Carnegie Mellon University | Winter 2020

MECHANICAL ENGINEERING

TRANSFORMING THE TOOLBOX

EMPOWERING FUTURE MECHANICAL ENGINEERS WITH AI AND MACHINE LEARNING

SHOOTING FOR THE STARS

WORKING IN A GALAXY FAR, FAR AWAY

Inside

On the Cover The true impact of AI and machine learning occurs when these technologies are translated into the physical world. This is the role of mechanical engineers – and we're leading the way. See pages 2-5.

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MECHANICAL ENGINEERING

Dear Alumni, Students, Parents and Friends,

It's stunning to reflect on the year we've had in MechE – what a year! Since our last issue, the department underwent two significant external evaluations: the first by the Accreditation Board for Engineering and Technology (ABET) and the second an Academic Program Review by an external team of mechanical engineering chairs from peer institutions. The results were overwhelmingly optimistic, confirming our very strong, positive trajectory.

Last spring, we received David and Susan Coulter's generous $10M investment to both endow the mechanical engineering headship and support the construction of new Scaife Hall. Their gift will help us to deliver innovative, collaborative education and research to future generations of mechanical engineers. Finally, we celebrated the first MechE Day, a new annual event organized by our students to build community and excitement in the department. And, as this issue went to press, we had opened the new ANSYS Hall, which doubled the size of our fabrication facilities to support hands-on learning.

This issue's feature story explores work that merges machine learning and artificial intelligence with mechanical engineering. Keeping with this theme, you'll meet four new faculty members (Amir Barati Farimani, Eni Halilaj, Conrad Tucker and Ding Zhao). Each of them uses machine learning tools to tackle diverse research projects such as energy-efficient materials discovery, the biomechanics of osteoarthritis, virtual reality for manufacturing training, and safe autonomous vehicles.

Also on these pages, we reflect on the inspirational stories of alumni Sophia Acevedo and Maynard Holliday while remembering Professor John Wiss and his role as mentor for the Carnegie Mellon Racing team.

I hope you enjoy this year's magazine. As always, we have so many stories to share that it's difficult to fit them into one issue – I'm hoping you'll continue to follow our news on: meche.engineering.cmu.edu.

Thank you for your continued commitment and support of our department. I hope to see you during Spring Carnival 2020 (April 16-18, 2020). Don't forget to follow and tag us on Twitter (@CMU_Mech) and Facebook (@CMU.Mech)!

Sincerely,

Allen L. Robinson
David and Susan Coulter Head of Mechanical Engineering
and Raymond J. Lane Distinguished Professor

TRANSFORMING THE TOOLBOX

EMPOWERING FUTURE MECHANICAL ENGINEERS WITH AI AND MACHINE LEARNING

"AI and machine learning are ubiquitous and exciting technologies and I view them as important tools for mechanical engineers. With these tools, mechanical engineers can take their work to the next level, to better understand physical phenomena and to develop a better device."

Allen Robinson
David and Susan Coulter Head of Mechanical Engineering and Raymond J. Lane Distinguished Professor

"AI and machine learning are new tools that are not going away, and they will help to inform engineers how to do their jobs better."

Jonathan Cagan, Professor of Mechanical Engineering

It was on this campus that two professors, Allen Newell and Herb Simon, pioneered the foundations of artificial intelligence (AI) decades ago. Today at Carnegie Mellon, faculty and students within the Department of Mechanical Engineering have embraced AI and machine learning technologies to confront big challenges. These tools are becoming increasingly integrated into the department's education and research programs.

"AI and machine learning are ubiquitous and exciting technologies. We view them as critical tools for the next generation of mechanical engineers," said Allen Robinson, head of mechanical engineering. "Our department is pioneering the use of these tools to better understand physical phenomena and to develop better products, from surgical devices to autonomous vehicles."

"While AI and machine learning are often associated with computer science, their true impact only occurs when they are translated into the physical world," he added. "This translation is the role of mechanical engineers. We are the physical connection, using these technologies to solve real world problems."

In the curriculum

Given the growing importance of AI and machine learning, the Department of Mechanical Engineering is teaching both graduate and undergraduate students how these technologies complement and extend the existing physics-based model.

A sampling of courses includes:

- Artificial intelligence and machine learning – project course
- Machine learning and artificial intelligence for engineers
- Bayesian machine learning for scientists and engineers
- Deep learning for engineers
- AI and autonomous vehicles (Fall 2020)

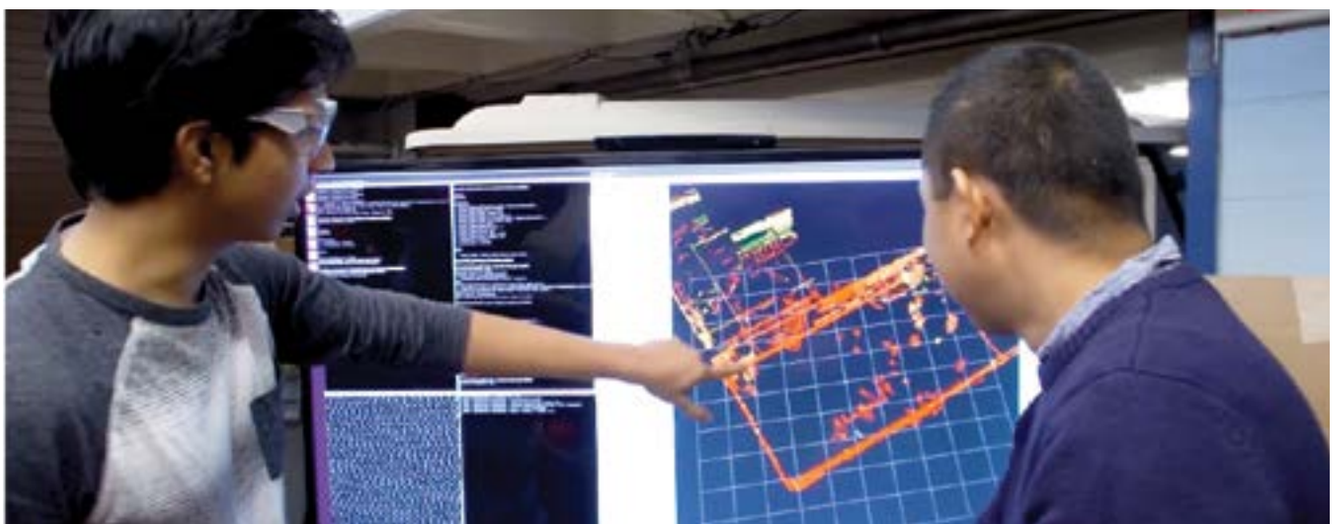
"AI and machine learning are new tools that are not going away, and they will help to inform engineers how to do their jobs better," said Jonathan Cagan, professor of mechanical engineering. "They will need to understand AI and machine learning, which will be embedded in the methods and techniques they use."

A pioneer among peers

Solving the world's biggest challenges requires collaboration among many partners, and preparing the next generation of mechanical engineers happens at many universities. While Carnegie Mellon is already integrating AI and machine learning tools into our curriculum, many of the departments at peer institutions aren't there yet.

Recognizing this, Robinson teamed up with Evelyn Wang, the mechanical engineering department head at Massachusetts Institute of Technology (MIT), to co-organize and co-moderate a panel on the topic for department heads and chairs at peer institutions.

The panel, titled "Artificial Intelligence in Mechanical Engineering: Opportunities for Education and Research," was part of the Department Head Forum at the 2019 International Mechanical Engineering Congress & Exposition (IMECE) in Salt Lake City, Utah in November.



RESEARCH AND BEYOND

In a world of increasingly complex challenges, our students and faculty are incorporating machine learning and artificial intelligence technologies as integral tools in nearly every area of mechanical engineering. Here are some examples of areas we are impacting:

Safe autonomous vehicles

We are using machine learning to make self-driving cars smarter and safer through simulations, unsupervised active perception, and the design and testing of intelligent physical systems.

By developing safe AI, we are ensuring that autonomous vehicles are safe—at intersections, on highways, and in parking lots—around pedestrians, bicycles, and other cars.

Novel material discovery

By applying machine learning tools to screen millions of potential material combinations, we are rapidly honing in on the best solutions to pursue. This is replacing a process that would take decades of trial and error in a traditional laboratory setting.

We are using machine learning to investigate safer, more robust batteries, new ceramic polymer hybrid materials that require less energy to produce, heat transport prediction, and improved energy conversion.

Robust human health

We are employing machine learning technologies to improve human health by better predicting and preventing musculoskeletal injuries, personalizing physical rehabilitation, and developing antibodies to thwart quickly-mutating pathogens.

We are engaging artificial intelligence to enhance the analysis of medical imaging, model the complex geometry of brain neurons, and design synthetic biological systems like artificial muscle. We are even applying machine learning to rapidly read vital signs and communicate them to the hospital trauma team awaiting a patient's arrival.

Efficient design and manufacturing

We are taking advantage of machine learning to transform and optimize the design and manufacturing processes, and are finding ways for AI and human engineers to collaborate together in teams for better solutions.

We are using artificial intelligence to create new concepts for cars and aircraft with "design DNA," applying computer vision to detect flaws during the 3D printing process, and animating static drawings into active simulations with smart design tools.

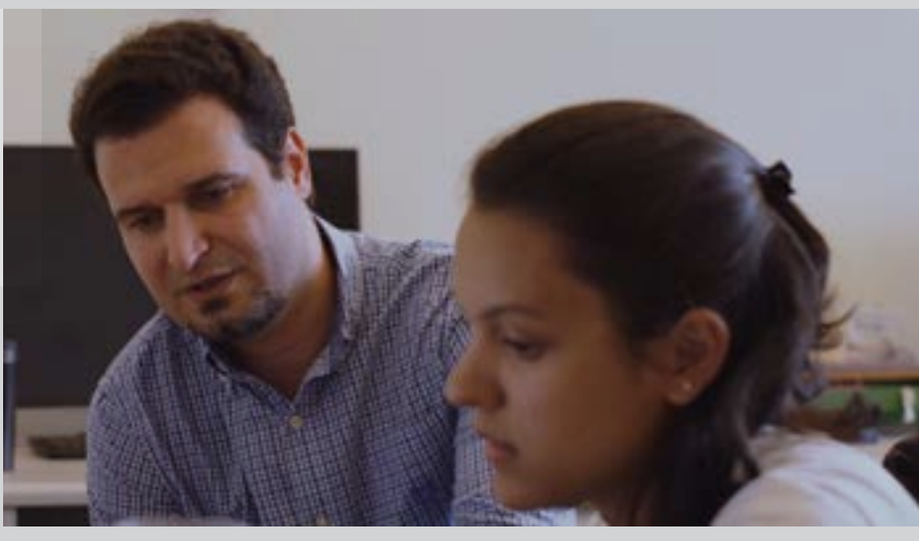
We are developing virtual reality simulations for engineering students to learn in an interactive, immersive manufacturing environment.

Infrastructure and smart cities

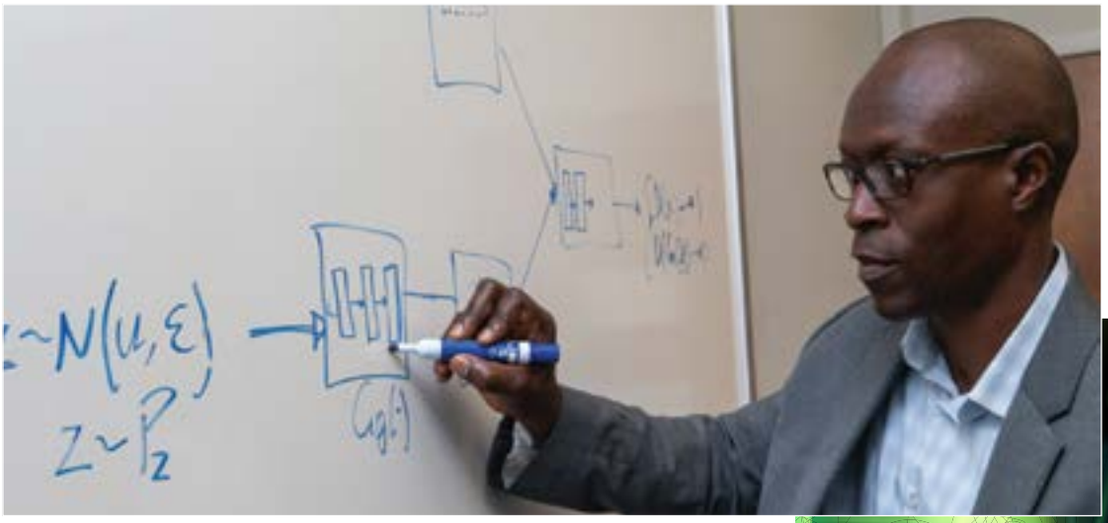
We are using machine learning and artificial intelligence to inspect, maintain, and improve the infrastructure in our communities, both rural and urban.

Our students and faculty are developing tools to inspect agricultural canals and power plants with drones, map air pollution, calibrate low-cost air quality sensors, and desalinate water with new, energy-efficient materials.

See videos and read news stories on the exciting work happening in AI and machine learning in MechE: **meche.engineering.cmu.edu/ml**



Progression of MechE activities will be available through the hashtag: **#STEMaiCMU**



SOCIETY, STEM AND AI

As technology continues to evolve at lightning speed, the need to educate a diverse and dynamic workforce in STEM (science, technology, engineering and mathematics) fields is critical.

While artificial intelligence (AI) is a powerful tool that offers great potential to broaden access to education, it can be used in ways that divide and discriminate.

These and other ideas brought together experts from industry, government and academia to the **Workshop on Artificial Intelligence and the Future of STEM and Societies** held at Carnegie Mellon University in December.

Kicking off the workshop was a reception to celebrate the 20th anniversary of the Gates Millennium Scholars (GMS) Program and its impact on STEM.

The workshop was conceived and led by **Conrad Tucker**, a professor of mechanical engineering and an alumnus of the GMS program. It was sponsored by a National Science Foundation grant.

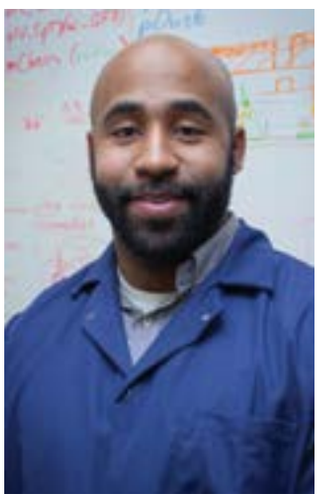
Over the course of the workshop, speakers addressed national and global impacts of AI and STEM and offered an industry perspective of capabilities in the digital age.

Panels discussed topics such as how AI can enhance STEM knowledge acquisition and application, challenges of biases in AI data sets and protecting AI from national and societal threats. Breakout sessions allowed participants to brainstorm and share ideas.

Next steps include prioritizing action items in AI and STEM education and workforce development, establishing new research teams, developing a network of advisors for future initiatives and disseminating the ideas and discussions to the community.

Progression of these activities will be available through the hashtag **#STEMaiCMU**.

Sophomore **Nicholas Acuna** earned a Perryman Family Foundation tuition scholarship for each remaining year of his undergraduate education.



Ph.D. student **Justin Bobo** was on a Carnegie Mellon team of finalists in Yale University's 8th Annual Case Competition. CMU's team was named the most innovative of the competitors, placing first in its group category out of 19 graduate student teams. The team's solution combined engineering design with market segmentation and regulation.

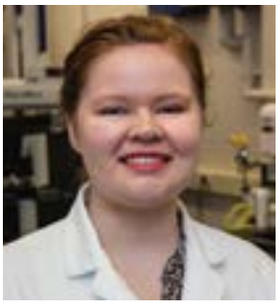
Senior **Cathy Fang** was part of Carnegie Mellon's Engineers Without Borders' trip to Nyadire, Zimbabwe. The students monitored, evaluated and gathered feedback on the chapter's four-year solar street light project and began a new effort to improve the cooking system for a local school.

As part of CMU's chapter of Global Medical Brigades, MechE students **Jakub Kowalewski** and **Joshua LaDuca** traveled to Pueblo Nuevo, Panama, to bring medical, dental and optical care to hundreds of underserved community members.

Two students were featured in cmu.edu stories: senior **John Mangual** about his unpowered exoskeleton research for which he earned a Summer Undergraduate Research Fellowship and integrated master's/bachelor's fifth year **Long Tran** who overcame a health setback to return to the Tartans football team.

M.S. student and GEM Fellow **Walter Parker** won third place for his project "Dynamic Insulation" in the Technical Presentation Competition held during the National GEM Consortium Annual Conference in Chicago, Illinois.

STUDENT ACCOLADES



Ph.D. student **Sandra Ritchie** was awarded a Center for Machine Learning and Health Fellowship in Digital Health for her neural probe research that uses a breakthrough nanoparticle 3D printing method to construct the next generation brain-machine interfaces.

Carnegie Mellon's sixth annual Three Minute Thesis Championship included two MechE finalists: **Dipanjan Saha** placed third for "Developing Superior Alloy Contacts to Enable Graphene Technology," and **Prince Singh** presented "Developing Materials for High Temperature Applications Aircraft Engines."

At the ACM CHI Conference on Human Factors in Computing Systems in Glasgow, U.K., recent graduate **Taylor Tabb** presented two-way morphing soft thread actuators for tangible interaction, and senior **Alex Baikovitz** presented a haptic feedback device to help blind people navigate in unfamiliar spaces.

Ph.D. student **Angran Li** earned the best poster award at the U.S. National Congress Conference on Computational Mechanics in Austin, Texas.

Seniors **Frank Andujar Lugo, Michael Fernandez** and **Julianne Igbokwe** were selected as 2020 Andrew Carnegie Society Scholars for academic excellence, volunteerism, leadership and involvement in student organizations, athletics or the arts.

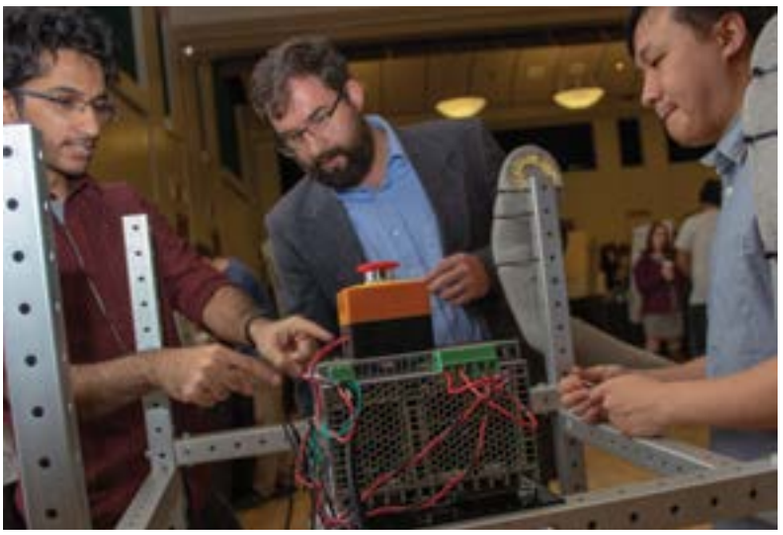
Senior **Jessica Yin** presented "Real-Time Visualization of Neural Network Training to Supplement Machine Learning Education" with ECE's Michael You at the IEEE Integrated STEM Education Conference at Princeton University.

In a course taught by Rahul Panat, students **Ryan Dubois, Michelle Kyin, Wade Lacey** and **Rahul Martinez** had their design for an improved railroad coupler purchased by Wabtech, a major rail transport company. The Janney coupler is a commonly used coupler that was first patented in 1873, and the design has changed little since. The company provided $15,000 to the students to redesign the mechanism. After completing the project, the students sold exclusive rights for their design to Wabtech, which may go on to patent the product.

The Carnegie Mellon Racing (CMR) team won the 2019 Formula SAE North championship with 19E, a fully electric Formula 1 style race car that the team designed and manufactured. CMR also beat out the competitors in the acceleration, autocross, cost, endurance, design and skidpad categories.

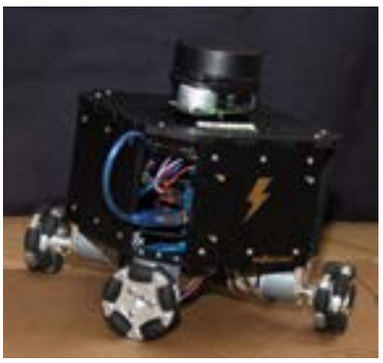
Left: Rethink the Rink 2019, a collaboration between the Pittsburgh Penguins, Covestro and the College of Engineering, focused its second annual Make-a-thon on player safety equipment.

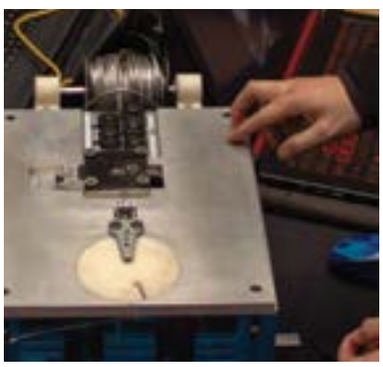
Below: MechE students are the ultimate makers so it's no surprise that so many participate in Build18's tinkering competition each January. One multidisciplinary team won the Builders' Choice Award with a colorful light panel that reacts to human proximity.



DESIGN EXPO

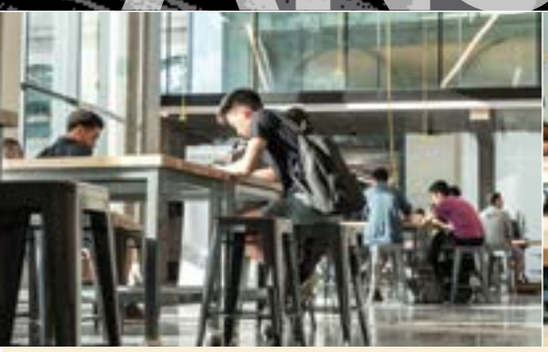
Undergraduate and graduate students in project-based courses demonstrate their creations during MechE's Design Expo each fall and spring.





MechE DAY

Students created the first MechE Day to celebrate the department. Activities included student organization and laboratory demos, free T-shirts, raffles and prizes, MechE-themed games, a picnic buffet and engineering-inspired ice cream flavors like chocolate aided design and makerspace mint. Students, faculty, staff and friends joined in the festivities.



Carnegie Mellon University Celebrates ANSYS Hall Opening

A partnership and a promise for the next generation of engineers

Three years ago, ANSYS Inc. and Carnegie Mellon University announced a partnership to elevate the skills of the next generation of engineers and accelerate breakthrough innovation.

This fall, the 36,000 square-foot ANSYS Hall opened as a spacious maker facility where students, faculty and collaborators innovate and interact with cutting-edge simulation and fabrication tools.

Students have access to the ANSYS solution portfolio of software, enabling them to explore, simulate and analyze solutions for real-world engineering challenges. Because a great deal of innovation happens during the manufacturing process, future engineers will need to learn to use simulation tools routinely to accelerate the speed and effectiveness of innovation. This means shorter product development cycles and final products that are better quality and quicker to manufacture.

After completing appropriate training, students from every discipline (as well as faculty and staff) may use the fabrication and assembly resources to transform their ideas into tangible results – not only for coursework but also for club activities, entrepreneurship and fun.

"The tight coupling of simulation and making in ANSYS Hall will allow students to rapidly transform their ideas from digital concepts to physical prototypes in the same facility," said Allen Robinson, head of the Department of Mechanical Engineering.

ROLL UP YOUR SLEEVES

The university's Tech Spark maker space extends seamlessly from Hamerschlag Hall into ANSYS Hall's expansive design, fabrication and assembly areas where several courses – from departments across the College of Engineering – take advantage of the opportunities for hands-on learning experiences. This fall, students in 18 courses used the new ANSYS Hall resources. Here are a few examples:

- Civil and Environmental Engineering Challenges: Design in a Changing World
- Gadgetry: Sensors, Actuators and Processors
- Introduction to Electrical and Computer Engineering
- Maker Series: Intro to Welding
- Rehabilitation Engineering
- Additive Manufacturing and Product Development

WHERE MECHANICS MEETS ARTIFICIAL INTELLIGENCE

Amir Barati Farimani was an instructor at Autodesk's Artificial Intelligence (AI) for Engineering Summer School 2019. During the two-week event, engineering graduate students and industry professionals learned state-of-the-art AI methods and techniques with a focus on deep learning and reinforcement learning.

As a researcher at Stanford University, Amir Barati Farimani worked in burgeoning fields of machine learning application like computer vision, image processing and natural language processing – all primarily computer science domains. From this work, a question formed in his mind.

"How can we integrate machine learning into other areas of engineering, like heat transfer, fluid mechanics or bioengineering?" he thought. With a background in mechanical engineering, he realized the value that machine learning could bring to his research.

"How can we integrate machine learning into other areas of engineering, like heat transfer, fluid mechanics, or bioengineering?"

Since reaching that epiphany, Barati Farimani has started to use state-of-the-art data science techniques, deep learning and machine learning algorithms to investigate a range of research applications: desalinating water with energy-efficient materials, adapting vaccine antibodies to keep up with rapid virus mutation and inspecting infrastructure with autonomous, unmanned aerial vehicles.

What drew him to Carnegie Mellon University? The institution's history of innovation and multidisciplinary collaboration.

"If you look at the faculty that we have in CMU's mechanical engineering department, all of them are doing non-traditional mechanical engineering," he said. "This type of vision, combined with also having a very strong machine learning department, encouraged me to join CMU. There are a lot of opportunities to undertake exciting projects."

He started the Mechanical and Artificial Intelligence Laboratory (MAIL), a multidisciplinary group bringing together researchers with different backgrounds and interests, including mechanical engineering, computer science, bioengineering, physics, materials science and chemical engineering.

Machine learning is already changing the engineering landscape, providing data-driven insights to understand complex phenomena and more accurate results and analysis, in just a fraction of the time it takes compared to traditional methods. However, leveraging this technology to its true potential will not only require forward-thinking engineers like Barati Farimani, but changes in how they're trained. Leading universities like Carnegie Mellon are already offering graduate engineering courses in AI and machine learning.

"If you look at current mechanical engineering graduate students, most go to computer science to take courses for machine learning, artificial intelligence, big data, all kinds of data science courses," says Barati Farimani. "I think my lab brings data science into mechanical engineering – not the other way around.

STEP BY STEP

Musculoskeletal injuries and diseases are a major cause of limited mobility and loss of independence in older adults. Eni Halilaj, an assistant professor of mechanical engineering, studies musculoskeletal biomechanics with the goal of designing personalized interventions to improve human movement and prevent pathology.

Nearly 60% of patients who tear their anterior cruciate ligament, for example, develop post-traumatic knee osteoarthritis at a relatively young age, despite significant time investment in rehabilitation therapy post-surgically. Failure to restore normal gait after therapy is one of the key contributing factors to post-traumatic osteoarthritis. Clinic visits are sparse, and even when patients are in the clinic, they move differently than they do when they are out of the clinic, making it difficult for clinicians to assess their long-term risk for disease.

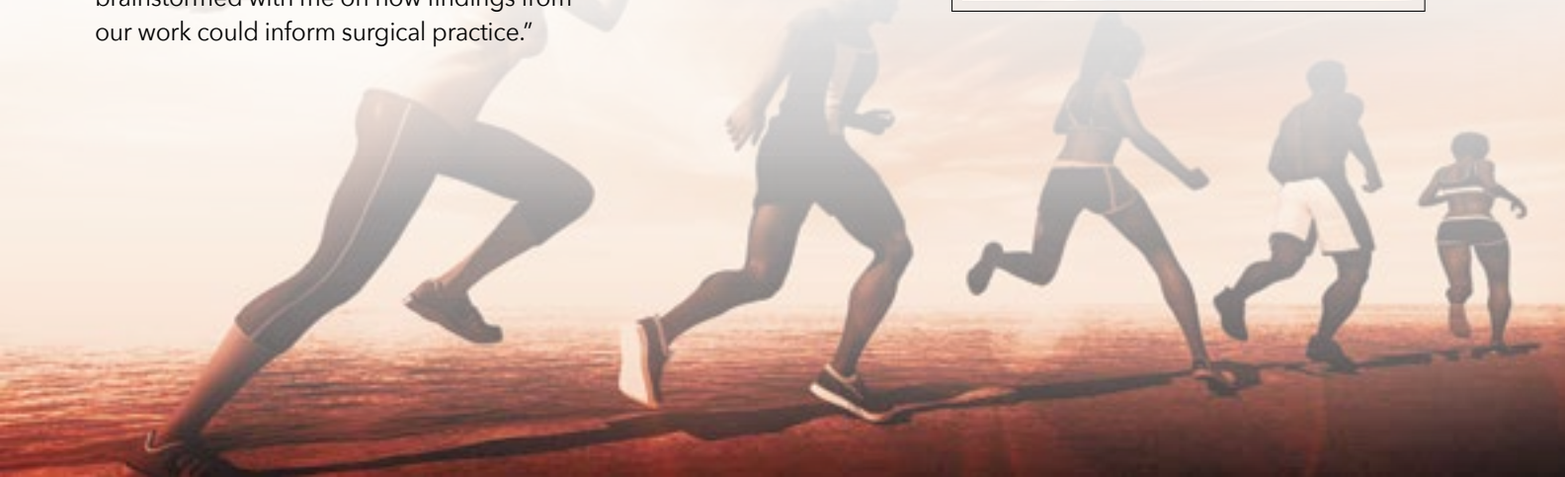
Halilaj monitors patient movement with wearable sensors throughout the day. "Our initial work aims to develop the scientific basis for personalized mobile health interventions. Combining data from wearable sensors with advanced magnetic resonance imaging, we are trying to understand what movement patterns are associated with disease progression. These digital biomarkers can then be targeted with adaptive real-time feedback in new patients," she said.

Because her work bridges engineering and medicine, Halilaj's collaborations with medical staff have always been vital in helping her anchor research questions in challenges that patients and clinicians face every day. "During my doctoral work at Brown, orthopedic surgeons and hand therapists taught me about the limitations of existing pain management strategies; they helped me recruit patients for experiments; and they brainstormed with me on how findings from our work could inform surgical practice."

" During my doctoral work at Brown, orthopedic surgeons and hand therapists taught me about the limitations of existing pain management strategies; they helped me recruit patients for experiments; and they brainstormed with me on how findings from our work could inform surgical practice."

Joining Carnegie Mellon University in fall 2018, Halilaj founded the Musculoskeletal Biomechanics Lab. She is particularly excited to find new avenues for collaboration at Carnegie Mellon, through researchers in human-computer interaction and machine learning. The chance to partner with the University of Pittsburgh's orthopedic surgery and rehabilitation staff is also a unique opportunity. "There are few places with such a wide range of synergistic research activities from which I can draw inspiration and expertise to push the boundaries of my field."

Halilaj also hopes to engage and motivate undergraduate and high school students to innovate in the field of rehabilitation. Her lab planned a Carnegie Mellon event during the National Biomechanics Day, joining tens of universities that celebrate this field annually by engaging students in fun biomechanics events. She has also worked with the Perry Initiative Program to host a hands-on workshop for high-school women to learn about the intersection of mechanical engineering and orthopedic surgery.



BRIDGING THE PHYSICAL AND DIGITAL WORLDS WITH HUMAN-MACHINE LEARNING

What roles do machines play in people's lives? Some people think that machines make their lives more convenient, while others worry that machines might replace humans someday. As for Professor of Mechanical Engineering Conrad Tucker, machines are tools that help enhance human capabilities.

"What I'm very interested in doing is getting machines to observe our physical universe or simulations of the physical universe and developing a type of learning so that they can work side by side humans to make systems more efficient," said Tucker, who joined Carnegie Mellon University in fall 2019.

Prior to coming to CMU, Tucker taught courses in the engineering design and industrial and manufacturing engineering departments at The Pennsylvania State University. He also directed the Design Analysis Technology Advancement (D.A.T.A) Laboratory, which focused on advancing human-machine learning using large scale, disparate data.

So how exactly can machines enhance human capabilities? For the past two years, Tucker's research team has been developing methods that teach computers to generate original design ideas and determine the feasibility of those ideas. "I envision a world where anyone could have an idea, and that idea could be realized through the help of machines," said Tucker. "It's really what we want to get at – the creativity of humans – and reduce the barriers that exist to getting something from your head to the conceptual and real world."

Tucker plans to advance this research thrust at CMU, and also aims to develop a virtual reality learning environment for students. The current teaching practice is a one-size-fits-all operation where students sit in a classroom and listen to their instructor explaining concepts. However, not every student learns in the same way. With virtual reality engineering simulations, students can immerse themselves in a manufacturing environment for example, and customize learning concepts based on their educators' guidelines.

This gamified setting ties closely with Tucker's previous research about using game design features to enhance user engagement. Like smartphone and TV screens, virtual reality is another piece of hardware that people use to consume content. If Hollywood can make its audience sit in front of a screen for hours watching pixels change, we may be able to enchant our students in a similar way too.

"How can we leverage some of these concepts that make games or interactive or passive media consumption engaging for education? That's really what we're trying to do: gamification for education," said Tucker.

Aside from advancing education, Tucker also wants to protect the infrastructure of our cyber environment. We live in an interconnected world where data is shared across people and systems. Though we use all these data for positive applications such as education and health care, that data might become corrupted and threaten many artificial intelligence (AI) algorithms.

"If your goal is to develop robust AI algorithms, you also have to think about the integrity of the cyber system that enables AI to happen," Tucker explained. Thus, he aims to develop algorithms that can detect and mitigate possible exploits.

With all these great ideas in mind, Tucker is excited to join CMU, an environment that promotes collaboration, scientific discovery and scholarly advancement. CMU's famous motto, "My heart is in the work," aligns closely with his personal value that work is far beyond an obligation or a chore. "I really like to think of it more like a passion and having fun," he said. "And academia is really an environment where I'm doing what I love."

BUILDING SAFER AI FOR A BETTER FUTURE

Artificial intelligence has been a buzzing field in the tech industry for decades, but in recent years, AI has moved into the mainstream consciousness of technology and innovation. Amazon shopping recommendations, Gmail smart replies, and voice assistants like Siri and Alexa – these are all examples of AI in our everyday lives. But as AI continues to grow and research has expanded to products like autonomous vehicles, the question of safety is now at the forefront of this cutting-edge field.

Assistant Professor of Mechanical Engineering Ding Zhao wants to make AI better for everyone. He joined Carnegie Mellon University in fall 2018 and currently leads the Safe AI Lab, spearheading research to develop safe, transparent and reliable AI that is backed up by data and provable experiments.

"Safety is the ticket to enter the world; without safety, AI can go nowhere," Zhao says. "$100 billion is being spent on autonomous vehicles globally – a lot of resources are being put into it, along with academia support. We have many big problems, yet we do not have any official regulation for safety all around the world. There are high requirements in safety for machines, therefore automated vehicles are the perfect machines to use for my research."

Building safe AVs is extremely complex. Even the top innovating companies, such as Tesla, Waymo and Uber, have had difficulties with maintaining safety, with reported crashes each year. But why is it so hard to realize safe AVs on the road?

In his work with the Safe AI Lab, Zhao highlights two divergent obstacles that engineers and computer scientists much tackle. The first is that cases with safety issues are rare, whether they are minor collisions or fatalities. These are the cases we hear of on the news, but out of all the experiments, there simply isn't enough data on these cases for AI technology to learn from.

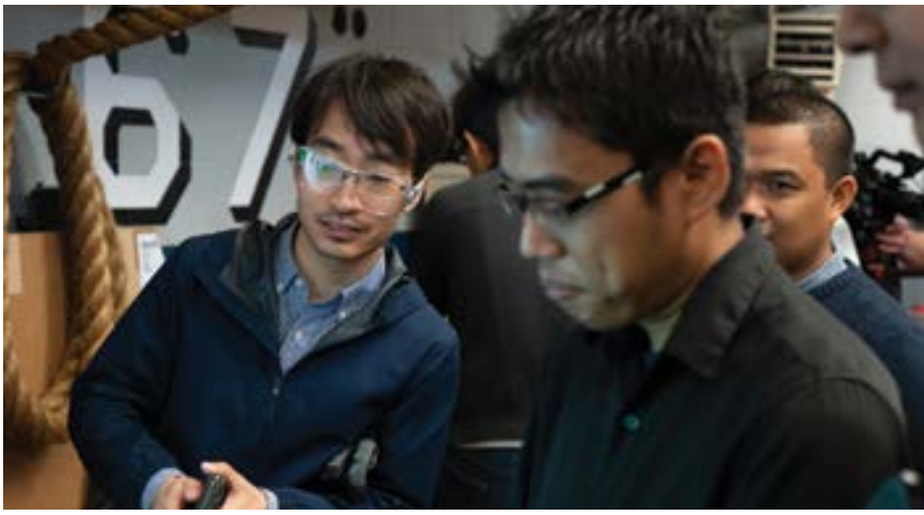
The second obstacle is how to describe the tasks for a certain operational environment. This process is very complex because the world itself is complex. Humans are unpredictable: We text or call on the phone (or do both), we get road rage, we daydream. On the road, there are jaywalkers and other pedestrians, there are cyclists and other unpredictable drivers. Each driving situation is different and varies with time.

"The traditional methods that are model-based methods cannot be efficiently used to analyze such a data set," Zhao says. "We need to use some machine learning that automatically extracts information out."

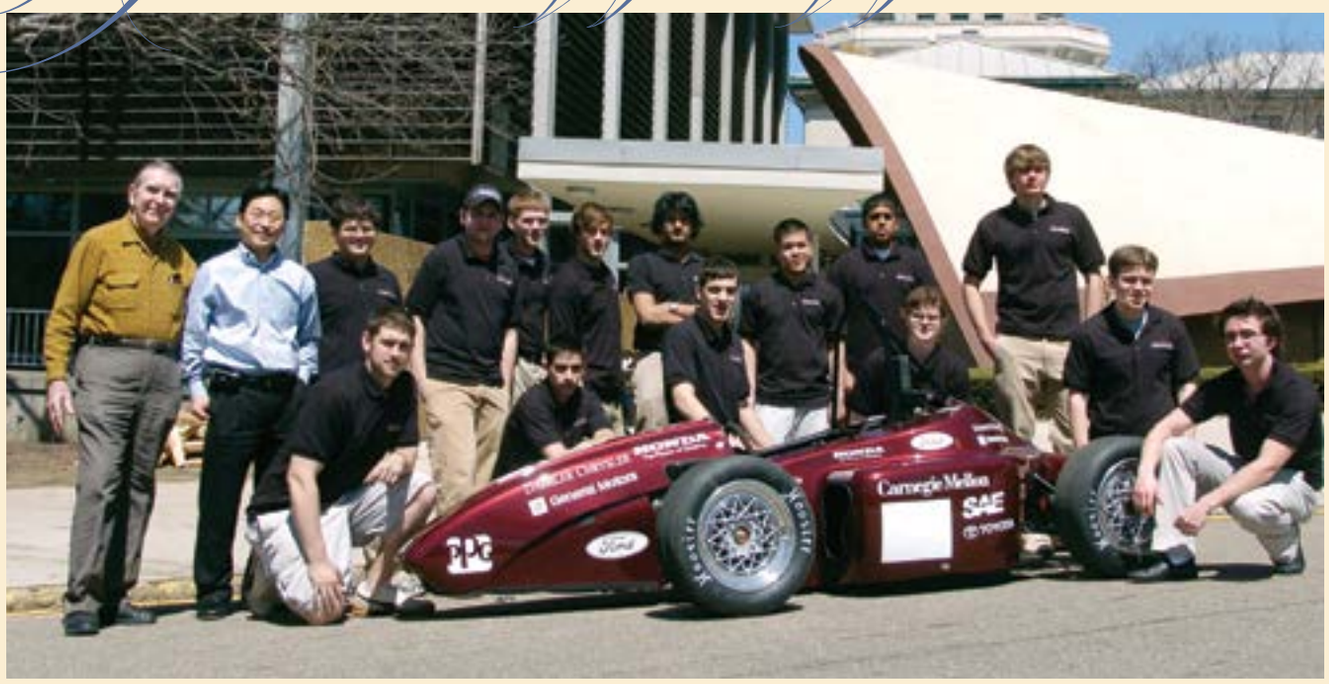
Since arriving at Carnegie Mellon last fall, Zhao has been working to address these challenges. In the research project Accelerated Evaluation, he and his colleagues use methods from advanced statistics, modeling, optimization, control and big data analysis to model this unpredictable environment using stochastic models.

He has also generated an unsupervised learning framework to analyze people's driving behaviors, which can vary drastically according to many factors, including geography, by breaking the data down into small building blocks, or Traffic Primitives.

"We use machine learning for the AI to learn something. However, the real thing it needs to learn is embedded in the corner of the gigantic data set."



REMEMBERING *John W. Wiss*



John William Wiss, a professor of mechanical engineering at Carnegie Mellon University for 30 years, passed away on January 13, 2019. He was a respected and beloved teacher, mentor and colleague.

"Professor Wiss truly cared about the students, and this did not end at the classroom door," said Allen Robinson, head of the Department of Mechanical Engineering. "He brought decades of experience from the military and industry to Carnegie Mellon, serving as a constant resource to students."

Wiss was an integral part of Carnegie Mellon Racing (CMR), the university's student chapter of the Society of Automotive Engineers (SAE) that designs, builds and races vehicles. He served as the faculty advisor for many years, often generously funding the team from his own pocket.

"John's heart was really in the work. He enjoyed teaching the internal combustion engines course and working with the CMR team. Indeed, he was partly responsible for starting CMR," said Satbir Singh, an associate teaching professor who now teaches the course and advises the team. "I learned a lot from John."

FORMER STUDENTS REMINISCE

"I remember working in the lab on the engines Professor Wiss had collected over the years. [It was] one of the only places at CMU where you could really get your hands dirty," recalled former student and CMR team member Christopher Heiser, now CEO of Renovo. "It's

possible that life would be very different without his support, encouragement and trust in us at such an early age. I only hope I have similar opportunities in my career to help catalyze young minds."

William Northrop, now an associate professor of mechanical engineering at the University of Minnesota, remembers Wiss as being tremendously influential to him when he transferred to Carnegie Mellon as an undergraduate student in 1994.

"He introduced me to the field of engine research and gave me virtually free reign in the engine lab, Northrop said. "We continued to stay in touch when I went to work in Detroit, and I came back to have lunch with him periodically leading up to my decision to go back to grad school. John helped me make the transition back to academia from industry, leading me to where I am today."

"He was one of those special professors that made a lasting impression with his genuine, caring nature," said John Black, now the senior vice president of new product development at Brain Corp.

IN HIS OWN WORDS

In a 2005 Carnegie Mellon Today article about the racing team, Wiss explained, "Designing, building and operating a race car is a very demanding student activity. Students must pay serious attention to their engineering fundamentals in addition to considering the fine points that put them ahead in competition. This stressful atmosphere brings out the best efforts of our students." He described the experience as being a "major exercise in teamwork."

A LIFETIME OF EXPERIENCES

Wiss received his education from the U.S. Military Academy at West Point, Rensselaer Polytechnic Institute and the University of Michigan. He was a retired lieutenant colonel in the United States Army. His career included work at the Jet Propulsion Laboratory, the White Sands Proving Ground and the Army Tank-Automotive Laboratories where he served as chief. Additional roles included chief technical officer at Rockwell Engineering, Fulbright scholar, entrepreneur of a fuel cell startup, husband, father, grandfather and great grandfather.

Wiss had been living in the Washington, D.C., area with his daughter. A burial with full military honors took place in Arlington National Cemetery in July.

The Department of Mechanical Engineering extends its condolences to Professor Wiss' family, friends, colleagues and former students. He will be missed.

The Professor John W. Wiss Carnegie Mellon Racing Fund was established by the Wiss family to support the costs of student travel and competition for Carnegie Mellon Racing.

Please consider making a gift at:
http://giving.cmu.edu/wissfund

WORKING IN A GALAXY FAR, FAR AWAY

From Mechanical Engineering to the Millennium Falcon, alumna Sophia Acevedo reflects on her path to Walt Disney Imagineering.

For some people, work means beige cubicles and boredom. For Carnegie Mellon alumna Sophia Acevedo, however, work means distant planets and DJ droids. Acevedo is not an astronaut or a fiction author; she is an Imagineer who worked on Disney's Star Wars-themed land, titled Star Wars: Galaxy's Edge.

Long before Disney, Acevedo was interested in physics and engineering. In her senior year of high school, she sent her resume to NASA's Jet Propulsion Laboratory "on the off chance that they needed someone to do work that no one else wanted to do," Acevedo says. She had an internship in the summer after senior year, which got her foot in the door. In the subsequent years, she moved into more technical roles, eventually working with the cryogenic physics group.

After graduating from Dickinson College, Acevedo began her graduate studies in mechanical engineering at Carnegie Mellon. During her time as a student, her classes gave her both valuable knowledge and a better idea of her desired career path. "All of my project-based courses were formative in figuring out what my next step would be," Acevedo says. "I started to see myself in a role that was

"We're taught to design and build systems that are optimized. But at WDI, creativity takes precedence. Making sure creative intent and technical requirements are met is a difficult thing to do."

Sophia Acevedo

more about guiding the process than the actual engineer doing the design work." She says Mechatronic Design, taught by Matthew Travers and Cameron Riviere, was particularly helpful.

During Acevedo's last year at Carnegie Mellon, Walt Disney Imagineering (WDI) held a session in the MechE graduate student lounge. "As soon as I saw Imagineering was coming to talk to us, I knew I had to go," Acevedo says. "I was born and raised in Los Angeles, so I grew up going to Disneyland all my life." At the session, she made a connection, got a business card and followed up when she applied.

Luckily, the force was with her. Acevedo started her job at WDI as a project controls planner in June of 2016. As a project planner, Acevedo says she works "with mostly technical teams to plan and strategize their scope from a design, production, and installation perspective."

To her delight, Acevedo was immediately assigned to work on Star Wars: Galaxy's Edge, a Star-Wars themed land that opened at both Disneyland and Walt Disney World in 2019. The area was set on a "never before seen planet called Batuu," Acevedo says, "a remote trading port and one of the last stops before you enter wild space." The land contains a market, a cantina, two signature attractions, and more.

The final product seemed effortless, but there was a lot of work going on behind the scenes. For Acevedo, the most challenging part of her job is the intersection of creativity and technology. "We're taught to design and build systems that are optimized," Acevedo says. "But at WDI, creativity takes precedence. Making sure creative intent and technical requirements are met is a difficult thing to do."

While the work is challenging, the results are always worth it. "I've been able to see a lot of the stuff that we've worked on go from hand sketches and drawings and models to fully produced items. It's probably the most exciting part of my job."

Acevedo reflects on her experience at Disney, NASA and Carnegie Mellon. She comes to one conclusion: "Amazing things can happen when you put brilliant people together with a common goal."

SHOOTING FOR THE STARS

MechE alumnus Maynard Holliday has worked to fulfill his childhood engineering dreams and to promote diversity throughout a career that has bridged policy, research and private industry.

"I grew up reading comic books, motivated by things like reruns of the original Star Trek and the diversity I saw there. I said, 'Hey, I'd like to go to space one day. How do you do that without going into the military?'"

This was the question that absorbed young Maynard Holliday, growing up in Scarsdale, New York. The answer, he says, was clear.

"Become an engineer."

"I grew up reading comic books, motivated by things like reruns of the original Star Trek and the diversity I saw there. I said 'Hey, I'd like to go to space one day. How do you do that without going into the military?'"

Maynard Holliday

Holliday would never make it to space, but he would go on to have a career that would take him from the boardrooms of Silicon Valley to the remains of Ukraine's infamous Chernobyl nuclear power plant.

Having been set on an engineering path at a young age, Holliday's voracious appetite for math and science brought him to Carnegie Mellon University. One of just 15 African American students in his Mechanical Engineering class, he found support through the Carnegie Mellon Action Program (CMAP, now CMARC: the Carnegie Mellon Advising Resource Center), a program for African-American students. The academic demands were still more difficult than anything he had previously encountered, though well worth the effort.

"It was grueling," he says, "and there was a lot of attrition. But I made lifelong friendships, and I credit what I went through with raising my capacity for hard work and analytical thinking. Once I graduated, I had a plethora of job offers from top companies and national laboratories."

Holliday accepted a position with Lawrence Livermore National Laboratory, working there for a short time before joining Stanford's mechanical engineering design graduate program. He had been a student at CMU during the nuclear accident at Three Mile Island and had followed CMU Professor of Robotics Red Whittaker's subsequent efforts to develop field robotics solutions. At Stanford, Holliday took every robotics class available.

With the collapse of the USSR in 1991, the Cooperative Threat Reduction Program was established to work with former Soviet scientists to help stabilize their newly independent states and ensure former weapons experts had gainful employment; this gave Holliday an idea.

"I wanted to go to Ukraine to work with the Ukrainians on stabilizing Chernobyl," he says, "so I started traveling there in '94."

With this in mind, he joined a technology policy fellowship with the American Association for the Advancement of Science at USAID in Washington, D.C. While completing this program, he successfully pitched a proposal – that any

international funding for the Chernobyl site should include funding for robotics – to the U.S. State Department's International Nuclear Reactor Safety Group.

An interagency group was convened to fund the project, including NASA, the Department of Energy and the Department of Commerce. Once funding was secured, Holliday reached out to RedZone Robotics, a company founded by CMU's Whittaker to apply robotics in natural and manmade disasters. Over the course of the next three years, the team created a robot capable of entering and gathering data from the hazardous ground zero beneath where the reactor once stood, delivering the finished product to Ukrainian scientists in 1999.

After the success of the project, Holliday pivoted, spending the next decade working his way around a series of Bay Area robotics startups and doing a stint at Apple. He had scarcely rejoined the national lab system at Sandia when, in 2014, he was tapped by the Obama administration to serve as special assistant to the Undersecretary of Defense for Acquisition.

Leveraging his past experience in both the private and public research sectors, he was tasked to help lead a new initiative to facilitate government investment in Silicon Valley toward key areas like robotics, cybersecurity, satellites and others. To attract his former colleagues in the Bay Area, the Defense Innovation Unit Experimental offered an array of advantages to their private partners.

Holliday would stay at the Pentagon until the end of the administration before joining the RAND Corporation, where he works today. In his 30+ year career, one thing has always stood out to him.

"In all of these rarefied environments, a lot of the time I've been the only underrepresented person there," he notes. "These organizations, whether national labs or Silicon Valley companies, are doing things that affect the entire population, and it's important that there are diverse voices at the table to be able to promote those viewpoints."

Though his feet would remain firmly on the ground (despite twice qualifying as an astronaut candidate), it wasn't just the futuristic setting of Star Trek that had enchanted the young Holliday – it was the diverse array of faces he saw reflected there. Now, Holliday spends much of his free time volunteering to teach a weekly afterschool robotics program with an organization called Citizen Schools, earning him the group's 2012 Volunteer of the Year award.

"I volunteer to teach in urban communities to show the kids a reflection of themselves, because I think that's important," he says. "They're able to see someone that looks like them, who has a background like them and who can show them these tremendous career opportunities."

ALUMNI NEWS

Eric Butler (1981, Tepper 1986) received a 2019 Carnegie Mellon University Alumni Achievement Award for his extraordinary accomplishments in business and vocational pursuits. He serves as the senior pastor of the Joy of Life Ministries Church in Omaha, Neb.

After completing postdoctoral research at Oak Ridge National Laboratory, **Matt Eicholtz** (2015) joined Florida Southern College as an assistant professor of computer science, specializing in artificial intelligence and machine learning.

H. Christopher Frey (1987, EPP 1991) received the 2019 Frank A. Chambers Excellence in Air Pollution Control Award from the Air & Waste Management Association. He is a professor in the Department of Civil, Construction and Environmental Engineering at North Carolina State University.

Nateé Johnson (2016) a research associate at the Institute for Defense Analyses, was selected to receive a Flatiron School DC Data Science Fellowship.

Bob Patterson Jr. (1989) was named Citizen of the Year by the Sewickley Herald for his community involvement in Sewickley, Pa.

The Society of Manufacturing Engineers' North American Manufacturing Research Institution awarded the 2019 Dave Dornfeld Manufacturing Vision Award to **Sudhanshu Nahata** (2018, 2018), a mechanical design engineer for ASML US.

Associate Professor Carmel Majidi ran into fellow presenters **Nicholas Parody** (2017) and **Jackson Wirekoh** (2016, 2017) at the International Society for Computer Assisted Orthopaedic Surgery (CAOS) 2019 conference in New York City.

Kelsey Scott (2016, 2016), a technical development specialist with Northrop Grumman, was named Miss Bel Air Independence Day 2019.

IN MEMORIAM

We are saddened by the passing of three special alumni who left lasting legacies in our department and our memories:

We extend our deepest condolences to their families and friends. We will honor their legacies.

Walter J. Blenko Jr. (1950)
August 11, 2019

Harold G. Hall (1948)
June 5, 2019

Bill McGaw (1939)
March 4, 2019

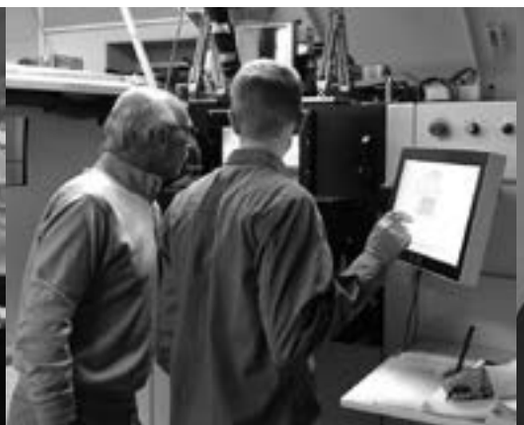
We want to hear from you! Email your news to **me-alumni@andrew.cmu.edu**

$10 MILLION COMMITMENT WILL ENDOW DEPARTMENT HEADSHIP, SUPPORT CONSTRUCTION OF NEW BUILDING

Trustee and alumnus David Coulter and his wife, Susan Coulter, have made the transformational commitment that will endow the headship for the Department of Mechanical Engineering, as well as support the construction of a new Scaife Hall, which will house the department. The endowment to support the department head will provide critical funds for emerging priorities in mechanical engineering and is the first endowed headship announced in the college.

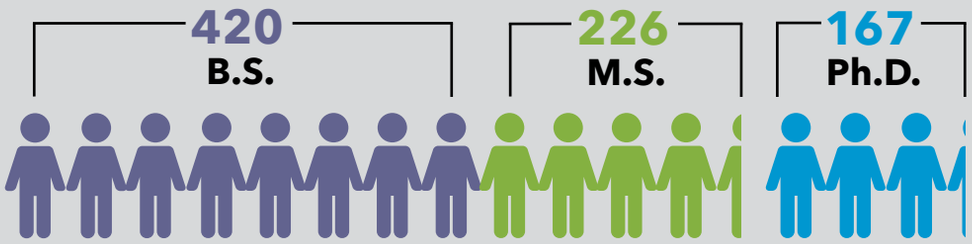
"Mechanical Engineering is a leader in emerging fields such as soft robotics and advanced batteries. We need world-class facilities in the department to support the exceptional work of our faculty and students," said Allen Robinson, department head and professor. "We are so grateful for David and Susan's extraordinary generosity, which will impact the department for decades to come."

Robinson, who is the first Coulter Head of the Department of Mechanical Engineering, will continue to hold the Raymond J. Lane Distinguished Professorship in Mechanical Engineering.

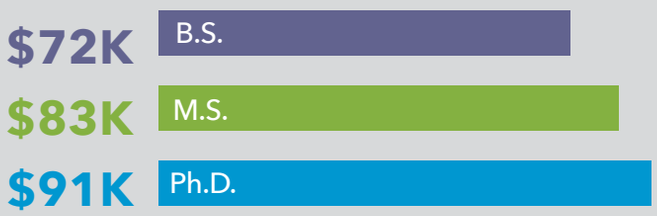


BY THE NUMBERS

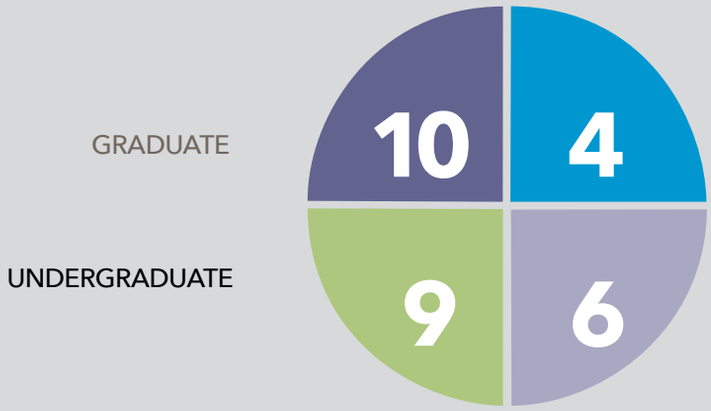
2019 student population: **813**



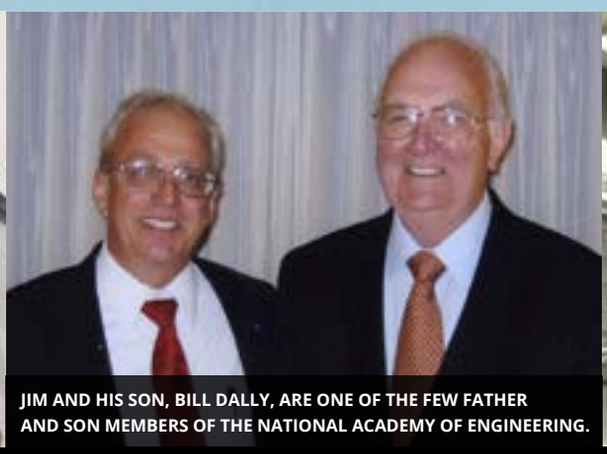
2018 median salaries after graduation



Rankings 2020 | U.S. News & World Report



Mechanical Engineering | College of Engineering



JIM AND HIS SON, BILL DALLY, ARE ONE OF THE FEW FATHER AND SON MEMBERS OF THE NATIONAL ACADEMY OF ENGINEERING.

JIM IN 1953 WORKING AS AN ENGINEER TRAINEE AT MESTA MACHINE CO.

JIM DALLY (1951)

Give strategically, Support generously.

Jim Dally (MechE 1951, 1953) followed his passion for engineering from the fitting room floor to the lectern of the lecture hall. After a long career in academic leadership and research, Jim now works as an engineering consultant and manages College House Enterprises, LLC, a niche publisher of engineering textbooks.

At Carnegie Mellon University, Jim has created a lasting legacy through a gift in his estate plan that will provide scholarship support to undergraduate students in the Department of Mechanical Engineering in perpetuity. Investing in a student's education is particularly important for Jim, who remembers the tremendous impact that scholarship funds had on his own undergraduate experience.

Learn how easy it is to achieve your philanthropic vision through a planned gift by visiting giftplanning.cmu.edu. Contact the Office of Gift Planning today at 412.268.5346 or askjoebull@andrew.cmu.edu.

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