload package for the in-space characterization of electric propulsion plasma plumes. I needed more background and hands-on experience. I was accepted into the AFRL Scholars Program at Kirtland Air Force Base to design, develop and test plasma diagnostics," Timm said.

Timm said she now feels proficient with vacuum systems. The diagnostics experience, in addition to having numerous AFRL experts close by for collaboration, put her in a great place to progress with her fellowship project.

"The first year at AFRL laid the groundwork for me to be successful the second year. That second summer, it was like a switch had flipped. I'd read so much about plasmas and diagnostics by that time, that it all just clicked."

Grad student's journey **from art to aerospace**

Ally Leeming spent her high school and undergrad years with one foot in physics and the other in the trumpet performance. Now, as one of **Joshua Rovey's** PhD students, both feet are firmly planted in electric propulsion.

Leeming holds a National Science Foundation Graduate Student Research Program Fellowship and has already participated in two unique programs. She was a summer intern at the U.S. Naval Research Laboratory in Washington, D.C. working with NASA's Jet Propulsion Lab on a project in the Planetary Science Mission Design School.

"For the NRL internship, I was an independent researcher in their spacecraft electric propulsion division," Leeming said. "They set me loose on the first day, giving me access to their electric propulsion sources."

Over that summer, she developed and deployed a novel catalytic probe technique to measure neutral density in electric propulsion radio frequency plasma sources.

Leeming said her experience at JPL was completely different.

"It was all planetary science, and I was the only pure aerospace engineer in the group of 17 PhD students. We chose to design a mission to Ceres—a body between Earth and Jupiter—to investigate if there is a liquid ocean underneath the surface."

Leeming's role on the mission was to help design the entire power system for the spacecraft.

On her journey toward the field of electric propulsion, Leeming said she found at least one overlap in her love for space science and the arts. Although her undergrad major was physics, her minor was creative writing, specifically poetry. The title of her award-winning poem: "Falcon 9," she said. "You can see where my true heart is."



Christopher D'Souza: Distinguished Alumni



Christopher D'Souza, BS '83, MS '84, is one of about 100 navigation specialists in the world. Since 2023, he has served as the NASA Technical Fellow for Guidance, Navigation and Control. He is this year's recipient of the Distinguished Alumni award.

He began his career at the Jet

Propulsion Laboratory as a maneuver analyst for the Magellan and Galileo missions. In 1991, he moved to the U.S. Air Force Research Laboratory at Eglin AFB where he developed trajectory optimization methods and advanced guidance laws for air-to-air and air-to-surface vehicles.

In 1996, D'Souza began working at the Draper Laboratory in Cambridge on guidance and navigation algorithms for rendezvous and capture and docking, primarily for the 2005 Mars Sample Return Mission.

He joined the NASA/Johnson Space Center in 2005 and in 2009, became the Deputy Branch Chief of the GNC Autonomous Flight Systems Branch where he led 22 engineers responsible for the onboard Guidance, Navigation and Targeting of crewed vehicles. In 2014, he became the Navigation Technical Discipline Lead for Human Spaceflight.

D'Souza is the principal architect of the Orion onboard navigation system consisting of four separate navigation filters, all of which flew successfully on Artemis I. He was the lead developer of the linear covariance toolset, which has been used extensively in the design of the Artemis missions and others. He developed guidance laws for planetary landing, rendezvous and intercept. His optimal landing guidance law was used on the successful Firefly Blue Ghost landing. He holds a PhD from the University of Texas and has over 100 conference and journal publications.

D'Souza served on numerous AIAA and AAS committees and has been associate editor of the *AIAA Journal of Guidance, Control and Dynamics* since 2014. He is a Fellow in both AAS and AIAA. He received the AIAA Mechanics and Control of Flight Award, the AAS Dirk Brouwer Award, and numerous NASA awards for the Artemis I mission.

Robyn Macdonald: Outstanding Recent Alumni



Robyn Macdonald, BS '13, PhD '19, is this year's Outstanding Recent Alumni. She was a postdoctoral associate at the University of Minnesota for two years before joining the faculty at the University of Colorado Boulder in Aerospace Engineering Sciences.

At CU Boulder, Macdonald develops models for the analysis

of hypersonic flow. She teaches methodologies for the prediction of aerodynamics forces and moments experienced by aircraft and the fundamental understanding of gas dynamics in nozzles with application to aircraft and rocket propulsion.

"Robyn has made an enormous impact in her first few years here in both research and teaching," said CU Boulder Professor Iain Boyd. "In research, she hit the ground running by winning a Young Investigator Program award from the Air Force on hypersonics."

The Air Force Young Investigator program aims to foster basic research in challenging science and engineering areas and enhance career development for outstanding individuals. AFOSR received over 175 proposals that year. Macdonald's is one of 36 awarded.

"She supports two large projects that I lead. In a NASA-funded institute on heat shield reliability, Robyn is advancing our understanding of how turbulence affects entry vehicle heating. In a multidisciplinary project funded by the Navy, Robyn is developing advanced models of complex air plasma chemistry. In the classroom, she teaches key required classes at both the undergraduate and graduate levels."

During her years at Illinois as a doctoral student, with her advisor, former faculty member Marco Panesi, Macdonald received the Illinois Space Grant Fellowship, participated in The Grainger College of Engineering Mavis Future Faculty Fellows program, and received the Faculty Outstanding Graduate Student Award.

She was also honored with the Weaver Thermophysics Best Student Paper Award at the AIAA Aviation Forum. The paper was also Editor's Choice from *The Journal of Chemical Physics*.

David Riley: Harry Hilton Service Award



Left: David Riley.

Right: Alumni board members at the 2018 meeting, pictured left to right top: Jim Mocarski, BS '89; John Rice, BS '81; Mark Crowley, BS '83; Steve Hoffman, BS '78, MS '80, PhD '84; John Soldner, BS '77, MS '79; Ben Doeckel, BS '81; Dan Jensen, BS '88; David Riley, BS '77; Gary Joseph, BS '78. Middle: Alex Kosmala, MS '90; Rick Zelenka, BS '87; and Bob Feconda, BS '81. Second: Earl Dowell, BS '59; Blaine Brown, BS '81; Erik Antonsen, BS '97, MS '01, PhD, '04, MD '09; and Tracy Elving, BS '85. Front: Abdi Khodadoust, PhD '93; Melissa Taylor, BS '03; Jeff Fisher, BS '83; Andrea Lackey, BS '06; Prof. Emeritus Harry Hilton, PhD '51; and Professor Philippe Geubelle

David R. Riley, BS '77, served on the department's alumni advisory board for over 30 years, volunteered as a guest speaker for classes, helped adjudicate student paper competitions, served as a judge for senior design projects, and participated in the Accreditation Board for Engineering and Technology re-certification efforts. For decades of sharing his time and expertise, Riley is named this year's recipient of the Harry H. Hilton Dedicated Service Award.

After getting his BS, Riley accepted a position at McDonnell Aircraft Company to work on fighter aircraft stability and control. He stayed for his entire career, rising through many levels of management at McDonnell Douglas which merged with Boeing in 1997. Riley retired from Boeing in 2017 after 40+ years of service.

Early in his career, Riley earned two MS degrees from Washington University in St. Louis.

Throughout his career, Riley worked on everything from fighter aircraft to transport aircraft, space planes, and even vertical and/or short take-off and landing aircraft.

In the early '90s, he worked on the flight control development efforts of multiple programs including the C-17, A/F-X, AV-8B, T-45, and ASTOVL. Riley led the flight control development team for the McDonnell Douglas/Northrop Grumman/British Aerospace Joint Affordable Strike Technology program.

After McDonnell Douglas merged with Boeing in the mid-90s, he moved to Seattle to lead the Boeing Joint Strike Fighter flight control development team. Later, he took over the management of a Boeing Phantom Works research group, which performed research for the X-40A and X-37 space planes, X-36, the Sonic Cruiser, and multiple classified programs.

Riley has served as program manager for several NASA and Air Force Research Laboratory programs including the Active Aeroelastic Wing Program, the Automated Aerial Refueling Program, the Integrated Vehicle Energy Technology Program, and the Power and Thermal Advanced Demonstration Design Program.

Riley remains active in AIAA. Throughout his career, he served on and led technical committees, served on the board of directors, served as the vice president for technical activities, and as a St. Louis section advisor. He is an AIAA Fellow, has 25+ technical publications, has presented papers at national and international conferences, and received the AIAA Distinguished Service Award in 2023.

Harry H. Hilton, PhD, '51 was a faculty member in the department beginning in 1949. When Riley was an undergrad, Hilton became the department head until he retired in 1990. Hilton continued to conduct research, teach graduate courses, and actively serve the department in retirement. He passed away in March 2022.

Faculty highlights



Phillip J. Ansell (Allen Ormsbee Faculty Fellow, associate professor/PhD, University of Illinois, 2013) was granted the Dean's Award for Excellence in Research at the associate

professor level, launched and chairs the AIAA Sustainability Integration and Outreach Committee, and co-authored a new book, *Aircraft Cryogenics*. He continues to direct the Center for Sustainable Aviation and the Center for High-Efficiency Electrical Technologies for Aircraft.



Jeffery W. Baur (Scott White Professor/PhD, Massachusetts Institute of Technology, 1997) is preparing for an in-space manufacturing of composites demo via

Mission Illinois, published on additive, low energy, and morphogenic composites. He led a first composite design competition entry and was elected vice chair to the Grainger Executive Committee.



Lawrence A. Bergman (research professor, professor emeritus/PhD, Case Western Reserve University, 1980)



Daniel J. Bodony (professor/PhD, Stanford University, 2005) is the associate dean for research. Bodony began studying the origins of differential ablation for

hypersonic vehicles and will give keynote presentations on modeling shock-laden and high-enthalpy flows.



Michael B. Bragg (professor emeritus/PhD, The Ohio State University, 1981) is the executive director for The Grainger College of Engineering Chicago Initiatives.



Timothy Bretl (William H. Severns Faculty Scholar, professor/PhD, Stanford University, 2005) served as an external honors examiner for five undergraduate

engineering students at Swarthmore College and participated in a four-day international workshop with the goal of expanding student opportunities for global engagement.



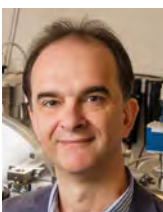
Rodney L. Burton professor emeritus/PhD, Princeton University, 1966) advised a MechSE senior design team on the design and fabrication of a 3-axis probe carriage for

in-vacuum thruster diagnostics. Invented issued U.S. Patent "Magnetoplasmadynamic Thruster with Reverse Polarity and Tailored Mass Flux," and published a paper on electric rocket modeling in the *Journal of Propulsion and Power*.



Wayne Chang (teaching assistant professor/PhD, University of California, Irvine, 2011) received three instructional innovation grants and the Provost's Initiative on Teaching

Advancement grant. The projects' scopes range from improving computational literacy in the aerospace curriculum to enhancing student engagement through podcasts.



Ioannis Chasiotis (Caterpillar professor and University Scholar/PhD, California Institute of Technology, 2002) is the director of graduate studies and an associate

head of AE and was named Fellow of the American Academy of Mechanics. He leads a research program on hypervelocity impact of materials for space environments. His lab just acquired a gas gun that can achieve projectile velocities exceeding 7 km/s.



Huck Beng Chew (professor/PhD, National University of Singapore, 2007) received a National Science Foundation grant, received the Zdeněk P. Bažant Medal from the

Applied Mechanics Division of the American Society of Mechanical Engineers, and published papers in *Journal of the Mechanics and Physics of Solids*, *International Journal of Solids and Structures*, *Acta Materialia*, and *Scripta Materialia*.



Matthew Clarke assistant professor/PhD, Stanford, 2022) joined the faculty in 2023. He was listed on the Forbes 30 Under 30 list for

Science for his work in developing computational aircraft design tools used by over 10,000 worldwide.



Victoria L. Coverstone (professor emeritus, PhD, University of Illinois, 1992) is the director of the Laboratory for Advanced Space Systems at Illinois and co-investigator

for an Air Force Research Laboratory University Nanosatellite Program mission demonstrating dual mode propulsion in a CubeSat form factor.



Bruce A. Conway (professor emeritus/PhD, Stanford University, 1981) and his PhD students presented a paper, "Adaptive Grid Refinement for Optimal Feedback

Control," at the AAS GN&C conference in Breckenridge, Colorado and he coauthored a book chapter, "Optimal Feedback Control of Aerodynamic Systems Using Solutions of the HJB Equation."



Siegfried Eggel
(assistant professor/
PhD, University of
Vienna, 2013) received
best paper awards
at the 46th AAS
Guidance, Navigation

and Control Conference and the 9th
IAA Planetary Defense Conference and
won an NSF grant to study the impact of
satellite constellations on astronomical
observatories.



Gregory S. Elliott
(professor/PhD, The
Ohio State University,
1993) continues to lead
the experimental team
on the DOE Center
for Exascale-enabled

Scramjet Design and on the executive
team for the Plasmatron X facility, which
replicates the high-enthalpy conditions
during reentry and hypersonic flight.



Fabien Evrard
(assistant professor/
PhD, Imperial College
London, 2018) received
the W. R. Marshall
Award from the
Institute for Liquid

Atomization and Spray Systems for
best paper, was named co-lead of the
Computation and Modeling Technical
Committee of ILASS-Americas, and gave
invited talks at Los Alamos National
Laboratory, the University of British
Columbia and Montréal, and Argonne
National Laboratory.



Jonathan B. Freund
(Donald Biggar
Willett Professor
of Engineering and
department head/PhD,
Stanford University,
1998) continued to

direct the Illinois DOE/NNSA-funded
\$17M Center for Exascale-enabled
Scramjet Design and became co-editor of
Annual Reviews of Fluid Mechanics. He is
chair of the Division of Fluid Dynamics of
the American Physical Society.



Philippe H. Geubelle
(Abel Bliss Professor
of Engineering and
executive associate
dean/PhD, California
Institute of Technology,
1993) is part of a DARPA-

supported multi-investigator project aimed
at manufacturing composite structures
in space, just outside of the International
Space Station. The mission launch is
scheduled for the spring of 2026.



Andres J. Goza (assistant
professor/PhD, California
Institute of Technology,
2018) published two
journal articles and the
research group he leads
gave several talks at

prominent conferences. He also chaired
the department's graduate admissions
committee and its aerodynamics, fluid
mechanics, combustion, and propulsion
group.



John Lambros (Donald
Biggar Willett Professor
of Engineering/PhD,
California Institute
of Technology, 1994)
became editor-in-chief
of *Engineering Fracture*

Mechanics, a leading international journal
on the mechanics of fracture. He was a
Distinguished Visiting Fellow of the Royal
Academy of Engineering, London during
his sabbatical and serves on the Provost's
Campus Budget Oversight Committee.



Cedric Langbort
(professor/PhD, Cornell
University, 2005) led a
research project that
considered bounded
rationality in the context
of multiagent decision

making. He presented related results at
invited seminars at Northwestern and
University of California Santa Barbara.
variety of venues this year including McGill
University in Montreal.



Deborah A. Levin
(professor/PhD,
California Institute of
Technology, 1979) is a
researcher in modeling
hypersonic shock
interactions, radiation,

and space plasmas using particle kinetic
approaches. She is the chair of the Rarefied
Gas Dynamics International Advisory
Committee and a member of the AIAA EP
technical committee.



Jason M. Merret
(professor of practice/
PhD, University of Illinois,
2004) received the AIAA
Teacher of the Year
award. He was reelected
to the College Executive

Committee as the research representative
for specialized faculty and will serve as ATIO
Technical Discipline Chair for AIAA's Aviation
Conference in 2025 and 2026. He taught and
advised the first and third place teams of
the 2024 AIAA Undergraduate Team Aircraft
Design Competition.



Xin Ning (assistant
professor/PhD, California
Institute of Technology,
2015) built a unique low-
earth orbit simulation
facility with thermal,
vacuum, atomic oxygen,

solar radiation and mechanical stressors.
This facility will advance research and
education in space materials, structures,
and manufacturing.



Melkior Ornik (assistant
professor/PhD, University
of Toronto, 2017) was
selected for the Office
of Naval Research
Young Investigator
Program award for a

project on AI-assisted tactical planning.
His work on assessment of AI capabilities
in the classroom has received extensive
international media coverage.

Faculty highlights



Francesco Panerai

(assistant professor/PhD, von Kármán Institute for Fluid Dynamics, Università degli Studi di Perugia, 2012) served on the Independent

Review Team for the NASA Artemis Char Loss investigation, published eight journal articles, and supported plasma tunnel testing of thermal protection system materials for the Space X Starship rocket.



John E. Prussing

(professor emeritus/ScD, Massachusetts Institute of Technology, 1967)



Joshua L. Rovey

(professor/PhD, University of Michigan, 2006) created a new and expanded electric space propulsion laboratory tailored for

the equipment, hardware and facilities for propulsion experiments and acquired, installed and commissioned a new 2.5-m-diameter, 4-m-long space simulation vacuum test facility. A major initiative supported by the new lab and test facility is isotopic carbon tracking, a new technique pioneered at Illinois for measuring carbon flux and transport in electric plasma thrusters and ground-test facilities.



Theresa A. Saxton-Fox

(assistant professor/PhD, California Institute of Technology, 2018) was the co-chair of a NATO Advanced Vehicle Technologies working

group on flow separation, published in the *Journal of Fluid Mechanics*, and led a peer-teaching mathematics program at Danville Correctional Center.



Michael S. Selig

(research professor, professor emeritus/PhD, The Pennsylvania State University, 1992) received a grant from DSO National

Laboratories in Singapore to develop instructional materials for airfoil, wing, and fuselage design, focusing on natural laminar flow applications. The project featured the use of his inverse airfoil design code, PROFOIL, which is available on GitHub.



Jordan T. Smart

(assistant professor/PhD, Stanford University, 2023) led research to develop "deepSPACE," an AI model for generating precise CAD

specifications. The work was introduced at AIAA Aviation, resulted in two patent filings, and selected by the NSF for a technology transfer showcase.



Huy T. Tran

(assistant professor/PhD, Georgia Institute of Technology, 2015) gave an invited talk at the NASA Collective Autonomy Seminar and had three papers

published on topics including explainable AI and machine learning for aviation—one was a finalist for the AIAA Intelligent Systems Technical Committee SciTech Student Paper competition.



Hiroyasu Tsukamoto

(assistant professor/PhD, Caltech, 2023) was named to Forbes 30 Under 30 Asia Class of 2025 and MIT Technology Review Innovators

Under 35 Japan 2024 for pioneering work in intelligent deep space exploration and mathematical foundations for decision-making under uncertainty.



Laura Villafañe Roca

(assistant professor/PhD, von Kármán Institute for Fluid Dynamics, Universitat Politècnica de València, 2014) was named AIAA Associate

Fellow Class of 2025. Her group published in the *Int. J. Multiph. Flow* and *AIAA Journal*. She was a keynote speaker at the 2025 Turbulence and Interactions conference, gave six invited talks, and continues as the Illinois Section AIAA chair.



Robyn Woollands

(assistant professor/PhD Texas A&M University, 2016) received funding from AFOSR and L3Harris Technologies, published 7 journal papers and 9

conference papers, graduated her first PhD student, joined the Space Flight Mechanics Technical Committee, and gave talks at the Aerospace Corporation, UC Berkley, ETH Zurich and U Vienna.



Brian S. Woodard

(teaching associate professor/PhD, University of Illinois, 2012) serves primarily in his collegewide role working to build the best class of

Grainger Engineering students each year beginning with community engagement and outreach, through the admissions process and finally, starting students in their first-year programming.



Elle Wroblewski

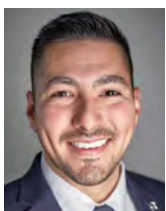
(teaching assistant professor/PhD, University of Illinois, 2022) is a specialized teaching faculty. Their research interests are sustainable

and safe engineering, agriculture drones, education outreach, and undergraduate student professional development. This year they taught AE 100, AE 202, and AE 298 RES.

New faculty



David Ehrhardt, PhD '15 University of Wisconsin Madison, was a research engineer with the Applied Research Institute and lab coordinator for the Advanced Material Testing and Evaluation Laboratory before becoming an AE research assistant professor in 2024. He leads an AFOSR grant examining structural designs in supersonic and hypersonic environments and subjected to fluid-thermal-structural interactions and was awarded funding for a metal additive manufacturing machine. He also leads a Rogue Space Systems Corporation project to develop a Contactless Laser Satellite Stethoscope to enable audio and harmonic diagnostics of resident space objects while in space.



Joseph F. Gonzalez, BS '10, MS '11, PhD '15 all from Illinois, is a new associate professor of practice. He brings a decade of experience from Boeing where he began as a principal investigator for battery technologies and testing, leading to a patent and two Boeing publications. Most recently, he served as the systems integration and specialty engineering manager for the Space Launch System where he led a multidisciplinary team of over 20 engineers for both the core stage and exploration upper stage space vehicles. For SLS and the Starliner program, he served as a materials and processes engineer and a mechanical/fluids test engineer.



Matt Hausman, BS '01, MS '03 University of Colorado Boulder, MA '09 Loyola Marymount University, began as an assistant professor of practice in 2024. He brought real-world knowledge from his years at Boeing and SpaceX. Drawing on his unique industry perspective, Hausman shaped two new courses to help prepare Illinois graduates for jobs in launch vehicle design and the small satellite launch vehicle market. He also works with the Laboratory for Advanced Space Systems at Illinois to provide students with hands-on experience working on satellite technology.



Sean Kearney, PhD '99, left his 25-year career at Sandia National Laboratories to take a position as an aerospace professor in October '24. He is also the Director of the Center for Hypersonics & Entry Systems Studies Experimental Operations and Plasmatron X. He delivered the keynote address at the European Conference on Nonlinear Optical Spectroscopy and served as vice-chair of the Gordon Research Conference on Laser Diagnostics in Reacting Flows in Diablerets, Switzerland.



Minduli Wijayatunga, PhD '24 University of Auckland, New Zealand, begins her first semester as an assistant professor in fall 2026. Her technical expertise includes convex optimization, optimal control, model predictive control, and reinforcement learning. She was a graduate research intern at NASA's JPL, contributing to the development of ion beam deflection for planetary defense. Prior to coming to Illinois, she was a research associate at the University of Sydney, focusing on mission autonomy for spacecraft servicing satellites.

Faculty research areas

Aeroacoustics

Daniel Bodony
Jonathan Freund

Aeroelasticity

Lawrence Bergman
Daniel Bodony
Philippe Geubelle
Andres Goza

Aerospace Materials

Jeffery W. Baur
Ioannis Chasiotis
Huck Beng Chew
David Ehrhardt
Philippe Geubelle
John Lambros
Francesco Panerai

Aerospace Structures

Jeffery W. Baur
Lawrence Bergman
David Ehrhardt
Xin Ning

Aerospace Systems Design and Simulation

Phillip Ansell
Matthew Clarke
Victoria Coverstone
Joseph Gonzalez
Jason Merret
Michael Selig
Jordan Smart
Huy Tran

Applied Aerodynamics

Phillip Ansell
Daniel Bodony
Matthew Clarke
Gregory Elliott
Andres Goza
Theresa Saxton-Fox
Michael Selig
Jordan Smart
Laura Villafañe Roca
Brian Woodard

Astrodynamics

Bruce Conway
Siegfried Eggl
Matt Hausman
John Prussing
Minduli Wijayatunga
Robyn Woollands

Combustion and Propulsion

Daniel Bodony
Rodney Burton
Wayne Chang
Gregory Elliott
Jonathan Freund
Philippe Geubelle
Joseph Gonzalez
Sean Kearney
Deborah Levin
Joshua Rovey

Computational Fluid Dynamics

Daniel Bodony
Fabien Evrand
Jonathan Freund
Andres Goza
Deborah Levin
Francesco Panerai
Jordan Smart

Controls, Dynamical Systems, and Estimation

Timothy Bretl
Victoria Coverstone
Cedric Langbort
Melkior Ornik
Hiroyasu Tsukamoto
Minduli Wijayatunga

Experimental Fluid Mechanics

Phillip Ansell
Gregory Elliott
Sean Kearney
Melkior Ornik
Francesco Panerai

Flow Control

Phillip Ansell
Daniel Bodony
Gregory Elliott
Jonathan Freund
Andres Goza
Theresa Saxton-Fox
Laura Villafañe Roca

Hypersonics

David Ehrhardt
Jonathan Freund
Sean Kearney
Deborah Levin
Francesco Panerai

Small Satellites

Rodney Burton
Victoria Coverstone
Siegfried Eggl
Joseph Gonzalez
Matt Hausman
Deborah Levin
Joshua Rovey

Space Systems

Timothy Bretl
Rodney Burton
Victoria Coverstone
Joseph Gonzalez
Matt Hausman
Deborah Levin
Melkior Ornik
Joshua Rovey
Jordan Smart
Hiroyasu Tsukamoto
Minduli Wijayatunga
Robyn Woollands

Uncrewed Aerial Vehicles

Phillip Ansell
Timothy Bretl
Gregory Elliott
Melkior Ornik
Michael Selig
Jordan Smart



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*Nicole Orloff, BS '25
studying on the
engineering quad*



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