2021

UNDERGRADUATE INNOVATION

THE OHIO STATE UNIVERSITY
COLLEGE OF ENGINEERING

DEPARTMENT OF MECHANICAL AND AEROSPACE ENGINEERING

Students participate in a socially-distanced weather balloon launch on the oval as part of AERO 2200

Message from Associate Chair for Undergraduate Education

REBECCA DUPAIX

When I began transitioning into this role in February of 2020, I had no idea that the emerging news of a few cases of novel coronavirus would soon upend most aspects of our lives—both at home and on campus. Yet one year later, I have been amazed at how the spirit of engineering, problem solving and resilience has allowed our students to grow and progress in their career paths despite the disruptions around them.

Our faculty have adapted by quickly learning to teach remotely, innovating to create virtual lab experiences, piloting new teaching paradigms and discovering it can be easier than ever to connect with students for quick homework questions over zoom than with the old ways that involved trudging across campus for in person office hours—especially on cold, snowy winter days.

I have been impressed by the resilience of our students during this past year. We were disappointed to miss the traditional rituals of academic awards banquets and commencement celebrations with our graduating seniors, but this impressive class of new alumni are headed for great things.

As you will read in the following articles, our undergraduates have been busy putting their quarantine time to good use. We have seen our undergraduate students continue to thrive in new endeavors, including work in our recently added Robotics and Autonomous Systems minor (page 6.) They have launched new project teams like Buckeye Vertical, who are exploring the field of urban air mobility (page 8). And they have continued to participate in industry-partnered capstone projects (page 7).

The research and accomplishments in *Undergraduate Innovation* were all made possible by the dedicated work of our students, who are our primary focus. As we highlight the efforts made by students in our department, we look forward to continuing to celebrate the achievements made by all current, former and future Buckeye engineers.

Rebecca Dupaix

Associate Chair for Undergraduate Education
Department of Mechanical and Aerospace Engineering

Cover: A student used the VM5i CNC machining center donated by Hurco Companies Inc. to the Mechanical and Aerospace Engineering student shop

Buckeyes helping prepare Black engineers for aerospace careers

In 2004 the National Society of Black Engineers launched a special interest group focused on space, which in 2016 became the NSBE Aerospace Special Interest Group (NSBE-ASIG). Since 2015, two Buckeye engineers have been instrumental in planning the group's activity and maximizing its impact.

Mechanical Engineering Assistant Professor of Practice **Russell K. Marzette, Jr.**, is the group's deputy director, while distinguished alumnus Ernest Levert, a Lockheed Martin technical fellow, serves as its chief technology officer.

One of 11 NSBE special interest groups, it prepares and serves black engineers to succeed in industry or academia, with four focus areas: research, outreach, policy advocacy, and technical development.

Each fall, Marzette, Levert and the other group leaders organize a technical forum covering topics relevant to professional and student members. This year's virtual conference featured another Buckeye engineer as a keynote speaker, Senior Associate Dean and Aerospace Engineering Professor John Horack.

The group has initiated a number of small, targeted research projects to help engage both students and professionals alike in opportunities to impact the aerospace industry. Projects range from concepts for lunar rovers to development of spaceports in Africa. Their "Arusha Rover Deployable Medical Workstation" concept paper is available online, and Marzette has

(Left to Right) Dr. Julian M. Earls Ret. NASA Glenn Center Director, Marzette and Levert at the 2018 NSBE Aerospace System Conference

integrated it into student capstone projects he advises. Marzette explained that the group's research activity is also a gateway for its outreach efforts. "Group members connect the research to what we're doing at our universities or organizations. And we carve out sections of the research projects that allow pre-college students to engage as well."

The NSBE Aerospace group also recently launched an internship program, currently supporting six students from around the country. Development of the program was accelerated when NSBE-ASIG leadership learned of students losing summer internship opportunities due to the pandemic.

The group's advocacy efforts are driven by its presence at conferences that impact aerospace policy or legislation, like the Space Legislative Blitz, AIAA's Advocate for Aerospace on Capitol Hill and Ohio Aerospace Day. Their recent technical forum also included public policy discussions to provide members opportunities to enhance their skills and knowledge in this increasingly important area. On November 13, NSBE Aerospace SIG Director Enanga Daisy Fale was a panelist in the closing webinar of Ohio State's Global Conference on Diversity in Aviation, Aerospace and STEM.

Marzette earned his BS and MS in mechanical engineering from the University of the Pacific and Georgia Tech, respectively. Prior to his arrival at Ohio State in 2016, he was a research scientist with Battelle for eight years. His teaching emphasis is in the area of mechanical design as well as continued development of the capstone program curriculum. His current research interests include additive manufacturing applications in aerospace, health and life sciences, and electromechanical systems.

"Space has always inspired me as an engineer from the days of the space shuttle, when I was in grade school until today," Marzette said. "Though never my industry per se, aerospace has been sprinkled throughout my career since grad school, and especially now."

As part of its 10-year strategic plan launched in 2016, NSBE has set a primary goal of increasing the annual number of Black engineering bachelor's degree recipients from 3,620 to 10,000 by 2025. Three years into the plan, a record **4,544 Black students earned degrees in engineering in the U.S., a 30% increase since 2014**. Marzette is a member of the NSBE Strategy Planning Task Force, and Special Projects Appointee for Operations and Development for all NSBE special

Marzette co-leading a recent NSBE Aerospace SIG Internship onboarding session via zoom

interest groups. He believes they each are instrumental in achieving the organization's 2025 goal.

> **"It is important that we produce engineers that are technically competent, able to contribute to the discipline, and understand and can influence the impact of that contribution. This is the NSBE mission,"** said Marzette.

Marzette wants to increase the Ohio State presence in the NSBE Aerospace special interest group even more. He encourages undergraduate and graduate students and faculty to reach out to him to get involved.

Article originally published on Engineering.osu.edu/news

MAE introduces robotics and autonomous systems minor to undergraduate program

MAE students present a robotic guitar built as their capstone project

Robotics and Autonomous Systems (RAS) encompasses transformative technologies for several key fields including healthcare, manufacturing and public safety. Recent advancements in computing, artificial intelligence and machine learning have led to an increased interest in the RAS field.

Goals of the RAS minor program include exposing students to robotics and autonomous systems engineering subjects ranging from design, analysis, control, interaction and operation. The minor will also equip students with an understanding of the robotics engineering fundamentals and basic research skills needed to succeed in R&D for the automation, healthcare and manufacturing industries.

In addition, the RAS minor aims to promote student interest in a career path in automation, manufacturing and healthcare in which robotic and autonomous technologies play a central role; and to produce a high-quality work force that is essential to revitalize manufacturing in the United States.

"While RAS programs are not new, resurgence of RAS has been fueled by recent advances in fast, mobile, computing, artificial intelligence, and machine learning," said robotics and autonomous systems program coordinator **Haijun Su**.

The new MAE minor program will add Ohio State to a growing list of engineering schools offering programs in the field.

"There are RAS undergraduate minor programs nationwide offered by a handful engineering schools," said Su. "These emerging RAS undergraduate minor programs directly respond to the recent call for revitalizing manufacturing sectors and regaining leadership of the U.S. in the RAS area."

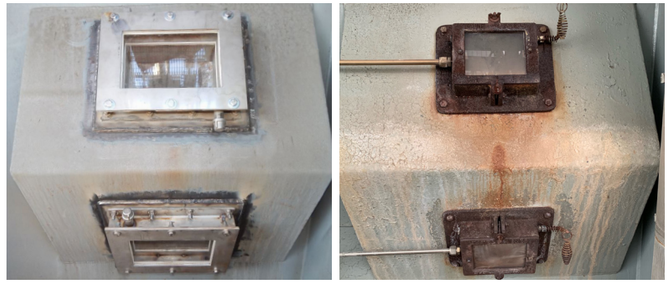
The courses offered as part of the RAS minor were selected to teach students in MAE and other disciplines basic skills in the research and development of robotics and autonomous systems. The program also aims to give students an understanding of how robotics and autonomous systems can be applied to a variety of fields ranging from manufacturing, to healthcare and automation.

The courses are taught by faculty members who have experience and expertise in the RAS field. And in addition to the specialty courses offered in the minor, students have the opportunity to take research credit by working closely with faculty members on projects relevant to RAS.

To complete the minor, students take ECE/ME 5463, introduction to real time robotics systems, and at least three credit hours from the list of program approved courses. The remaining six credit hours can be fulfilled by minor approved courses or by participating in a research project relevant to the minor.

LEARN MORE ABOUT THE ROBOTICS AND AUTONOMOUS SYSTEMS MINOR HERE: go.osu.edu/uirobotics

Capstone students gain experience through industry partner project



Ohio State designed view port (left) compared to original corrosion-prone view port (right)

Senior mechanical and aerospace engineering undergraduate students have the chance to take part in capstone design projects that allow them to gain real-world experience in industry.

One senior capstone project is being done in collaboration with HRST Inc. HRST specializes in product design and service for heat recovery steam generators, water boilers and small gas/oil-fired power boilers.

A team of MAE students are working with HRST's products for heat recovery steam generators (HRSGs). These HRSGs take the heat from gas turbine exhaust and use it to make steam to turn a standard steam turbine for electricity generation. This process takes place in a combined cycle power plant and increases plant efficiency.

HRST proposed two projects to the MAE students. These were based off of the success of an initial project that was completed a year prior.

Initially, HRST came to Ohio State with the idea that students would be able to redesign and improve the viewport that is used to look inside firing ducts. The student capstone team was led by MAE professor **Russell Marzette.**

"These view ports are, in effect, windows and are important for inspecting the inside of firing ducts which are components in Heat Recovery Steam Generators," said capstone student **Daniel Prater**.

The old view port had a small, four-inch by six-inch window. And these older versions of the firing duct view port are prone to deterioration.

"Current view port designs are prone to corrosion, have poor viewing capability, and are dangerously hot which is why this new design is important," said Prater.

HRST's ask for the student team was to improve the viewport in a variety of areas, including corrosion resistance, increasing safety, and improving the overall view

Last year's students designed and delivered a prototype viewport, which is currently patent pending. HRST then took the students' design and elected to work with a regional power plant to have the viewport installed in the field.

The success of that initial project brought HRST back to Ohio State with two more capstone projects for MAE students. The first ask was a continuation of the initial project. Students were asked to do a cost-reduction study, field testing, and potentially add remote viewing for the Ohio State-designed view port.

"This cost-focused design is more tuned for implementation and manufacturing given that it has been field tested, and its performance in HRSGs can be better understood," said senior capstone student **Nick Trent**.

READ MORE ABOUT THE HRST CAPSTONE TEAM'S WORK HERE: go.osu.edu/uicapstone

by Sam Cejda, MAE Communications Coordinator

Buckeye Vertical begins to explore Advanced Air Mobility and Urban Air Mobility

At the Ohio Air Mobility Symposium hosted by The Ohio State University in February 2020, **Adithya Ramaswami** and **Michael Valcarcel** were introduced to the complexities and challenges within Advanced Air Mobility (AAM) and Urban Air Mobility (UAM).

Ramaswami

Adithya found himself to be captivated by the field of Aerospace Engineering and absolutely loved it.

From there, he began to explore deeper in AAM and UAM. As a student, Adithya was excited to be at the beginning of a rapidly developing sector within Aerospace.

AAM is the innovation of new airborne technology supporting an ecosystem designed to transport people and items to locations not traditionally served by current modes of air transportation, including both rural and the more challenging and complex urban environments.

Valcarel

Adithya and Michael knew that AAM was to be the future of air travel and had the ability to connect our world in a revolutionary way.

They heard about the Vertical Flight Society's announcement of their first Design Build Vertical Flight Competition.

"Upon hearing of the competition, I immediately jumped in and was eager to assemble a team to compete," Ramaswami said. "We are excited to dive deeper into vertical flight technology and continue to further explore AAM."

After assembling the team, Adithya felt that taking one step further and creating a student organization that had the potential to introduce AAM and UAM to more students at Ohio State.

That next step led to the creation of Buckeye Vertical, a new club in the Mechanical and Aerospace Engineering department at Ohio State that aims to help students explore the new world of AAM and UAM.

"This is a growing sector in Aerospace and will continue to change our National Airspace System in the many years to come," Ramaswami, president and founder of Buckeye Vertical, said. "It is important for students to be aware and understand AAM and UAM and the impact it will have on our communities. Transportation is constantly evolving, and air travel is going to see a momentous change in the next few decades."

The club, which was founded Sept. 2020 is advised by Dr. Jim Gregory, chair of the MAE department, and Dr. Matt McCrink, a Research Scientist at Ohio State's Aerospace Research Center.

The goal of Buckeye Vertical is to provide students the opportunity to explore and understand AAM and UAM through professional development opportunities and project-based competitions that will support and create a platform of academic enrichment and excellence, according to Valcarcel, vice president and co-founder of Buckeye Vertical.

"Buckeye Vertical strives to create a platform readily available for students to explore unmanned aircraft technology, air vehicle design and fabrication," Valcarcel said. "Additionally, students will develop hands-on skills and familiarization with electric-powered remote-control vertical take-off and landing (eVTOL) aircraft and Urban Air Mobility technology."

Buckeye Vertical holding a recent team meeting via Zoom

Buckeye Vertical is to compete in the Vertical Flight Society's first Design Build Vertical Flight Competition against other universities across the country. The contest focuses on designing, building, and flying an electric vertical take-off and landing vehicle to complete two main courses.

The two courses consist of an endurance course testing the aircraft's flight time ability along with speed, and the second course is a maneuverability course testing the accuracy of the autonomous flight and agility of the aircraft, Ramaswami and Valcarcel said. Buckeye Vertical plans on competing in more competitions in the future to create more opportunities for students to explore this field.

More recently, Buckeye Vertical has launched the "Buckeye Vertical Lecture Series," which aims to help students critically think about AAM and UAM's complexity and the future of this rapidly growing sector within Aerospace. There will be guest speakers and events on a variety of topics within industry, government, and academia for any student to attend.

LEARN MORE ABOUT BUCKEYE VERTICAL AND HOW YOU CAN SUPPORT THEIR MISSION HERE: go.osu.edu/uivertical

by Jake Rahe, MAE Communications Program Assistant

Professor Returns to Ohio State with lab in energy system control and optimization

Professor **Stephanie Stockar** returns to The Ohio State University bringing along her lab and research in the optimization and control of energy systems. Dr. Stockar is now an assistant professor in the Department of Mechanical and Aerospace Engineering (MAE) at Ohio State.

Stockar earned her PhD at Ohio State, and worked as a Research Associate at the Center for Automotive Research (CAR) before joining Pennsylvania State University as an assistant professor of mechanical engineering in 2016. At the end of the 2018/2019 academic year, Stockar transitioned over from Penn State University back to Ohio State, bringing her lab and research with her.

Upon returning to her alma mater, Stockar brought with her research in the optimization and control of energy systems, a research that was not a major thrust area in her previous institution. In particular, Stockar is interested in how to optimize and improve the efficiency of systems that are characterized by energy conversion and storage.

"I first arrived at Ohio State in 2008 as a visiting scholar. At the time I was pursuing my master's degree from the Swiss Federal Institute of Technology and my research focused on Hybrid Vehicle Energy Management. I was interested in conducting research abroad and my advisor suggested a period at CAR where I could work with Professor Rizzoni. I truly enjoyed the whole experience: the research, the environment at CAR, the university and Columbus and decided to apply for a PhD at Ohio State," Stockar said. "The opportunity to work with exceptional undergraduate and graduate students and the amazing colleagues in the department and college was something I was looking forward to coming back to."

One area of Stockar's research revolves around the optimization of district heating networks; a system for distributing heat generated in a centralized location

Stockar (far left) with lab researchers

through a series of pipes.

These networks typically provide heat to public buildings, so there are many variables that make testing and improving the efficiency of the energy systems difficult.

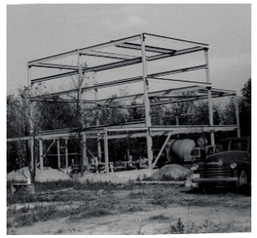
"It's not very easy to test those strategies because it would require us to override what they are doing now. The other problem is that the repetition of testing is very difficult. You want to rerun the same test multiple times under the same conditions, but with district heating networks we have temperature in the environment changing, and people in the building asking for more or less heat, so you have a lot of variability, hence it's very difficult to understand, evaluate or benchmark your control strategy," Stockar said.

With her laboratory setup however, Stockar is able to solve the issues that come with trying to test and increase the efficiency of these systems.

READ MORE ABOUT PROFESSOR STOCKAR'S LAB HERE: go.osu.edu/uistockar

by Muhammed Al Refai, CAR Communications Intern

Nuclear Reactor Lab celebrates 60 years of research and education at Ohio State



Reactor construction (1959)

In 1960, The Ohio State University Research Reactor was built with the help of a $217,100 grant from the Atomic Energy Commission to establish a small-scale research reactor. On March 6, 1961 the Ohio State reactor first went critical – when the reactor was, in essence, first turned on and began to have self-sustaining reactions. This year the Nuclear Reactor Laboratory (NRL) celebrates the 60-year anniversary of its initial criticality.

The Ohio State reactor is the only research reactor in the state of Ohio, and one of just 24 research reactors located on a college campus. From its origin, the reactor was a 10-kilowatt training reactor used for research and the training of engineering, chemistry and physics students.

In its early years the reactor's core used high-enriched uranium (HEU) fuel. In 1988, the reactor converted its fuel source, becoming only the second reactor in the United States to use proliferation-proof low-enriched uranium (LEU) fuel. Four years later, the reactor's power was upgraded from 10-kilowatts to the 500-kilowatts it currently operates at today. This opened the door for expanded avenues in experimentation and research.

"What started as a 10-kilowatt training reactor and is now the only operating research reactor in the State of Ohio, NRL continues to be a vital technical and physical asset providing services to allow advancement in materials, medicine, manufacturing, and nuclear technology related industries, not only in Ohio, but nationally," said College of Engineering Associate Dean for Research Dorota Grejner-Brzezinska.

A reactor operator giving students a tour of the reactor's control room

The mission for the nuclear reactor is to produce neutrons and radiation for research support, industry service and education of reactor dynamics through experiments and demonstrations.

In recent years, the Nuclear Reactor Lab has continued to expand its capabilities. The NRL has added the ability to conduct neutron beam experiments, as well as high-temperature experiments. This has continued to heighten the reactors standing among industry researchers. NRL became a partner facility of the Department of Energy's Nuclear User Facilities program in 2017, expanding the access to new researchers from across the country.

READ MORE ABOUT THE NUCLEAR REACTOR LAB'S HISTORY AND PLANS FOR THE FUTURE HERE: go.osu.edu/uireactor

by Sam Cejda, MAE Communications Coordinator

Ohio State's RIYA Program persevered amidst COVID-19 pandemic

As universities across the country are searching for new ways to adapt to COV-19, Ohio State's Research Internship for Young Academics (RIYA) Program has found a way to persist.

Through innovative online methods and great communication, **Gunda Sai Venkat**, **Harsh Manani** and **Yash Mange** are three students from top institutions in India completed internships in the RIYA Program online.


Sai Venkat

"Before the start, I was skeptical on how things would progress," Sai Venkat said. "But I have to say the experience turned out to be much better than what I expected. I got the opportunity to learn a lot about how research is done and how things progress in academia apart from the technical knowledge in non-linear dynamics."

The RIYA program is designed to facilitate cutting-edge research experiences for undergraduate mechanical engineering students from top institutes in India. Participants work closely with renowned faculty in Ohio State's Department of Mechanical and Aerospace Engineering, along with a world-class research team.

Sai Venkat, a third-year undergraduate in the Department of Mechanical Engineering at IIT Madras, was mentored by **Raj Singh** on a research project based on the vibro-impact phenomenon observed in torsional systems with clearances.

His work was focused on understanding and improving this model by using different methods, Sai Venkat said. The benefits of this research could have applications in the automobile industry.

Doing this project completely online came with its own set of challenges for Sai Venkat who is a self-proclaimed visual learner.

> **"I could understand things much better if I saw it and felt it. Most of my earlier projects were also more experimental where I could get the feel of the things,"** Sai Venkat said. **"This made me change my learning strategy to understand concepts without any visual aid. This was challenging and fun. Ultimately, this was a completely new experience for me."**

In light on these challenges, Sai Venkat is thankful for how well his mentor handled the situation.

"I am thankful to Rajendra Sir for his continuous support and guidance throughout the program," he said. "All my discussions with him were a delight. He gave me a lot of insights into the working of academia and industry. He also taught me the research methodologies employed worldwide. He has also helped me develop my technical knowledge. I am extremely grateful to him for this."

Sai Venkat plans to pursue more research in either robotics or non-linear dynamics while pursuing a masters and Ph.D.

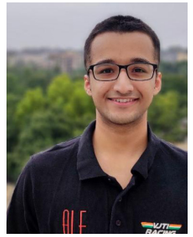
Harsh Manani, an undergraduate student at the Indian Institute of Technology Bombay, worked with Prof. **Ardeshir Contractor** and Dr. Navni Verma in Smart Vehicle Concepts Center on a project based on energy generation from a curved solar panel mounted on a vehicle roof.


Manani

Manani found challenges of an online internship because in his area the connection to the internet was poor and the major time change difference. Even though, he had a great experience and he says it prepared him for remote work in the future.

"I would like to thank Prof. Singh, Prof. Contractor, Dr. Verma and other people for making this program possible during this pandemic," he said. "Despite the devastating impact COVID-19 is having over the world, The RIYA program helped me gain clarity about research and future decisions."

Manani plans to pursue a Ph.D. after completing undergrad with a dual degree from IIT Bombay.


Mange

Yash Mange, an undergraduate student at Veermata Jijabai Technological Institute, focused his research on Microgeometry variations on characteristics like Load Distribution, Mesh Stiffness, Contact Ratio, Transmission Error and Mesh Harmonics. He also did some work with neural networks. Mange worked with Dr. **David Talbot** and Lokaditya Ryali as mentors for the research.

Initially, the RIYA program moving online was an incredible shock to Mange, who would have been travelling abroad for the first time. Although the major upside to him was being able to be closer to family during the pandemic.

"The support from Prof. Rajendra Singh to enable us to have an enriching experience despite the circumstances helped in accepting the reality," Mange said. "Two months prior to the initial RIYA date, I got time to explore a completely new field of Machine Learning which then ended up being the crux of my research project. The pandemic thus gave me opportunities to get into something I would have not been able to otherwise."

Overall for Mange, RIYA was a program he is extremely thankful for which helped him solidify his future career choices.


Singh

"RIYA presented an exciting opportunity to utilize advanced topics of machine learning from computer science blended with core mechanical concepts to solve problems by utilizing the best of both fields," he said. "I look forward to pursuing similar challenges in graduate school especially in domains such as Autonomous Vehicles and Generative Design."

With the help of MAE's incredible faculty and facilities, the RIYA program and the recipients of the 2020 internships were still able to have valuable experiences that they can take with them into their careers and beyond.

"In spite of a string of bad news (since March 2020) due to COVID-19 conditions and travel restrictions, we wanted to give the RIYA scholars a positive research experience and expose them to selected cutting-edge projects in a virtual mode," Prof. Singh said. "I sincerely thank Prof. Ardeshir Contractor, Dr. Navni Verma and Prof. David Talbot for their enthusiastic participation and one-to-one mentorship."

LEARN MORE ABOUT THE RIYA PROGRAM HERE: go.osu.edu/uiriya

by Jake Rahe, MAE Communications Program Assistant

Buckeye engineers interning at Dynetics spent the summer helping develop technology to land humans on the moon. ***Read More Here go.osu.edu/uidynetics***

Undergraduate Honors, Awards and Recognitions

STUDENTS

- Outstanding students were the 2020 MAE Student Awards – ***go.osu.edu/ui2020awards***
- MAE students win multiple awards at AIAA region III Regional Student Conference competition – ***go.osu.edu/uiAIAAawards***
- Ohio State MAE student to receive DOE NEUP Fellowship –***go.osu.edu/uifellowship***

STUDENT PROJECT TEAMS

- Student motorsports teams continue despite pandemic – ***go.osu.edu/uimotorsports***

INDUSTRY PARTNERS

- Techsite names MAE capstone office – ***go.osu.edu/uitechsite***

With the resources and expertise in the Mechanical and Aerospace Engineering student shop and Center for Automotive Research's motorsports team garage, students are able to make quality parts they design themselves.

Ohio State's aerospace research takes off, targets the future

It's not every day that most people contemplate how to improve society through enhancing air transportation, but it's an ever-present thought for **James Gregory**, departing director of The Ohio State University Aerospace Research Center.

"I am struck with gratitude that we get to work on projects that advance the state-of-the-art, deepen our understanding of physical phenomena and improve society through R&D," comments Gregory, professor and international leader in aerospace research.

Success launches

Gregory

Over the past two and a half years as ARC's director, Gregory has quietly guided the multi-laboratory center's growth from $2.8M in research expenditures in 2017 to $8M in 2020. The center connects core strengths across the university, advancing knowledge and technology to address current and future air transportation challenges. ARC, which has over 20 faculty and 50+ graduate and undergraduate student researchers, also serves as a unique resource for industry, academia, government labs and other organizations to collaborate on complex research challenges.

"I would say it's our people that make ARC strong," shared Gregory. "The collegiality, our cooperative approach to research, innovativeness, mentoring of graduate students and the vision to tackle the most challenging problems facing society. These are the things that make us strong and great at what we do."

Samimy

ARC launched from the Department of Mechanical and Aerospace Engineering in 2013 under the purview of Professor **Mo Samimy**. When Samimy returned to a traditional faculty role in 2017, Gregory assumed the directorship after serving as the Associate Director of Unmanned Aerial Systems since 2015. Now, the center has grown to encompass research projects from across the university.

"The growth that we've seen in the center has come from the exceptional talents and abilities of the faculty who are in ARC. It's not one individual person who's been doing it, it's a broad and widespread energy and enthusiasm and vision for the faculty and the students to enable this growth," Gregory commented.

Strength in partnership

Located on the campus of the university's executive airport, Don Scott Field, ARC's unassuming brick building houses world-renowned research labs producing patents and solutions reaching nearly every facet of the aerospace and aviation industry. Here,

Gregory (right) with the record-setting drone and team at Kelleys Island Airport

laboratories outfitted with cutting-edge experimental facilities test components for some of industry's biggest names and scholars work to solve air transportation challenges.

One such program aims to maximize the efficiency and safety of jet turbines through the Pratt & Whitney Center of Excellence in the Gas Turbine Laboratory. A series of projects being investigated by the Turbine Aerothermodynamics Laboratory addresses aircraft efficiency and safety while flying through very dusty skies. ARC is also a core member of the Federal Aviation Administration ASSURE Center of Excellence on Safe and Efficient Integration of Unmanned Aircraft Systems into the National Airspace System, a national consortium investigating the safe and efficient integration of drones into national airspace.

Although much of Gregory's work has been done with an air towards subtlety, not all of his successes have been discreet. In 2017 he led a team of researchers to set the record for the world's fastest drone, a technology demonstration that allowed the team to push limits while creating an inspirational project for younger students. He was also selected by The Great Courses and the Smithsonian Institution to produce a video series, The Science of Flight.

"The common theme at ARC is that we're doing impactful research, which helps shape society by developing policies at the federal level," he described. In turn, "that leads the way for new technologies that are being integrated into aviation products or aircraft today."

Future-focused

Gregory's passion for research extends beyond the lab. He counts some of his most enjoyable achievements as mentoring students and new faculty. "We are an educational institution and we are training graduate students to be the next generation of researchers and scholars and R&D developers," he said. "It's actually a multigenerational impact that we have, and that's what makes it rewarding and lasting beyond any specific technology developments that an individual faculty member may do on their own."

This outlook fits well with Gregory's next challenge. June 1 he took the pilot seat of the university's Department of Mechanical and Aerospace Engineering. With over 80 faculty members and over 2000 graduate and undergraduate students, Gregory looks forward to providing good organizational structure, as well as vision and empowerment to the faculty.

"I'm excited about the prospect of serving the faculty of our large, complex department. I look forward to tackling academic programs, as well as the research," said Gregory, who will still maintain his UAS laboratory space at ARC.

LEARN MORE ABOUT THE AEROSPACE RESEARCH CENTER HERE: go.osu.edu/uiaero

by Holly Henley, Ohio State Airport Communications Specialist

STANDOUT ALUMNUS | SIMON KALOUCHE

Sparking Interest: A Q&A with Nimble Robotics Founder Simon Kalouche

Nimble Robotics founder and CEO Simon Kalouche earned his bachelor's with honors in mechanical engineering from The Ohio State University in 2014. As an undergraduate, Kalouche was the recipient of Ohio State's Outstanding Undergraduate Research Award and the first place winner of the Denman Undergraduate Research Forum. He also minored in entrepreneurship and innovation.

Kalouche went on to earn his master's in robotics from Carnegie Mellon in 2016. Later that year, he began working towards a PhD in Robotics at Stanford University. Kalouche eventually paused his academic work to found Nimble Robotics.

Nimble is reinventing fulfillment with intelligent robots that can pick and pack anything. They already have fleets of robots out in the real world, picking millions of products for some of the world's largest retailers. Kalouche was recently named one of Forbe's 30 under 30 in manufacturing and industry for 2021.

For those who don't know, what does Nimble Robotics do?

Nimble is creating intelligent robots, and we're using those robots to reimagine and reinvent e-commerce fulfillment. If you look at the best Amazon warehouse in the world today, it has a lot of automation but it's still designed around people: what people can do, where people can go, what's safe, productive, ergonomic for people. And if you look at what those people are actually doing, they're doing the picking and packing step – the last manual fulfillment task. When you fulfill an online order, you have to pick the items and pack them into a box. That part is still manual in

every warehouse because it's really hard for robots to do, because there are millions of different products and objects and all of them are different sizes, shapes, weights, textures, stiffness, etc. And what we're doing at Nimble is teaching robots how to handle all of these objects, all those millions of objects. Once you have robots that can intelligently pick, pack, and handle any object you no longer have to design warehouses around people. You can completely reimagine, reinvent, and redesign warehouses around what robots can do and where robots can go and that unlocks a new kind of robotic warehouse that fulfills online orders an order of magnitude faster and cheaper than the best Amazon warehouse in the world. In a one sentence summary, we're building autonomous fulfillment of the future.

When you were an undergraduate you worked in a lab with MAE professor Haijun Su. What kind of research did you work on?

I worked with him, and I worked with professor Umit Ozguner out of the ECE [electrical and computer engineering] department who worked on autonomous vehicles. I worked with him first, and we built this self-balancing bicycle. It used a control moment gyroscope, which is basically a flywheel that spins really fast, and you can rotate the flywheel about an axis and that will induce a moment which you can use to balance a bicycle. So that was the first big research project I did at Ohio State. Then I went to work at NASA's Jet Propulsion Lab where I started working on a gecko adhesive climbing robot. Aaron Parness, who was my advisor there, he created this synthetic material that basically emulates how geckos' feet work. Geckos can climb on walls and climb on ceilings, and they use Van der Waal forces to do that. He created this material that has the same properties. And what I did was I used that material on this robot's feet, and built a robot that could use that material to climb up walls, or up a ceiling. Then I brought that work back to Ohio State when I worked with Dr. Su, and we continued the iterations. We made the robot better, and we made it more capable, and faster and able to do more things. So that's what my research with Dr. Su was. It was kind of an extension of the work at NASA.

Over your experience through undergraduate, master's and PhD work, how has robotics education evolved?

Once I went to NASA, my whole view on engineering kind of changed. When I was in school I thought mostly 'how can I get good grades, pass all my classes, and graduate at the top of my class and get a good job?' That's how I thought. Once I went and did an internship, especially with NASA where there's a lot of freedom and they kind of just throw you in, that kind of just exposed me to the real world of engineering. I was surrounded by insanely smart people, and that put all the equations in my textbooks into context in the real world. All these things came together for me, and that was a pivotal moment for me. Then when I got back, that's when I started working with Dr. Su, and when I got really interested in grad school. Carnegie Mellon is where I went for my master's before Stanford. And I'd say Carnegie Mellon is unmatched in robotics. They have a whole institute dedicated to it [robotics]. That was a great experience for me, I learned a lot about robotics and I hope that Ohio State has their own institute for robotics one day. I think that robotics is the future.

What is the ideal future of Nimble?

We want to build the future of fulfillment. We want to reimagine everything from the inside of the warehouse to your front door, to get you what you want, when you want it, in a faster, cheaper, more environmentally friendly way than Amazon can. There's still tons of opportunity to do that, and we're onto something. Stay tuned for the next couple years.

What advice would you give to students who want to work in robotics?

In Robotics, specifically, I would say do hackathons, have side projects, tinker and build stuff. That's honestly the best way. Find something that's super interesting or that you're passionate about and just build it, because that's the way you learn. You're not going to learn robotics by reading a textbook. The equations are great, but really to build something you have to tinker with it, you have to wire up the Arduino, you have to create a motor controller, hook up a camera, do some computer vision. And open source has made it so easy to just dive into. So I would just encourage people to build stuff. That's the best way to learn in my opinion, by doing.

READ MORE OF SIMON KALOUCHE'S Q&A HERE:
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Department of Mechanical
and Aerospace Engineering

Peter L. and Clara M. Scott Laboratory
201 W. 19th Avenue
Columbus, Ohio 43210
mae.osu.edu

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UNDERGRADUATE INNOVATION

Peter L. and Clara M. Scott Laboratory

Department Chair Jim Gregroy,
gregory.234@osu.edu

Sam Cejda, editor, cejda.1@osu.edu

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