

## Cybersecurity and Forensics Work Makes National Impact

### Groundbreaking Research on the Vulnerabilities of Virtual Reality

Imagine you've got your virtual reality headset on; you're playing a game and suddenly you are no longer controlling it – a hacker is. Or the hacker has taken hold of the VR camera and can see into the room where you are playing or found a way to take down the "chaperones" or virtual protections that keep you from bumping into a wall.

Just as cybercriminals are at work on the Internet and the Internet of Things (IoT), gaining access to networks through connected smart devices, the worlds of virtual reality (VR), augmented reality (AR) and mixed reality (MR) are also extremely vulnerable to attack, says Ibrahim (Abe) Baggili, Elder Family Endowed Chair. Baggili and a team of graduate students are doing groundbreaking work in VR, AR and MR cybersecurity and forensics at the University of the New Haven' Cyber Forensics Research & Education Group/Lab.

With a grant from the National Security Foundation, the team discovered they could break into virtual reality systems – the HTC Vive and Oculus Rift – and they could alter what happened once they got in.

Baggili, Peter Casey, the technical lead on the project, and Ananya Yarramreddy published their findings and presented them at the Systematic Approaches to Digital Forensics Engineering workshop at the Institute of Electrical and Electronics Engineers IEEE Symposium on Security and Privacy in San Francisco in September. A second paper is under peer review.

"Unlike many other Computer Science related projects, MR research has a physical component," Casey said. "Because MR users entrust their safety to these devices, the stakes are higher." The team found that "immersion amplifies the consequences of cyber bullying and sexual harassment, where the misconduct feels all too real."

In the study presented, they examined Bigscreen, Altspace VR, Rec Room and Facebook Spaces and focused on "the two most widely adopted consumer VR systems: the HTC Vive and the Oculus Rift." "These applications represent the future of social networking, as people can see each other's avatars and interact with one another in VR," Baggili said. "Being able to analyze these virtual environments can help solve future crimes that may occur in them."

In another project, Casey said, "we just wanted to see if the participants would respond to our attacks. In doing so, we ended up opening up more questions about what is possible and what factors are at play when manipulating someone in virtual reality."



Rebecca Lindsay-Decusati, Ananya Yarramreddy, Peter Casey and Abe Baggili

The team "tried to put ourselves in the shoes of hacker," Yarramreddy said. Their findings are garnering a great deal of attention in the press and the team's research will be featured in an upcoming documentary on Canada's *Discovery Channel*.

Baggili was inspired to do the research because he wanted to teach a course on VR cybersecurity and "there was very little research out there." If hackers could control wreak havoc on a smart car, a water system or an electric grid, Baggili wondered what could they do to people who are fully immersed in virtual reality?

Focusing on the HTC VIVE, the team devised and carried out four attacks and named them:

- **overlay:** The team was able to overlay the image the user was seeing, blocking it or replacing it with another image.
- **disorientation:** The team was able to disrupt movement and cause the VR user to feel dizzy or disoriented while wearing the VR headset.
- **chaperone:** When someone is playing a game in VR, they first outline the room they are in and when they go near an actual wall, a chaperone or virtual wall goes up on the screen and the team found they could alter or remove the chaperone all together.
- **human joystick:** The team controlled movements of the VR user without their knowing it.

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This fall they plan to research an AR system, Microsoft's HoloLens, "which is a bit different from the tethered immersive VR systems," said Rebecca Lindsay-Decusati, a computer science graduate student, who joined the team last spring.

In a 2017 piece in *Forbes*, Paul Lamkin reported that International Data Corporation predicted 81.2 million headsets would ship in 2021, up from 13 million in 2017, "representing an annual growth rate of 56.1 percent." Earlier this year *Fast Company* ran a tech forecast piece that explored "Why 2018 Will Be the Year of VR 2.0" focusing on the arrival of "standalone virtual reality systems."

With that expected growth, the time for this research is now, Lindsay-Decusati said.

Baggili is quick to point out that VR, MR and AR have very positive uses in education, in business, in the military and in the area of psychology. According to *Psychology Today*, dozens of studies have been done focusing on using VR "to treat anxiety disorders and particularly phobias, social anxiety, and PTSD. The results have been encouraging—VR is a proven means of delivering rapid, lasting improvements."

Making the world of virtual reality safe is key, Baggili said. "The developers of the internet got it wrong," he said. "They invented the web and then they created security for it. With virtual reality, we want to develop security at the same time."

## What it Takes to Become One of the Nation's Best Cyberforensics Teams: Grit, Innovative Problem Solving and Collaboration

The TCoE's Cyberforensics Team competes against universities with programs two, three, even five times their size and they continually find a way to win or become finalists in national competitions.

The team members – graduate students Justin Grannis, Trevor Haigh and Peter Casey and undergraduate Tyler Balon – are gritty and they don't back down, said Ibrahim (Abe) Baggili, Elder Family endowed chair and associate professor of computer science.

They'll puzzle over a problem and find their way around it as they did last spring when they were among the ten university finalists selected for the 2018 National Cyber Analyst Challenge (NCAC), described as "a competition that supports the best students currently pursuing cyber-related degrees in the top programs in the nation."



TCoE's cyberforensics team

The University's team advanced through the first and second rounds and, in April, they competed in the finals against teams including Brigham Young University, Carnegie Mellon University, Howard University, Pennsylvania State University and, Syracuse University at Temple University's Institute for Business and Information Technology. Syracuse University won the challenge and the University of New Haven team placed among the top finalists.

Each team had six hours to sift through a fictitious company's enormous data files, identify the cyber attack, where it came from, the damage it caused and how they would solve the problem. The team presented their findings and recommendations to industry panelists. Because the teams were not given the same hardware, the "enormous amount of data they were given" it was too much for their laptop to handle, Baggili said.

"For three hours our students had to find unique ways of solving the problem," he said. "One of the competition mentors said after that they couldn't believe our students had pulled it off. I was really proud of what they did. They're definitely problem solvers."

Casey pointed out, "The most difficult part was combining data and evidence from multiple sources – disk, RAM and network. I am very impressed with how quickly we were able to piece together the story under pressure. If the competition was judged solely on technical proficiency, I have no doubt we would have won."

It was one of a number of big wins for the team in national challenges over the last two years. In 2016, TCoE students placed third among 184 teams from universities around the world in the international Black T-shirt Cyber Forensics Challenge, a joint academic and industry contest with 1,012 contestants from 42 countries and 45 states.

Becoming one of the top cyber analyst teams in the country has a lot to do with grit, resilience, and knowing exactly where their teammates' strengths lie, said team members. It is a year-long quest to hone their talents, skills and insights through coursework and extensive and complex research. "Our students are publishing more than students at universities that have millions more dollars in funding," Baggili said.

From the minute students enter the program, Baggili and Frank Breiting, assistant professor of computer science, let students know "You have to have a strong work ethic, ask questions, work independently and you have to be able to be part of a team," Baggili said. "If you do that level of work, you might discover a security issue in an app that affects a billion people worldwide. Once our students experience success, they want to work that hard."

"We don't accept anything but excellence," Baggili said. "As faculty members we push ourselves. The Cyber Forensics Lab – it's our office. We're right there working with the students; they're learning and we are."

Challenges are built into courses. In the Digital Forensics course, in place of a final exam, there's a national challenge. Students receive a copy of a hard drive, the network traffic, a computer memory and have to determine how the system was penetrated and what was stolen.

All that work is worth it, Grannis said. He said he relishes the opportunity to compete against top programs across the country. "The best part of the competition was after it concluded," he said. "We were approached by many of the people representing the competition sponsors. These people, including the chief technical officer of cybersecurity at NBC Universal, handed out their business cards and told us that they were very impressed by our team."

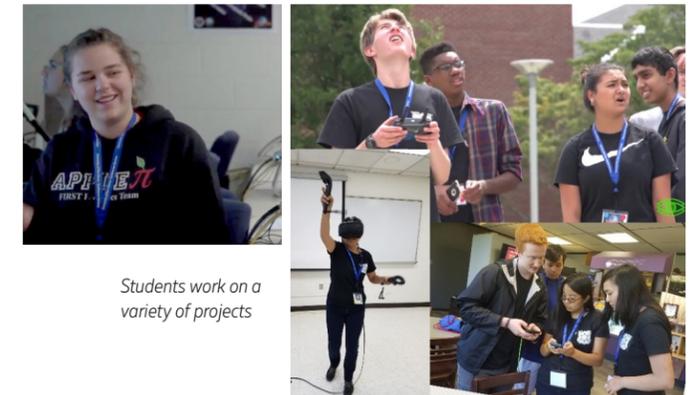
## Cyber Sleuths Fly and Investigate Drones and Solve Cyber Forensic Challenges in TCoE's Summer Academy

Kaitlyn Sandor spent six days immersed in the world of cybersecurity at the high school GenCyber Agent Academy at the University of New Haven. Her favorite part was a scavenger hunt, using an app created by Teaching Assistant Justin Grannis. The high school campers fanned out across the entire campus, exploring the University while "we worked to solve challenging cybersecurity problems."

"I also loved the Python coding classes because it covered the basics and encouraged more experienced programmers to try something new with difficult challenges," she said.

This was no 'dangle your feet in the lake' kind of summer camp. GenCyber Agent Academy was rigorous, intense and exciting, said Liberty Page, TCoE practitioner in residence in computer science.

Each morning began with a talk by experts in the field – from an FBI agent to the owner of a "white hat" or ethical hacking firm. Then they hunkered down for courses in coding, the Internet of Things, Cyber Forensics and Ethi-



Students work on a variety of projects

cal Hacking. The high school students had the chance to do their own research projects and collaborated in teams on a variety of cyber forensic challenges.

They flew a drone and forensically investigated where that drone had been. They learned about the undergraduate and graduate cyber research work going on at the University. TCoE Undergraduate and graduate students help law enforcement and organizations solve real cases, identifying vulnerabilities in systems and helping close them up. "It's important work and we want high school students to see the kinds of research they could be doing," Page said.

The academy faculty also discussed the many possible career paths in a field expected to grow by 30 percent in the next decade, according to the Bureau of Labor Statistics.

The first of its kind in the state, GenCyber Agent Academy encourages traditionally underrepresented students to delve into cyber security forensics. In 2016, Ibrahim (Abe) Baggili, the camp's principal investigator and Elder Family endowed chair, Frank Breiting, assistant professor of computer science, and Page applied for and received funding from the National Security Agency and the National Science Foundation so that 40 students, an equal number of females and males, could take part, with all of their costs covered by the grant.

Baggili said it's critical to teach the next generation of Americans "to defend cyberspace and bridge the knowledge gap, and gender gap in cybersecurity."

"While there is a huge talent shortage in the field, two out of three high schoolers say the idea of a career in cybersecurity had never been mentioned to them," he said. "It is imperative that we take action as an institution of higher education to offer students an opportunity at a career that will not only improve the security posture of the nation, but also offer our graduates a stable future quality of life given that the incomes in that space are extremely competitive."

"We received 160 applications for 40 slots," Page said. The 40 students, grades 9-12, came from Connecticut, New York, New Jersey, Massachusetts and Florida. "They were a wonderful group of young men and women, all extraordinarily talented," she added.

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Cyber Sleuths continued...

After learning how people construct phishing emails containing links to websites made to look real "but are actually designed to steal information," Sandor shared that with senior citizens at the Madison Library's Teen Tech support program where she volunteers.

She also shared what she had learned with members of her high school's Hacking Club. The club was able to identify and alert school officials to a potential vulnerability in one of the school's learning management systems, which the IT department was able to quickly remedy, said David Buller, a Daniel Hand math and computer science teacher and advisor to the Hacking Club.

"Programs such as the GenCyber Academy give high school students a chance to develop their critical thinking and problem solving skills in an authentic, engaging, real-world setting, while also exploring potential career paths," Buller said. "And when students bring that experiential learning back to the high school classroom, it enriches our discussions and brings our curriculum to life."

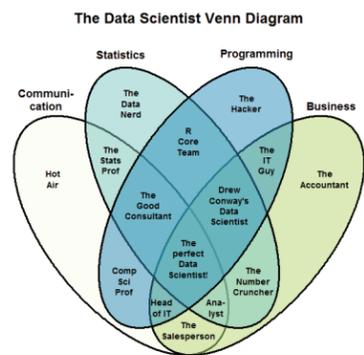
This past summer, Sandor returned to the camp as a special agent/counselor, excited "to learn new techniques and skills as well as share what I learned last summer with new participants," she said. "The camp encouraged diversity and inclusion, which I loved because I got to meet so many new people and make new friends."

## TCoE Launches MS in Data Science - One of the Fastest Growing Jobs in the U.S.

A Career Known for High Salaries and High Levels of Job Satisfaction

Data Science has revolutionized banking and media; it's a field, said Keith Dillon, that's been "steadily getting hotter for over a decade as companies and governments have amassed larger and larger data sets. At the same time, new data science technologies such as scalable computing to process so much data, and machine learning to make sense from it, are really hitting pay dirt."

Many fields are still doing things "the old-fashioned ways because they lack the technology and know-how to exploit their data" said Dillon, assistant professor of the



Electrical and Computer Engineering and Computer Science Department and coordinator of the TCoE's Master of Science program in Data Science that is being moved from San Francisco to New Haven. "All of it points to opportunities for data scientists everywhere, whether the inclination is to work at the world's largest corporations or its hottest new startups."

"There are two key features that set the TCoE's data science program apart," he said. "The first is the experiential approach of the University of New Haven. This means a heavy focus on active learning to build the needed professional skills, starting with the first class. Students will not only be learning the theory and methods, but also applying them to real problems immediately."

The second key feature is that the content of the program is built around emerging machine learning and artificial intelligence methods. "As areas such as data science emerge, and the skills become highly sought-after, there is a tendency by some to repackage programs they already have under a more marketable name," Dillon said. "Our program, however, is based on technologies such as machine learning and artificial intelligence, that hold the most promise for the future, in addition to being highly-valued today."

According to Glassdoor, data scientists – who can work in areas including healthcare, law enforcement, energy, and commerce – earn about \$110,000 annually and those in the position have reported high levels of job satisfaction.

Dillon has more than a decade developing data science technology, at the Hughes Aircraft Company, and a series of startups. Co-founder of Formulens, which licenses data-driven algorithms, his recent research includes developing new algorithms, for finding disease from medical sensor data.

He's been working in the field "since long before it was cool.. Now everyone is clamoring for the technology and know-how, and I get to help fill that need."

## "If I had a Million Cryptos..."

Trevor Haigh Wins Best Paper Award at International Conference on Digital Forensics & Cyber Crime

As soon as cryptocurrency became a 'thing,' Trevor Haigh grew wary. "I suspected that app developers would hop on the bandwagon and quickly create applications with poor security," he said.

So Haigh, who is pursuing his master's in computer science and is a member of the TCoE's Cyber Forensics Research and Education Group (CFREG), decided to find out whether cryptocurrency applications were as secure as they should be. He soon discovered they weren't.

"In actuality, many of the applications tested did not properly secure sensitive data," Haigh said. "This allows for an attacker to potentially steal cryptocurrency since it's only as secure as the wallet it's stored in. This is dangerous as most people expect cryptocurrency to be secure."



In September, Haigh presented his findings at the 10th Annual EAI International Conference on Digital Forensics & Cyber Crime in New Orleans. He won the Best Paper award for "If I Had a Million Cryptos: Cryptowallet Application Analysis and A Trojan Proof-of-Concept."

Haigh said he hopes his research "reinforces the idea that security should be a priority for app developers." He also hopes his findings will help with forensic investigations.

Frank Breitinger, assistant professor of computer science and CFREG co-director and Ibrahim (Abe) Baggili, Elder Family endowed chair and associate professor of computer science, co-authored the paper and supported Haigh's research.

"The international conference, which took place in the U.S., Europe, Asia and the Middle East over the past years, is well known among researchers in digital forensics," Breitinger said. "This is a great success for Trevor and our research group."

Haigh called the win "exciting and very rewarding" and said he knows he'll be using the skills he honed – researching and writing – in his career. He graduates in May and already has a job offer to do federally-funded research.

Meanwhile, he's on to his next project: exploring automating Android applications to assist with reverse engineering.

## TCoE's New Master of Science in Chemistry

A New Frontier: Blending Theoretical and Computational with Experimental Chemistry Methods

Today's chemist has to be a nimble thinker, said Dequan Xiao, able to blend theoretical and computational work with experimental chemistry methods to solve all kinds of practical problems in chemistry.

So when the TCoE's chemistry program was shaping its new Master of Science program, "we knew we would take a cutting edge, integrative approach," said Xiao, MS program coordinator and assistant professor of chemistry.



Students in chemistry lab

"This is a new frontier of chemistry research. It reflects the direction where the National Science Foundation is heading," Xiao said. "It integrates theoretical and experimental approaches and it crosses disciplines to attack important problems. We will be one of very few chemistry programs around the country that have a curriculum designed using this approach. Others include top research universities such as Yale, MIT and UC Berkeley."

Dr. Xiao said graduate students "have the chance to learn, practice and apply those knowledge and skill sets to attack critically important problems such as molecular drug discovery, green catalyst design, polymer materials design, and chemical analysis for sustainable environment."

Michael Saliby, Chemistry and Chemical Engineering Department Chair, added, "If one can use theoretical and computational methods to design important molecules and pathways to making such molecules, it makes the experimental work less time-consuming."

In the new program, graduate students choose between three tracks – a research-based internship, a research project or a graduate thesis. They'll have opportunities to collaborate on projects with Yale researchers or intern at a biomedical firm, a materials science and engineering laboratory or a forensics laboratory. Courses include three-semester of research seminars. "We are inviting experts across all areas of chemistry research, speakers from the region and, eventually, from across the country, so our students will constantly be exposed to state-of-the-art ideas in the fields of chemistry," Xiao said. Students will also delve into research ethics. Around 10 students make up the inaugural class and Xiao anticipates the number will grow to 24 after two years.

The Master's program came about after years of planning on the part of the department and to meet an ever-growing demand. "We have so many undergraduates interested in chemistry," Xiao said. "A third of the forensic science undergrads pursue a major in chemistry and the graduate program in Forensic Science is very selective. So we know we needed to have a pipeline for those students and for all students who have an interest in pursuing graduate degrees in chemistry."

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M.S. in Chemistry continued...

Having a strong MS program will, in turn, "attract more students to the undergraduate Chemistry program, especially if we eventually are able to offer a 4+1 BS/MS program," Saliby said. "We also expect that the integrative approach to research will attract funding for both graduate and undergraduate research.

Xiao said that chemistry plays a vital role in so many industries. "When you have chemistry knowledge, you have the freedom to create novel functional chemicals needed in the world. For example, you can create new molecular drugs to cure diseases; you can create new polymers for biomedical applications," Xiao said. "You can work in the pharmaceutical industry, materials industry, data science, forensic science, or renewable energy which is a booming field now."

According to the U.S. Bureau of Labor Statistics, job growth will be robust for chemists and material scientists over the next decade and those "with advanced degrees" are expected to have better opportunities."

"We need more innovative ideas in STEM fields to drive the economy," Xiao said. "In all of these fields you need functional chemicals – and chemists to research and create them."

## Innovation: It's in the University's DNA

### Now, Students Can Work to Creatively Solve Problems in the New Entrepreneurship and Innovation Minor

University President Steven H. Kaplan has said that "Innovation has been part of the institution's DNA since our founding nearly 100 years ago."

Tagliatela College of Engineering students, alumni and faculty have long been innovators – in aerospace engineering, in biomedical engineering, in cybersecurity, in sustainable development, across all of the engineering disciplines. Now TCoE students – and all undergraduates from across the University – will have the opportunity to minor in Entrepreneurship and Innovation as part of the new shared Department of Entrepreneurship and Innovation (E&I). The department was created initially as a collaboration between the TCoE and the College of Business.

The University established the department "to build a comprehensive, collaborative and competitive E&I program with a national reputation," said Ravi Gorthala, associate professor of mechanical engineering, and the chair of the department.

The E&I minor will challenge students to be bold, creative thinkers and collaborators who work to solve complex problems, Gorthala said. "Through rigorous academic curriculum, co-curricular activities and competitions, extensive networking and mentorship, and hands-on learning experiences, students will develop an innovative mindset vital to entrepreneurship and intrapreneurship," he said.

Students – from all five colleges and all majors – will take courses including Fundamentals of Design Thinking, Design and Innovation, Sustainable Entrepreneurship, Business Planning and Modeling. Other courses include Business Principles and Entrepreneurship for Engineers and Scientists and Venture Capital Economics & Business Governance.

They'll take their creative ideas and move them from the concept stage to the development stage and beyond in innovation competitions including Charger Start-up Weekend, the Alvine New Venture Pitch Competition and DesignX. The minor also includes a practicum and students can opt to develop a project, create a start-up or take part in an externship.

The program was developed by Dean Brian Kench and Dean Ron Harichandran and an advisory board comprised of experts from industries promoting entrepreneurship. Brian Marks, Executive Director of Entrepreneurship and Innovation Program, spearheaded the faculty group that shaped the minor program.

Many faculty members were involved in developing the program. "Dr. Maria-Isabel Carnasciali has been monumental in organizing the extra-curricular activities and getting so many TCoE students involved in innovation," Gorthala said.

"The E&I department and minor are natural extensions of the work we have been engaged in for the last five years with support from the Kern Entrepreneurial Engineering Network (KEEN)," Harichandran said. "The new structure broadens participation to include students and faculty from across the university and deepens what we started," he added.

## University Innovation Fellows:

### Diving into the Complexities of Being a Change Agent on Campus

Cameron Niemiec wanted to pursue an idea to create a community garden on campus. He pictured a greenhouse as a collaborative space where students could grow fresh vegetables that could be sold to Sodexo and eaten in the campus dining halls. Alice Antcliff was also interested in encouraging students around the University campus to eat locally. She wanted to work with the University to create a composting program that could turn food waste into nutrition-rich soil for community gardens here.

Maria-Isabel Carnasciali, associate professor of mechanical engineering, encouraged Niemiec and Antcliff – two University Innovation Fellows – to request a meeting with administrators and staff in the Facilities department. There, they discovered that the University had a greenhouse and that Donald Stankus, a practitioner in residence in Nutrition and Dietetics, and his students were growing microgreens there.

That gave Niemiec a new idea – no need to start from scratch but better to work with those already at work on the greenhouses. "The greens are highly nutritious and they grow in a very short time. With several greenhouses around campus other produce and herbs could be grown," Niemiec said. "My part in all of this is to help design a way for watering the plants, gathering rainwater and pressuring it, so it can be misted over the plants." In the fall the civil engineering student worked with TCoE faculty, developing a water system and Antcliff hopes the compost can be used in the greenhouse.

"This is how things happen when you are an innovator," said Carnasciali, who is also a faculty member in the University's new Entrepreneurship and Innovation department. "You have an idea and then you talk to people and make connections. You begin to understand how the University ecosystem works and how you can move your idea forward."

Antcliff, a chemistry major, said she "has learned a lot about the weight of leadership, and the impact that the small motions a leader makes can have on a bigger community."

Last year, Antcliff, Niemiec, and Christopher Dinnis, who were all first year engineering students, and Amanda Arango, a junior marketing major, became the 4th group of University students named University Innovation Fellows (UIF), a program of Stanford University's Hasso Plattner Institute of Design created as part of the National Center for Engineering Pathways to Innovation, a five-year National Science Foundation grant to provide students with tools and strategies to make change on their campuses. The UIF motto? "We believe students can change the world."

Mentored by Carnasciali, the Fellows took part in six weeks of online training and traveled to the University Innovation Fellows Silicon Valley Meetup in Palo Alto, California, sharing and shaping their ideas with more than 250 Fellows from 64 universities around the world, part of a larger network of 1500 fellows from around the world. They collaborated in



2018 Fellows: Alice Antcliff, Cameron Niemiec, Chris Dinnis and Amanda Arango

labs on the Google campus and received year-round mentorship from Stanford professors and industry leaders across many disciplines. The Kern Entrepreneurial Engineering Network (KEEN) has funded University of New Haven students' costs each year.

Matthew Sheehy, a junior mechanical engineering major, said his UIF experience "showed me that it is possible to make a difference on your campus and gave me the courage to do it myself."

Sheehy and Austin Thomas, who became Fellows in 2017, are leading efforts to grow the maker community on campus. "They're encouraging students from across the University to make something, to give it a try, fail fast and try again," Carnasciali said.

Sheehy talked with engineering faculty about purchasing more tools and, after they did, he found that the tools had a steep learning curve. So he set out to teach himself how to use them all. He created a how-to display and regularly instructs students on how to use the tools. As a result, he said, "there has been a lot more activity in the space," he said.

Thomas, meanwhile, worked with TCoE faculty to organize workshops to get more TCoE students involved and to encourage art and graphic design students who used the University Makerspace for typography and digital fabrication classes, to develop new projects. "They brought passion, creativity, and a desire to use the resources we have available," Thomas said. "I have been working with Dr. Carnasciali to reach out to students all across the University."

With the University Makerspace flourishing, Arango is working with Brian Marks, executive director of the Entrepreneurship and Innovation program, aspiring to create a different kind of collaborative place: a thinking space/startup incubator. "Creativity, new ideas, and a startup mindset are imperative to marketing because you need ideas to sell ideas," Arango said. "The other newly initiated Fellows have been so inspiring, making me excited and motivated to do more to make a difference on my campus."

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Innovation Fellows continued...

Daniel Delgado '17, now an associate engineer at Metro-North Railroad, said the UIF program taught him how important it is to "take innovative approaches to solve problems and how, in project management, stakeholder buy-in and acceptance is critical. I've learned that it never hurts to suggest a new way to conduct business."

The University's first Fellow, Jonathan Spiegel '17, organized the first 3 Day Start Up event on campus learned "to develop a timeline, execute tasks, advertise, lead a team, fundraise, pitch and do much more," he said, noting that these are skills he uses as an applications engineer at RBC Heim Bearings in Fairfield. Both Delgado and Spiegel continue to serve as mentors at the University and in the UIF national program.

Jillian Jacques, a computer science major and 2017 Fellow, said she is grateful for the University's emphasis on innovative thinking. "The most helpful part of this innovation ecosystem, for me, is knowing that the support starts at the top with President Kaplan and is working its way down to the roots, our students," Jacques said.

"The UIF program changes the Fellows as students and they change our campus culture," Carnasciali said. "And then they will make contributions to the communities they decide to live in."

For an inside look at the UIF program, check out Sheehy, Austin, Jacques and Dan Woronick's insights in the 2017 KEEN Viewbook: <https://bit.ly/2L3Of8D>

## Engineers Without Borders:

### Working to Develop a Water Filter to Bring Clean Water to Communities 3,127 Miles Away

The instructions for the wooden mold that would eventually become a concrete BioSand Filter were 60 pages long and full of diagrams and charts. They were complex and, at times, a bit unclear.

The members of the TCoE chapter of the Engineer Without Borders (EWB) did what engineers do: they worked as a team to solve the problem. They built the mold; they disassembled part of it and built it again. "Trying again, that's been a big part of this," said Cory Senney, a senior civil engineering major and EWB chapter president.

Their goal: to construct and test a BioSand Filter that would provide a sustainable method for treating drinking water for 26 communities in the parroquia of San Lucas, Ecuador. Residents living in the farming communities in the Andes Mountains have lacked access to clean water. This has caused illness among residents and has often forced residents to miss work, said Jean Nocito-Gobel, civil engineering professor and EWB chapter advisor. "The way they resolve the problem right now is by giving pills to elderly residents, children and pregnant women," Nocito-Gobel added.

Developed by O Horizons, an international non-profit organization at work on projects in the areas of clean water, agriculture, energy and economic development, the BioSand filter uses sand, gravel, and biological processes to filter out contaminants in water, making it safe for drinking. According to the O Horizon website, the BioSand Filter can "effectively eliminate cholera, typhoid, E coli, amoebic dysentery, and many additional pathogens that are harmful to humans."

The filters – which can fit inside or just outside a house – don't need electricity to run. "They can be constructed using local materials and the mold can be used 25 times, so communities can share minimal costs," Nocito-Gobel said.

The process of creating the mold and the filter "has been a real learning curve," Nocito-Gobel said. But the club members – Senney, Skyler Szerszen, Emann Stennett, Glen Craig, Pedro Martinez, Rebecca Giedraitis, Reinaldo Buitron, Michael Bond, Sam Zurowski and Sophia Oselador – were undaunted. "We broke the process down step-by step," said Martinez, a senior civil engineering major.

Originally, the chapter planned to build a very large sand filter but Nocito-Gobel said costs would be prohibitive for the economically-challenged community. A fortuitous moment occurred when EWB chapter members attended the Maker Faire in New York last year and met representatives from O Horizons who shared their insights into the BioSand Filter as well as their designs.

Club members said they liked how the project continually stretched their skills and they liked how purposeful the project is. "I learn best doing hands-on projects and I've learned so much," Szerszen said.

"We're using what we're learning in the classroom and doing what we love – engineering – working on a project that could make a real impact on people's lives."

"When I heard that our work could help people halfway around the world, I was all in," Bond said.

In April, they showcased the project at the University's Scholarship Ball. "Everyone was very excited about the work we were doing," Senney said. "It was very rewarding."

This fall, they'll submit their plan and drawings to the national offices of EWB-USA and an advisory committee of engineers will review the project. "They want to make sure that the design, the logistics and the



Skyler Szerszen and Sam Zurowski assemble mold

construction plans are all very sound," Nocito-Gobel said. "They want to ensure that the project will work."

Once the project is approved, six members of the club, Nocito-Gobel and a program mentor will travel to Ecuador next spring to teach community leaders how to construct the molds. The student chapter must raise the funds to cover the expenses. Financial support provided by the Provost's Discretionary Fund, the Tagliatela College of Engineering, John Falconi of the University's Board of Governors, and alumni has allowed the student chapter to travel to Ecuador in the past, Nocito-Gobel said. "We rely on the generosity of the university and donors to provide the financial resources needed to allow us to implement this sustainable drinking water strategy in San Lucas," Nocito-Gobel added. Szerszen is exploring crowdsourcing.

Emann Stennett, a sophomore mechanical engineering major, said she was drawn to the organization "because I loved the name – Engineers Without Borders," she said. "It seems limitless."

So too are the possibilities for the project to create positive change, say EWB club members. "We can teach one community how to build the molds," Senney said. "And they can pass what they've learned onto the next community and the next. We hope it will help many, many people."

## Popular VEX Robotics Competition Completes its 4th Year

The robot moved its arm, picked up an orange cone, moved around an obstacle and gingerly picked up another cone. The robotics team from Masuk High School constructed and programmed their robot to move and it did so, seamlessly, through each round of the third annual VEX Robotics Competition at the Tagliatela College of Engineering, taking the top prize.

"It was amazing to watch the complexity of what that robot was doing," said Liberty Page, TCoE practitioner in residence in computer science. "Having the engineering perspective that comes from having built robots, I was aware of everything that could possibly go wrong because of all of the complex movements and nothing did."

VEX Robotics and VEX IQ competitions are held around the country and locales around the world each February. VEX Robotics partners with the Robotics Education & Competition Foundation, a non-profit to involve students of all ages in STEM challenges.

To prepare for the competition, teams of students use VEX kits and build robots using an array of everyday materials. At the competition, the teams control their robots competing in challenges and games, tossing nerf like balls or picking up cones, in a series of rounds like an NCAA tournament.

The TCoE's involvement began four years ago. Page, who was a mentor to a regional high school robotics team, Apple Pi, started talking robotics with Alec Andrulat '17, an engineering student – now an alum – who played on a competing team. They started a new TCoE Robotics team and planned a VEX Robotics Competition to encourage students across the region to get into robotics. That first year, 42 high school teams took part.

Last year, 49 high school teams faced off against one another in the Beckerman Rec Center and 31 VEX IQ (Middle school and elementary school) teams competed in the German-American Alliance Club.

"We've seen young people redesign and manufacture and build components and new drive systems," Page said. "They're learning cutting edge techniques. They're coming to understand how things work and how to make things work."

Participating high school students who have strong GPA's and are actively engaged in robotics or other STEM programs can also apply for University scholarships. Three students were awarded \$20,000 in scholarships, \$5,000 a year for four years and all three enrolled.

Last year 300 people – families and friends of the high school teams and many from the University community – watched the teams compete. "It's a really exciting day for everyone," Page said.

The event involves dozens of volunteers from across the University, from University Undergraduate Admissions and Facilities and TCoE student volunteers from the TCoE's Robotics Club and the University chapters of the American Society of Mechanical Engineers, the Society of Women Engineers, the National Society of Black Engineers, the American Institute of Chemical Engineers, the American Society of Civil Engineers and the coed Theta Tau Professional Engineering Fraternity. "The student volunteers learn so much about putting on a large event, about recruiting other volunteers and speaking before a large group," Page said.

The competition fosters creative thinking, problem solving and team work, skills in great demand in engineering and other STEM fields, said Andrulat '17, an Associate Systems Engineer for the CH-53K heavy lift helicopter program at Sikorsky, a Lockheed Martin Company.

It teaches resilience too, Andrulat said. He recalled a high school team that had to do some quick thinking and collaborating when they arrived with a robot that was taller than the height requirements. "Instead of



Students compete with robot

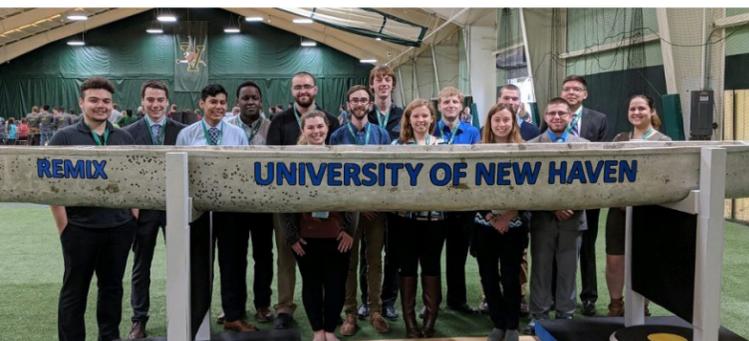
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VEX Robotics continued...

giving up, the whole team worked hard to have a functional robot while meeting the size limit," he said. "Most new teams would just give up and go home, but the students on the team were passionate and wanted to solve the problem. One core value every engineer should have is working through a problem no matter how hard the problem is."

## Even on Dry Land, ASCE Student Chapter Calls Concrete Canoe Competition a True Learning Experience

### TCoE Team Places 5th in New England



TCoE concrete canoe team

In the American Society of Civil Engineers' (ASCE) New England Concrete Canoe competition, the best moment comes when the teams from universities across New England finally take to the water and race, said Andrew Sarza '19, ASCE last year's chapter president.

But last spring, at the American Society of Civil Engineer's (ASCE) New England Concrete Canoe competition at the University of Vermont, the rain came down in buckets on Friday and Sunday, so while the teams did have the chance to swamp their canoes in water, testing to see if they could float for three minutes, they couldn't race.

Instead, the members of the TCoE's ASCE Chapter – and all of the teams – were stuck on dry land. They presented their design to a panel of judges and showed their final product, "Remix," a concrete canoe that took 1,120 volunteer hours to design, build, sand, seal and test.

The TCoE team placed 5th out of 14 teams. Thirty-five TCoE students from across the engineering disciplines worked on the canoe last year and 17 attended the competition including e-board members Glen Craig, Cal Reinhart, Mark Lucich, and McKinley Straub.

While team members said they were disappointed they didn't get the chance to race, Sarza and Brian Maloney '20, a civil engineering major and this year's ASCE Chapter president, said they gained hands-on experience and skills they will use in their engineering careers.

"This whole process will help me, as well as my teammates, in many different ways as we move on to our careers, said Sarza, a civil engineering major who plans to become a water resources engineer after graduation. "The most obvious is problem solving. Throughout the whole process there were many problems that we faced and, in order to move on, had to fix. We also had to be able to communicate as a team to make sure that any changes that were made to one aspect of the design would not affect another aspect."

Maloney said they are already looking toward next spring's competition. "I am most excited to meet another class of engineering students and teach them what I have learned and about our club," he said.

## A Perfectly Timed Scholarship, a Winning Pitch and a National Science Foundation-Funded International Research Grant



Melissa Mickolyzck

In her first career, Melissa Mickolyzck was a horse trainer and then she decided to become an electrical engineer. It was an exciting new path, but not a simple one. She earned an Associate degree in Engineering Science from Housatonic Community College, graduating with high honors and receiving many awards for excellence, while

holding down all kinds of jobs – working in a dog kennel, a sporting goods store and at a water company.

Arriving at the University, she dove right in, working in a co-op internship part-time at Sikorsky Aircraft and interning in the summers with United Illuminating, where her engineering skills and work ethic caught the attention of supervisors who recommended her for an Institute of Electrical and Electronics Engineers (IEEE) PES Scholarship plus Initiative. The national scholarship program aims to build the next generation of electrical engineers working in the power industry.

The scholarship arrived, she said, at just the right time. "As a non-traditional student, work and going to school go hand-in-hand," Mickolyzck said.

"Although UNH has supported my endeavors throughout my attendance at the university, the scholarship money provided me with days of studying that I would otherwise be working."

Last Spring, Mickolyzck received the Most Outstanding Undergraduate Award in Electrical Engineering. Ali Golbazi, professor and chair of electrical and computer engineering, praised her exceptional academic record and her involvement in the Society of Women Engineers, the IEEE and Eta Kappa Nu Honor Society.

"I don't take my achievements for granted but I am proud to be have been recognized alongside with my fellow peers," she said.

The TCoE faculty played a huge role, she added "The best part about being engaged in the Electrical Engineering department was the life support that I got every day when I walked into Buckman. The electrical engineering professors took interest in my career and life path and they offered their experiences to help with some of the tougher choices that I have had to make," she said. "They are the ones who have given me the tools to go to a job and call myself engineer."



Brandon Vaughn

It was all about "practice, practice, practice," for Brandon Vaughn.

He had worked all year devising and developing Direct Charge, a device to help reduce diesel fuel consumption in trucks and cars and was confident it was a product that could make a difference. "By installing my device into the vehicle, the vehicle will use less diesel fuel, which in turn will emit less harmful gasses," he said.

What he worked to strengthen was his pitch. During his first pitch at last year's Alvine New Venture Pitch Competition he said he struggled as he spoke to the panel of judges. So he turned to "a collection of professors and a professional who helped me, Dr. Maria-Isabel Carnasciali, Dr. Brian Marks, and Mike Maguire, to name a few." They gave him suggestions and pointers, urging him to continue to perfect the pitch and try again. That, they told him, is what an innovator has to do. So he did.

This time, when he presented Direct Charge at the Connecticut New Venture Competition, a startup and new business pitch competition sponsored by the Entrepreneurship Foundation, Inc., Vaughn took home the award for "Best Presentation," \$500 and a "Startup Legal Services" award/voucher.

"That was a gratifying moment," Vaughn said. "It was a great learning experience and a confidence booster that will only help me down the road."

Carnasciali, associate professor of mechanical engineering and faculty member of the entrepreneurship & innovation program, said, Vaughn's

willingness to take advice from his professors and mentors, and to try again illustrated just the kind of perseverance a budding entrepreneur needs.

Whenever there was an entrepreneurship learning opportunity, Carnasciali noted, Vaughn was in, taking part in the 3 Day Startup in 2015, the Yale University Medical Hackathon, and the Alvine Pitch Competition in 2016, the 24 Hour Imagination Quest, Charger Startup and Pitch Perfect in 2017. Along the way, he said he learned pitching techniques and how to create a business model.

After graduating in May, Vaughn plans to start his own company to further develop Direct Charge and partner with an automotive manufacturer so the device can be installed during the manufacturing process. "This product is a game changer for the transportation market," he said. "With it, we can reduce our dependence on diesel/fossil fuels and shift to electric and renewable energy transportation in record time."



Daniel West

Daniel West spent the summer in Madrid researching electrical vehicles and autonomous vehicles, studying energy storage and generation. One of just three undergraduates from the United States to win a highly selective National Science Foundation funded international research grant, West said he was excited to be part of a collaborative international research team.

He did his research as part of the IRES Electrified and Autonomous Transportation program in conjunction with the University of Maryland's Electrical and Computer Engineering Department. "As an engineer I will be regularly working with teams, and extending that to international teams will be a great experience, bringing diverse minds together to achieve a common goal," he said.

West, who says his electrical engineering strengths lie in "the theoretical realm" couldn't wait to get to Spain – for many reasons, but particularly to attain "a lot of hands-on experience and combine theoretical and academic understandings of electrical theory with practical applications."

He was grateful to Professors Ali Golbazi and Junhui Zhao who encouraged him to seek "this rare research opportunity." West studied Spanish for a decade and was looking forward to speaking the language, trying the food and exploring the world's largest urban garden in Madrid.

Zhao said West, an EE department teaching assistant, was the perfect fit for an international research team. "He's energetic, bright and creative," Zhao said. "In class, he was willing to articulate his questions about the

continued...

Daniel West continued...

more abstract notions of set theory, a genuine asset for many of his classmates and the class dynamic as a whole. When placed in group work sessions, Daniel easily adopted a leadership role, helping his peers learn how to solve problems on their own."

Returning to campus this fall, West hopes to continue working at Precision Combustion, a North Haven-based clean energy technology company where he interned last spring. He has lots of ideas for life after graduation in 2019; continuing to travel is one goal.

"I'd love to get involved with renewable energy," West said. "But there are so many interesting areas in electrical engineering that I could see myself pursuing many different avenues."

## Making the Production Line Safer:

### TCoE Graduate Students' Research Paper Wins Third Place at ASEE Regional Conference



Graduate students with advisor, Ali Montazer (seated)

Despite automation, manual lathes are still used on most manufacturing production lines as well as in school and university fabrication shops. Yet research into injuries related to manual lathe use is relatively scant, say a team of TCoE Industrial Engineering and Engineering Management graduate students.

Armed with background in mechanical and industrial engineering and a keen interest in finding a way to prevent injuries in the manufacturing workforce, Chaitanya Matapathi, Ramcharan Pulugurtha, Girishwaran Sundar, Madhuri Kudke, Harish Kusekar and Sohail Shaikh started researching the effects a lathe operator's posture can have on muscular-skeletal injuries. "The manual lathe is used abundantly, but the research done in this field isn't a lot considering how much it is being used," Matapathi said.

In April, the team won third place at the 2018 American Society of Engineering Education – Northeast Conference held at the University

of Hartford for their paper Quantification of Posture in Human-Lathe Interface. "In our research we found appropriate postures that one must be in, while working on a manual lathe, in order to prevent musculoskeletal disorders," Matapathi said.

Ali Montazer, professor of industrial and systems engineering, and the team's faculty advisor, said he was proud of the work the team put into their research and that their work "addressed human operator safety and well-being while working with manufacturing machinery."

"All of the students, except one who earned a credit hour of independent study, volunteered to work on this project for the sake of learning and professional development," he said.

The team members are planning to get their research published and hope that it can help make production lines safer for those who use manual lathes. "I have personally worked on lathe machines," Kudke said. "So I know the dangers of it." She added that their research could provide "proper guidance about ergonomic practices in human-machine interaction."

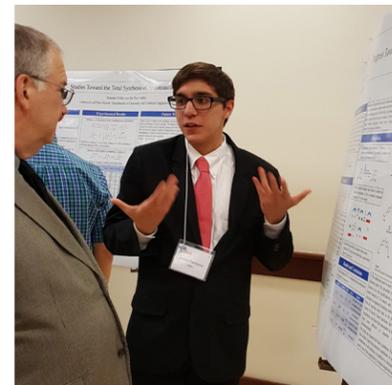
Matapathi said they were grateful to "Dr. Montazer who guided us and motivated us at every point of the research."

"Presenting our paper boosted our confidence," he said. "It inspired us to challenge ourselves to achieve something big in the coming years."

## Chemistry Students Place First and Second at American Chemical Society Local Section Symposium

TCoE Students had a very strong showing at the New Haven Local Section of the American Chemical Society (ACS) Third Annual Student Research Symposium at Quinnipiac University in April. University of New Haven students placed first and second in the poster presentations and Nicole Langlois '18 was invited to speak about her research.

Langlois, winner of the ACS Local Section Undergraduate Research Award, presented her research on the total synthesis of cadiolides, secondary metabolites isolated from marine ascidians and tunicates (sea squirts) that show potent antibiotic activity against dangerous Gram-positive bacteria like Methicillin-Resistant Staphylococcus Aureus (MRSA) and therefore hold promise as potential new antibiotics in the fight against resistant strains of pathogens. This work was performed in collaboration with Pier Cirillo, assistant professor of chemistry. All other student speakers were graduate students from Yale University, Cirillo noted. Langlois is currently pursuing her master's in Chemistry at Northeastern University.



Justin Pantano (BS '18 Chemistry & Forensic Science) is pursuing his PhD in chemistry at the University of Rhode Island

presented posters along with students from Yale, Quinnipiac and Southern Connecticut State University.

Miller placed first in the poster competition and Goriounova placed second. Miller and Pantano worked under the supervision of Professor Cirillo. Chong Qiu, assistant professor of chemistry, supervised the research of Goriounova and Ng.

"Congratulations to all our students for all their efforts and making such a strong showing, highlighting the challenging research being done at the University of New Haven," Cirillo said.

## Long Nights in the Chem Lab:

### Creating a Car that Starts and Stops by Chemical Reaction

The days stretched into nights as the 10 engineering students "discovered a deep rooted electrical inefficiency in the battery" of the small car they'd designed and were building for the American Institute of Chemical Engineers' (AIChE) annual Chem-E-Car competition. They had just a couple of weeks before they would be racing against teams from other universities at the regionals in Rochester, New York.

"Each day we would break our work up and focus on just one, small piece of the end goal," Nicholas Mahar, a senior Chemical Engineering major and former AIChE Student Chapter president. "This kept spirits high each day and helped us stay focused without the overarching stress of the final product creeping into our minds."

Kristine Horvat, assistant professor of Chemical Engineering and the University's AIChE chapter advisor, said what makes the competition

TCoE students Brandon Miller ("Studies Toward the Total Synthesis of Spiromastixone J"), Justin Pantano ("Progress Towards a Templated Synthesis of Usnic Acid and its Analogs"), Alexandra Goriounova ("Collection and Chemical Analysis of Micrometeorites"), and Yo Ng ("The Effect of Solar Eclipse on Ground Level Ozone Concentration")



James Montesano (ME), Stacie Meruelo, Thomas Hong, and Nicholas Mahar

so challenging is that there are so many possible approaches a team can take using a chemical reaction to make a car start, travel a distance and stop.

While the University's team didn't reach the nationals last Spring, what they learned from the process was a huge win, said Stacie Meruelo, a senior chemical engineering major. Their sights are already on the 2019 competition.

"It was great because we had a senior Mechanical Engineering student, James Montesano, helping us with a lot of the building of the car," Meruelo said. "We're hoping to get other engineering disciplines involved this year." The team also included Emily Tassinari, Thomas Hong, Joseph DiBella, Danielle Belskis, Dan Masi, and Malaika Matumbu.

"We started with a team of three at the beginning of the fall semester and with the incredible determination of our new adviser Dr. Horvat, we brought a team of 10 to the competition," Mahar said.

Horvat said the students gained hands-on experience building the stopping mechanism and battery, but they also performed the preliminary testing and assembled the final product. "They are very enthusiastic and excited about improving their car for next year, which speaks volumes to their dedication and desire to learn and improve their skills," she added. "These are all qualities that will make these students very successful engineers in their future careers, and I am very proud of all of them."

Working all those nights in the lab allowed them to trust everyone was on the same page. "This was great practice for the future, when there will be very complicated systems and projects," Meruelo said. "I will have to work with other engineers, and have that level of trust, that we're all working toward the same goal."

In the AIChE's Jeopardy competition where they had to test their chemical engineering knowledge against 11 other teams in categories like "Dead guys of science," "chemistry puns," "fluid dynamics," "process control," "organic chemistry" and "thermodynamics," as well as a few surprises like "Disney songs," "World capitals" and "music theory," the University of New Haven team placed second. "The only team to beat us was MIT," Meruelo said.

## New Faculty Answer Three Questions



**Keith Dillon**

*Keith Dillon received his Ph.D. in Electrical Engineering in 2014 from the University of California, San Diego. He comes to the TCoE from Tulane University where he was a post-doctoral fellow of biomedical engineering. He is president and co-founder of Formulens, LLC.*

**Q. Can you share some details about your research work?**

**A.** My industry work and my research are essentially the same, making computational methods for new kinds of sensor data. I actually started out in reconnaissance imaging; it was really cool. We developed technology to spy on people from very far away without using light (and that's all I'm allowed to tell you).

I decided the area I most wanted to make an impact in was healthcare. So since then I've been developing new algorithms for finding disease from medical sensor data, particularly in imaging the brain. It's a really hard problem because there's so much bone and tissue between us and the brain cells we need to look at. It's like reconnaissance imaging from an extreme distance, but even harder because we aren't even sure what to look for. So we have to use all the info we can get. At Tulane I combined both brain imaging data as well as genetic testing to diagnose mental illness.

**Q. What will you be researching at the University of New Haven?**

**A.** Today, I'm still working on brain data. It's been said that the 20th century was the century of the gene and the 21st century will be the century of the brain. There's so much left that we don't understand about mental illness, and the societal impacts are so large. As many as half the people suffering from these diseases aren't receiving treatment, and collectively they're the biggest cause of disability. One of the first things we hope to achieve is technological ways to automate much of the diagnoses, to help bring costs down and allow treatment to be provided to more people.

**Q. What are you looking forward to about teaching and researching at the Tagliatela College of Engineering?**

**A.** I think we've returned to a time where industry is doing more interesting things than academia. Top professors and top students are lured away by industrial research labs, while academia has stayed largely focused on last decade's jobs descriptions. So what really drew me to the University of New Haven was how serious you are about keeping engineering school up to date with the new data science program, the revolutionary new teaching methods, and the central focus on entrepreneurship. That's a big one for me especially. Engineers aren't just resources for companies to trade and manage, engineers find and solve problems. So I'm really looking forward to helping students understand how they can make an impact.



**Kristine Horvat**

*Kristine Horvat, assistant professor of chemical engineering, earned her Ph.D. in Materials Science and Engineering from Stony Brook University in 2015. She was a visiting professor in the chemical engineering department last year.*

**Q. Can you share some details about your research work?**

**A.** I am interested in research projects pertaining to alternative energy sources that result in a minimal net release of carbon dioxide into the atmosphere. One source, methane hydrates, exist naturally under high pressure, low temperature conditions. Estimates indicate that they contain more volumes of methane gas than all other sources of fossil fuels combined. To make the utilization of this methane as a fuel source greener, there is interest in exchanging carbon dioxide with methane in methane hydrate reserves to store carbon dioxide out of the atmosphere. Before attempting this exchange process on a large scale, more must be understood about the kinetics and thermodynamics of mixed gas hydrates. Another source for energy that I am interested in is algae as a biofuel. Their fast growth, ability to grow in locations unsuitable for crops, absorption of carbon dioxide for growth, as well as their coupling to waste water treatment are some of the many benefits to algal biofuels. One of the steps that is most crucial to using algae as a fuel is the dewatering step, therefore I am interested in investigating dewatering techniques.

**Q. What are you working on now?**

**A.** I am looking forward to working on research projects pertaining to gas hydrates and algal biofuels with UNH students, and I am looking forward to teaching a new special topics course in sustainable energy that is running for the first time this semester. I also enjoy working with AIChE, and I am looking forward to even more success at the Spring 2019 AIChE ChemE car competition.

I hope to become involved in outreach events to connect the general public to STEM fields, and I am particularly interested in getting involved in the University's Women's Leadership Conference. As the number of women pursuing engineering studies is low, I hope to encourage young women to explore STEM opportunities.

**Q. You were a visiting professor in the TCoE last year. What did you discover about the University and what made you want to be part of the full-time faculty?**

**A.** Very soon after my arrival to the University of New Haven I realized that it was a perfect fit for me. In addition to celebrating stellar research, there is a strong focus at the University on innovative and interactive teaching, which has always been a passion of mine. TCoE students genuinely

want to learn, which makes them a pleasure to work with. TCoE faculty have been very welcoming and have gone above and beyond to make sure that I have all that I need to teach my classes.



**Eric A. Dieckman**

*Eric A. Dieckman, assistant professor of mechanical engineering, earned his Ph.D. in Applied Science from The College of William and Mary in 2013. Last year he was a TCoE visiting assistant professor in mechanical engineering.*

**Q. Can you share a few lines about your research work?**

**A.** My background is different from the "normal" engineering professor. My undergraduate degree is in physics, during which time I did a number of research projects in acoustics. This led me to a Master's program in Architectural Acoustics, literally how to build concert halls, but that didn't have enough hard science content to satisfy me. So I completed a Ph.D. in Applied Science, focusing on sound propagation and scattering both in solid materials – to find flaws in materials – and air – making new sensors for robots. Then I worked for a few years for a Department of Defense (DoD) contractor focusing on writing Small Business Innovation Research (SBIR) proposals. These multi-phase awards are a great way to try out new concepts on a short timeline, with a well-defined end goal in mind that will benefit the DoD. I've written about a dozen of these so far, several of which have been funded thru Phase II.

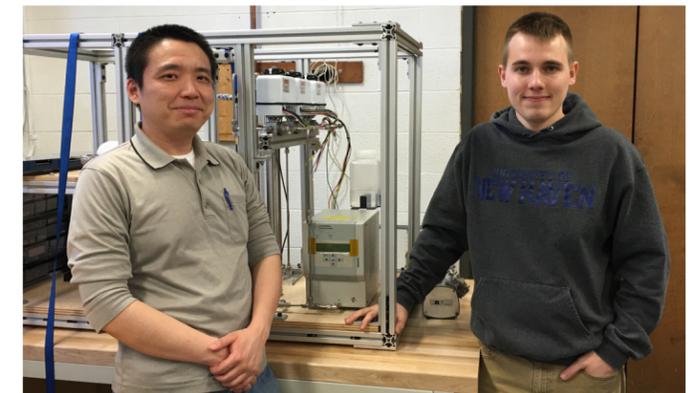
**Q. What are you researching now?**

**A.** The main goal of my research is to find useful information hidden inside of noisy signals. We do this by looking at how the frequency content of the signal changes with time (in a highly mathematical way) to find "features" which describe the signal. These features can then be used in machine learning algorithms to find hidden information. One example of our time-frequency signal processing and machine learning process on real-world problems is acoustic vehicle classification. A useful robot (i.e., one that can go get your coffee) needs to be aware of its environment, which requires a number of sensors at both close and far range. We wanted to see if we could use a special nonlinear speaker called a parametric array, which works like a flashlight for sound, to bounce sound off of cars to determine the vehicle type. We were able to classify vehicles with 92% accuracy at distances of 50m, showing that acoustic echolocation is a viable long-range sensor for mobile robots.

**Q. You have been a visiting professor. What drew you to the TCoE and made you want to stay?**

**A.** Once I completed my Ph.D. I was only able to stay out of academia for six months before coming to the University of New Haven as an adjunct to teach a graduate course in acoustics. I really enjoy the challenge of presenting complicated material to students in a way that they can gain a deeper understanding. This often means combining hands-on projects with in-depth mathematical and computational analysis to get at the real heart of the problem.

## Spotlight on: Dr. Chong Qiu



Chong Qiu believes in citizen science and that both longtime scholars and beginners can help move scientific research forward and "add knowledge to the library of mankind."

The assistant professor of Chemistry is at work on a complex research program and pursuing a \$600,000 National Science Foundation research grant to study the properties of aerosols (also known as particulate matters) in the atmosphere and delving into "the chemistry and physics of aerosol, which exists in the air we breathe in every day."

His collaborators are graduates and undergraduates from Chemistry, Biology and across the fields of the Tagliatela College of Engineering. They also include high school and middle school students from around the region, as young as 12, who are collecting micrometeorites from rainwater "using tools designed from simple plumbing parts."

"One of the goals is to move aerosol research forward by investigating chemicals, such as amines, that were previously not thought to be important and our discovery indicated otherwise," Qiu said.

*continued...*

Dr. Chong Qiu continued...

The research hones in on aerosols – tiny particles suspended in the air, with sizes ranging from a few nanometers to a few micrometers. "These are very important to us, without them we wouldn't have precipitation but, on the other hand, having too much in the atmosphere can be toxic," he said.

The study could help to shape understanding of the impact of air quality on climate change, weather forecasting and human health. "We are trying to contribute a piece to the larger puzzle," Qiu said.

Graduate and undergraduate students are conducting laboratory experiments, doing computer modeling and field work, using and testing low-cost devices that measure pollutant levels in the atmosphere. "Traditionally you had to pay tens of thousands of dollars to measure those levels, but we are trying to test portable devices that are a fraction of the cost," Qiu noted.

Meanwhile, teams of engineering seniors will design and construct equipment and instruments, such as a thermal denuder that determines the volatiles in ambient aerosol for their Senior Design project. "The engineering students are perfectly positioned to construct such a device," Qiu said. "It's mutually beneficial, giving them the chance to do research and build the instrument. It will cost 10 times less than a commercially available instrument and it can be customized to specifically suit our research."

Qiu was drawn to the University of New Haven because of this kind of collaborative possibility. He arrived in 2016, setting out immediately to work with faculty and students across the disciplines. "I couldn't wait to become part of the chemistry program because of the faculty in the program and because chemistry is so uniquely positioned in the Tagliatela College of Engineering," he said. Qiu teaches analytical chemistry courses, including Quantitative Analysis and Instrumental Methods.

Qiu grew up in Central China, the son of two blue collar workers who encouraged his love of science. He pursued a Bachelors in Chemistry in China and his Ph.D. at Texas A & M. As an assistant professor at the University of Northern Alabama, Qiu received a National Science Foundation-Atmospheric Geospace Science grant to investigate "Kinetics and Mechanism of Restructuring of Atmospheric Soot and Associated Impact on Light Absorption." It was there that he began to wonder about the role amines play in the atmosphere.

Qiu says he's energized daily by his teaching and research, having the opportunity to look closely at minute particles that may have a very large impact on environmental and human health.

By involving middle and high school students in research, he said he hopes they discover the magic and power of science and engineering and consider making it their life's work. "We need to continue to encourage talented students to pursue STEM fields," he said. "And I hope we can galvanize support for science and discovery."

## Making an Impact: David and Lisa Harding



David and Lisa Harding's ties to the University of New Haven are deep and abiding. Harding, professor of chemical engineering, has previously served as the TCoE's Associate Dean for Faculty Affairs and Accreditation and chair of the Chemistry and Chemical Engineering Department. He has been a faculty member since 1993, and Lisa Harding holds a Sc.D. in Management Systems from the University.

Longtime supporters of the University, this past spring they gave a significant gift to the Mary and Walter Harding Endowment Fund, which was created to honor David's parents. The endowment provides financial support to aid in the recruitment of female engineering students, preferably in chemical engineering, and to potentially increase the number of females entering the field of engineering.

In their testimonial, the Hardings said, "This fund has been established to specifically support engineering education. Engineering is a fundamental profession that builds the infrastructure to support modern life. This includes our transportation, information systems, and financial infrastructure as well as our industrial and agricultural infrastructure. Our planet faces many challenges whose solutions will require the contributions of talented engineers."

"We support the educational mission of the University of New Haven because of our close relationship with the University and because we believe the mission of the University is closely aligned with our values," the couple said. "The University of New Haven strives to bring a high-quality education to students from a wide range of backgrounds."

## Remembering a Professor Always There for His Students

In Memoriam: Ronald N. Wentworth

Professor Ali Montazer still remembers the first time he met Ronald N. Wentworth, former professor and chair of the TCoE's Industrial Engineering department.

Montazer was waiting at the New Haven shuttle station, heading to his first professional job interview at the University of New Haven. Up pulled Ronald Wentworth in a big red Chevy – "probably a '60's vintage," Montazer said.

"I will never forget his bright-bearded and kind face," he said. "I was nervous and cautiously quiet. He was so welcoming and easy-going that I lost all my nervousness. He comforted me throughout the interview day and made me feel wanted and at home."

Montazer got the job and the two became colleagues and friends, developing courses and labs in human engineering, ergonomics and work design.

Wentworth, who died in July after a battle with Parkinson's disease, had a long and stellar career at the University of New Haven. He began as an assistant professor of management science in 1975 and then became coordinator of the MBA program. He was named coordinator of the master's program in business administration and, in 1981, he was appointed associate professor and chair of management science before moving on to become associate professor and undergraduate coordinator of the industrial engineering and computer science departments.

He earned tenure in 1983 and became an associate professor of industrial engineering and four years later, he was named full professor. He went on to become the industrial engineering program coordinator and chaired the department from 1999 until his retirement in 2004.

He received his Ph.D. from Purdue University, married his wife, Janet in 1975, and they raised three children, Alison, Todd and Jennifer, in Clinton where he was active in the Freemasons. According to the *New Haven Register*, though Parkinson's caused him to lose his mobility later in life, he was able to discover a love of painting during that time and maintained a love of cars throughout his life. He was predeceased by his wife and is survived by his children and their spouses, his three grandchildren, his brother and his nieces and nephews.

Ronald Wentworth was "an innately kind person who always had stories to tell," Montazer said. "He loved his work, his teaching, and his students. He particularly enjoyed working with and talking with the non-traditional students who were working full-time and attending the university part-time to earn their bachelor's or master's in industrial engineering. He is dearly missed!"

## Elizabeth M. Doane – University Alumna and Great Friend to the TCOE - Receives HCC Foundation's Lifetime Achievement Award

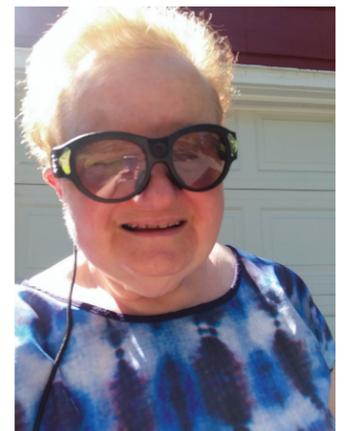
Math was what spoke first to Elizabeth "Betsey" Lombardi Doane. She loved everything about numbers and solving problems, and she knew exactly what she wanted to do: teach mathematics.

That some doubted her only made her all the more certain. "I was told I could never teach math because I was blind," said Doane, MS '88. She and her twin sister, Barbara Lombardi, were blinded as premature babies by a high concentration of oxygen in their incubators. Her engineer father and her mother encouraged them to follow whatever dream they were after. When her high school teachers told her to reconsider her goal, "I didn't listen," Doane said.

She went on to teach mathematics at Housatonic Community College in a career that spanned four decades. Doane, MS '88, was honored last spring with the Housatonic Community College (HCC) Foundation's Lifetime Achievement award for outstanding teaching, for groundbreaking work developing computer literacy courses for students with visual impairments and for her philanthropy.

"In honoring Betsey Doane, the Foundation brings recognition to one of HCC's most dedicated and outstanding professors," HCC President Paul Broadie II said. "Betsey's commitment and contributions to HCC run deep. Over the years she has had a profound impact on hundreds, perhaps thousands, of HCC students. This honor is well-deserved."

A longtime friend of the Tagliatela College of Engineering, Doane is a member of the Professional Advisory Board and the Engineering and Science University Magnet School's (ESUMS) Advisory Board. She established the Elizabeth Lombardi Doane STEM Fund, providing financial support to programs and activities that foster an interest in STEM for middle and high school students with emphasis on ESUMS students and for programs/activities geared to female students.



continued...

Elizabeth Doane continued...

She's been encouraging young women to consider STEM fields since the 1970s, when she first visited middle schools with her Albertus professor and mentor Florence Jacobson to talk about "the art of mathematics and to show girls that this is something women do."

Dean Ronald Harichandran said, "Betsey is passionate about encouraging young women to develop an interest in STEM fields. She also is a living example of how someone who is visually impaired from birth can leverage technology to enhance all aspects of their lives. She is an incredible role model."

Her tenure at HCC began in 1970, after she received her BA in mathematics at Albertus Magnus and her MA in mathematics at the University of Massachusetts, Amherst. Creating transparencies for the overhead projector meant using a typewriter that required manipulating symbol keys by hand and keeping a braille notebook with her as she taught classes so she knew when to put the next transparency up. When students wrote problems on the board, they'd talk out their process and Doane would share her responses.

"On the first day of classes each year, my students would watch me approach the desk differently and they'd go quiet. And I would just set everything up and start right in with the lesson," Doane said. After class students often had questions. "They'd ask how I could do what I did," she added. "I think for some of them, who had struggles outside of school, they saw what I was doing and looked at their own situations and said 'ok, I need to get going here.'"

Doane was promoted to assistant professor, associate professor and then professor. A fortuitous moment at a New England Mathematics Association of Two Year Colleges conference opened a whole new passion and world to her. "They showed us how we could use a computer – very primitive at that time – to demonstrate theoretical concepts in mathematics," she said. "I could get my students to understand the central concepts of the calculus by using a computer to generate lots of data and look at the results." With the help of a program that translated what was on the screen into Morse code – as a ham radio operator, Doane knew Morse code – she was able to read the computer screen.

She couldn't wait to learn more about computers and enrolled in the Computer and Information Science MS program at the University of New Haven. "The professors were excellent and very accommodating to me," she said. "I had a braille terminal that I would hook up to the system and I was on my way. I did a lot of work in that computer lab." In 1988, she earned her M.S.

As technology advanced, she kept learning and developed a transfer computer science program for HCC students, sharing her work at national conferences. As Housatonic officials noted, "For more than four decades she has been on the cutting edge of major industry advancements in teaching techniques for all including the visually impaired."

She marvels at how changes in technology have impacted her life, whether smartphones or smart home devices, or Power Point presentations or WebEx and Blackboard which she uses to teach online, and Aira glasses which have changed the way she navigates a trip to the bank or travel abroad.

"My sister and I can now travel using special glasses with a camera or video, a wifi device for connectivity and our iPhone with an app for audio," Doane said. "We still use our canes but we are connected to trained agents who can see where we are and where we are going and direct me where I need to go." Last Spring Doane and Barbara Lombardi shared those experiences as Alvine Engineering Series lecturers speaking on "Aira: A New Way for the Visually Impaired to Explore the World."

"I am so excited about where the Tagliatela College of Engineering is going, with its emphasis on innovation and entrepreneurship," she said. "They are keeping up with how companies handle work now with open environments and maker spaces."

Though retired, Doane continues to teach online at the college and continues to work with visually impaired people on how to use technology to enhance their lives whenever the opportunity presents itself. "I stay up-to-date on software and I also learn from what other people are doing. There is always something new to learn," she said. "I'm grateful to be able to use what I've learned to help other people."

Hear Elizabeth "Betsey" Doane discuss the impact new technologies have had on her life on NPR's *Story Corps*: <https://archive.storycorps.org/interviews/thankful-for-technology-and-how-they-help-blind-people/>

## Glenn House Named to the Inaugural Class of the University's Entrepreneurship and Innovation Hall of Fame



Glenn D. House was working as a senior vice president of strategy and operations at Mentor Graphics, overseeing 2,200 employees in a company that did half a billion dollars in business, when he decided he wanted to strike out on his own. "I wanted go into small companies and build small businesses because I wanted to make an impact," he said. "When you want to change a big company, it takes years to make small corrections. In a small company, you can make a correction in a day."

House went on to create three start-ups. "I went into a small company in the internet boom, built it up, sold that one. I bought a small supply chain company, built that up and sold that one," he said. In 2002, he co-founded 2Is Inc., a military supply chain analytics firm with clients including the U.S. Department of Defense (DoD), Ministries of Defense and major original equipment manufacturers.

Although he's been with 2Is for 16 years, the imagining, inventing and creating continue apace. "We've reinvented ourselves as a company no less than three times," he said.

To honor his achievements as an entrepreneur, House was inducted into the inaugural class of the University's Entrepreneurship and Innovation Hall of Fame last spring. "It's always nice to be recognized by your alma mater, but it's also great to see your alma mater moving in a direction where you've made your life's work," House said. "I'm very enthusiastic about the fact that the University is really stepping into entrepreneurship."

On the night he was inducted, House also served on the panel of judges in the Alvine New Venture Pitch Competition. He applauded the University's emphasis on creativity and innovation, providing experiences like the Alvine competition and spaces like the University Innovation and Design Makerspace where students can test new ideas.

"You need an environment where aspiring entrepreneurs feel safe to try out ideas, to fail and to try again, and the Deans are providing that," he said. "The difference between highs and lows in an entrepreneurial

venture is a nanosecond. Having a good grip on your ability to deal with failure and being able to morph that failure into success and forward direction is so important."

In a field like technology where change is constant, a climate that "fosters innovation," is imperative, House said. When he was developing 2Is he said he knew "the social model was as important as the business model," he said.

The key, he said, is hiring diverse thinkers who bring their own ideas to projects, who know how to collaborate and who aren't afraid of challenges. "If you have the freedom to do what needs to be done and you incorporate the thinking of others, how much management does there need to be?" he asked. "Unlocking potential of your employees in an entrepreneurial venture is absolutely essential."

As an innovator, House said he has to "be constantly staying current, constantly learning and taking classes and constantly understanding what the latest technology is," he said. "I've chosen a field where I'm on a treadmill all the time. I love it. The benefit of being on a treadmill as long as you run fast, there's not a lot of people to compete with."

While always looking forward, House said he also relies heavily on the knowledge he gained as an electrical engineering student at the University. "I was blessed to have gone to the University of New Haven," he said. "The Electrical Engineering department faculty members were a tight-knit, very bright team and you studied with a professor in a class of 10-12 people. You knew your professors and they knew you very well."

He noted that "there's not a day that goes by when I'm not dealing with calculus, statistics and random variables. What I learned from the professors in Electrical Engineering and the professors in Mathematics has been with me throughout my career."

As an undergraduate, House had to juggle working full-time while attending the University full-time. "That was only possible because the professors cared," he said. "That's why the University of New Haven was so strong and remains strong; they are motivated, in-touch teaching professionals who truly care about their students' success. It's exciting to see where the University is heading."

To learn more about the University of New Haven, please contact:

**TAGLIATELA COLLEGE OF ENGINEERING**  
300 Boston Post Road, West Haven, CT 06516  
203.932.7168 | [www.newhaven.edu/engineering](http://www.newhaven.edu/engineering)



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