National Science Foundation Early Career Program

2021-22 Award Recipients

UCONN | RESEARCH

Celebrating the Success of Our Early Career Faculty Members

Dear UConn Community -

Earning a National Science Foundation Early Career Program award is no small feat. These prestigious awards are reserved for researchers who demonstrate groundbreaking ideology and a commitment to their disciplines. Additionally, they reward educators who answer the call to inspire and teach the next generation of students to pursue their own careers in science and technology.

Dr. Pamir Alpay (right), Interim Vice President for Research, Innovation, and Entrepreneurship, meets with NSF Director Dr. Sethuraman Panchanathan at UConn.

UConn is among the leaders in earning CAREER awards out of the hundreds of universities across America that specialize in research. Our success exceeds the most esteemed Ivy League colleges and technical institutions in the country. Over a five-year period, UConn faculty members have earned 61 CAREER awards, resulting in millions of dollars in grants to fund ambitious projects and employ post-docs, graduate students, and even undergraduates.

There are many conclusions to draw from this success:

- UConn is drawing bright early career faculty from throughout the world to come and work at our university
- Our deans and department heads have a great eye for talent and recruit exceptional educators and researchers.
- Staff in the Office of the Vice President for Research, as well as our schools and colleges, are doing a tremendous job of training faculty members on applying for the CAREER awards and are guiding them well through an arduous process.
- Students receive a first-class education at UConn, with the opportunity to learn from renowned professors who are as engaging in the lecture hall as they are in the laboratory.
- UConn is succeeding in its goal to be one of the nation's best public research universities.

I anticipate that UConn's Research enterprise will continue to grow in the years to come. That expansion is largely due to the efforts of our NSF CAREER award recipients and those who will be similarly honored in the future.

It is the pleasure of the OVPR to profile this year's CAREER award recipients in the pages of this document. We hope you will enjoy learning about their research and their stories. They have all made UConn proud and they are a credit to our university and our state.

Sincerely,

Dr. Pamir Alpay

Interim Vice President for Research, Innovation, and Entrepreneurship

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UConn Faculty Winning NSF CAREER Awards at Record Pace

Since 2015, UConn has experienced a remarkable increase in the number of major National Science Foundation (NSF) awards bestowed upon early-career faculty members. This year, the University saw unprecedented success, with 11 awards announced.

NSF Early Career Development (CAREER) Program awards are highly prestigious, offered to early-career faculty members who demonstrate the potential to serve as academic role models in research and education. Approximately 500 awards are given annually to universities and research institutions throughout the country.

"Over the past several years, UConn has joined an elite group of research universities in the number of CAREER Award winners on our faculty," said Interim UConn President Radenka Maric. "In fact, the number of CAREER Awards won by our faculty in 2018-2020 puts us ahead of top research universities like Harvard, Dartmouth, and Cal Tech. This is a testament to the quality of research work being done at UConn, and also to our institution-wide commitment to pursue excellence. I am very proud of our progress, and look forward to reaching even greater heights in the years to come."

The awards are very competitive, and few institutions have seen as much success in winning research funding as UConn, particularly over the past seven years. The 11 awards for 2022 are the most ever for UConn.

The awards range from about $425,000 to $1.4 million. The School of Engineering leads with seven faculty members awarded, followed by three for the College of Liberal Arts and Sciences and one for the Neag School of Education - the first in its history.

Historically, Engineering faculty at both UConn and UConn Health have received the most CAREER awards, followed by CLAS.

"I am proud of numerous engineering faculty who have been in this elite group," said Kazem Kazerounian, Dean of UConn Engineering. "This is a testament to the caliber of young faculty that we're hiring, the investments being made by the school and university, the commitment and skill of our research support staff and research associate deans, and finally the creativity and strength of our research overall."

The NSF states that the CAREER program is the embodiment of the Foundation's commitment to encourage academic institutions to support the integration of research and education.

UConn's CAREER award success can be tied to internal efforts by its schools and colleges to guide faculty members through the difficult process of writing effective proposals. From 2012-14, the University won a total of five awards. Then in 2014, Engineering initiated monthly CAREER workshops for faculty, led by retired associate dean Michael Accorsi and writer Bethany Javidi.

The next year, Engineering won three CAREER awards. The Office of the Vice President for Research launched its CAREER workshops in 2015. The OVPR expanded its programs and coordinated with schools and colleges in 2016 while CLAS was establishing its own CAREER workshops, led by Allison Goldsnider, director of grants management services.

The guidance was helpful for faculty, who found themselves able to navigate the process and earn NSF funding that altered the course of their careers for the better.

Ido Davidesco: Perfecting the Science of Distraction

By Matt Engelhardt
Research Communications Coordinator

Learning sciences professor Ido Davidesco is an expert on a subject quite familiar to most students: distraction. It's his hypothesis that a little disruption to the learning process might be beneficial.

Davidesco is the first ever researcher from UConn's Neag School of Education to receive a National Science Foundation Early Career Development (CAREER) Program award. This prestigious grant supports the research of early-career faculty who demonstrate remarkable potential to become leaders in their field. Additionally, the award seeks to support projects that actively engage students and the community.

"I hope to advance our basic understanding of attention but also have an impact on how we teach students in classrooms," Davidesco says. "CAREER awards are designed to promote the integration of research and education, which is the main goal of this project."

Maintaining attention for long periods of time is extremely challenging because attention, by nature, is dynamic and often shifts between external and internal states. Students sitting in long lectures, whether in-person or online, can easily get distracted and lose focus. Before long, they have fallen behind the lecturer and are lost at what they are intended to learn.

However, intentional breaks in attention may be a different matter.

Ido Davidesco
Assistant Professor of Learning Sciences
Grant Amount: $1.326 million
The Role of Internal Attention in Undergraduate Biology Learning

Professor Ido Davidesco is the first ever faculty member from the Neag School of Education to earn an NSF CAREER award.

Davidesco's award of $1.3 million will fund a project that focuses on the role of internal attention as it applies to learning science. Davidesco says that it is currently unknown whether internal attention (e.g., pausing a lecture to allow students to quietly think about a problem) is beneficial or detrimental to learning.

"The hypothesis here is that internal attention can actually be beneficial to learning," Davidesco says. "But it depends on how 'thinking periods' are used. For that reason, we plan to experimentally manipulate the frequency and duration of these 'thinking periods' as well as the guidance given to students."

Davidesco's team will use electroencephalography (EEG) to identify neural correlates of attention fluctuations that occur during lectures. They will also develop course-based undergraduate research experiences allowing undergraduate students to investigate their own attention states and associated brain activity.

"There is a need to understand better how undergraduate students pay attention in virtual and face-to-face classrooms, where most instruction still heavily relies on lectures," Davidesco says. "We hope that this research will help instructors teach science more effectively."

Cara Battersby: Investigating the Turbulent Stars

By Anna Zarra Aldrich
Office of the Vice President for Research

Professor Cara Battersby plans to use her CAREER grant to research how turbulence factors into the formation of stars.

Stars are the building blocks of the universe – the origin of all life. But scientists only have a limited understanding of how they form.

Cara Battersby, assistant professor of physics, will investigate the role turbulence plays in how stars form in the center of our galaxy in a newly awarded CAREER grant. Currently, scientists understand how stars form in the area directly around our sun. But what happens elsewhere in the vast cosmos is largely unknown.

The environmental conditions, such as temperature and pressure, in different parts of the galaxy vary greatly meaning the process by which stars form also varies.

Previous studies found that the rate of star formation in the central 1,000 light years of the galaxy was 10 times less than expected. Battersby identified that turbulence - a measure of how much gases are shaken up - is likely the most important factor in determining why this rate is so low. When the gases are highly turbulent, it is harder for them to condense into stars.

Through this award, Battersby aims to identify the driving force behind turbulence in the center of the galaxy to gain a better understanding of how stars form there.

Cara Battersby
Assistant Professor of Physics
Grant Amount: $697,118

Shining Stars Amidst the Turbulence

"I think there's going to be so much more to look at," Battersby says. "The work we're doing here is just addressing some of the key fundamental questions."

Battersby will also develop an outreach program, STARS, to recruit and retain students from historically underrepresented groups in the physics major at UConn. The program will connect undergraduates from these groups with peers and mentors to develop community and provide support to encourage these students to study physics.

These students will also develop lessons about star formation for local schools serving underrepresented populations. They will work with the classroom teachers on this project and receive a stipend for their work.

A pilot of this program, supported by the CLAS Diversity, Equity, and Inclusion initiative, worked with the SAND school in downtown Hartford.

Battersby has taught at UConn since 2016 and has been published more than 70 times.

Sarah Knutie: A Little Help from the 'Parasite Squad'

By Matt Engelhardt
Research Communications Coordinator

When she began her research in 2017, ecology and evolutionary biology professor Sarah Knutie knew she would need some help collecting data on how parasites affect nesting bluebirds.

Sarah Knutie

Knutie wondered how species interactions with parasites varied across geographic ranges and how environmental factors like temperature played a role. She had data from nest boxes in northern Minnesota, from where she grew up, but she needed to understand more.

Thankfully, as she sees it, "everyone loves a bluebird." Knutie found a way to crowdsource her research through Twitter, finding a large community of people across the country with nest boxes in their own yards. The "Parasite Squad" took the samples and reported the data to Knutie and her team.

The next phase of Knutie's research will be considerably better funded. She is one of 11 UConn faculty members to receive a National Science Foundation Early Career Development Program Award during the 2021-22 academic year. Her award, totaling almost $1.4 million, is the largest of any of this year's recipients.

Her research will further investigate how experimental changes in nest temperatures can influence host-parasite relationships by affecting the effectiveness of host defenses and parasite survival. She will use coordinated, experimental approaches to determine how environmental factors affect interactions between nest parasites and bluebirds across the eastern United States.

Knutie will have a large team assisting her in the effort. Most of the award money will fund graduate students and fellow professors, who in turn will work with 20 undergraduate researchers.

The CAREER award not only recognizes Knutie's potential as a researcher, but also her impact as an educator. She especially enjoys working with undergraduates and finds that UConn students are "amazing and hungry for opportunities."

"The CAREER grant is the integration of research and education," Knutie says. "My teaching approach is to provide real hands-on experiences. Going through the process of science is very important for budding young scientists."

Knutie's students and peers greatly admire her and enjoy her classes. The UConn Chapter of the American Association of University Professors bestowed a Teaching-Excellence – Early Career award on Knutie in 2021. She also received the student-nominated 2022 Mentorship Excellence Award.

"A large part of Dr. Knutie's research focuses on scientific communication and making the questions we investigate digestible to the public," wrote student Mahima Mehta, who nominated Knutie. "She has shown me the importance of making science accessible to everyone."

Sarah Knutie
Assistant Professor of Ecology and Evolutionary Biology
Grant Amount: $1.4 million
Understanding the Mechanisms that Mediate the Effects of Local Ecology on Geographic Mosaics of Host-Parasite

Tomoyasu Mani: Designing Light-Emitting Molecules

By Anna Zarra Aldrich
Office of the Vice President for Research

When molecules exchange electrons, they sometimes produce light. Scientists do not fully understand why this happens and usually consider it wasted energy. Through a CAREER grant Tomoyasu Mani, assistant professor of chemistry, is working to harness this phenomenon.

Mani will design molecules that produce light over a long distance. In preliminary data, Mani found that an electron transfer can occur and emit light at 2.4 nanometers, a world record.

"I strongly believe the undergraduates and high school students should learn cutting-edge research, not decades-old textbook experiments."

When an electron transfers from one molecule to another, it forms a radical ion pair, meaning there is a molecule left with an unpaired ion. The unpaired electron interacts with the surrounding magnetic field. Mani will work to determine if he can use magnetic fields to manipulate the radical pairs' spin dynamics to selectively emit light.

This work could have applications in bioimaging or quantum sensing.

Quantum mechanics is the study of matter on the atomic and subatomic scale. Quantum sensing technology uses quantum mechanics to measure physical quantities. By working on the atomic and subatomic scale, quantum sensors can be much more accurate than traditional instruments.

The basic unit of quantum computing, the process of using quantum states to perform calculations, is known as a qubit. Like a piece of binary code, the qubit can have one of two states. Mani says that by harnessing the power of radical pairs, which already have an up and down spin, molecules could be designed for work in quantum sensing or computing.

Tomoyasu Mani plans to connect with his former high school in Matsuyama, Japan, through his CAREER grant.

In this project, Mani will also develop a series of photochemistry lesson plans for college students in advanced and general chemistry laboratory classes. Mani will also work with local high schools in the Early College Experience program and his alma mater, Matsuyama Minami High School in Ehime, Japan.

"I strongly believe the undergraduates and high school students should learn cutting-edge research, not decades-old textbook experiments," Mani says.

Tomoyasu Mani
Assistant Professor of Chemistry
Grant Amount: $700,000
Control of Intramolecular Long-Range Charge-Transfer Emission

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Benjamin Fuller: A Calling in Cryptography

By Loretta Waldman
Special to the OVPR

Benjamin Fuller was a math major with a weightlifting hobby when he took some undergraduate computer science courses at Rensselaer Polytechnic Institute that changed the course of his life.

Computer science, his minor, seemed to offer more opportunities than math. He found his calling in cryptography, what was then an emerging discipline at the intersection of math and computer science.

Benjamin Fuller

Now an assistant professor of computer science and engineering at UConn, Fuller's research focuses on the development of architectures and technologies that ensure security and resilience in mission-critical systems; what he calls "provably secure cryptographic protocols that address real-world problems."

As a 2022 recipient of an NSF Early Career Development (CAREER) Program Award, he now has the support he needs to vigorously pursue solutions to those problems.

"The biggest thing it provides is long-term predictability which is important to address big research questions," Fuller said. "With a five-year award you can really support PhD students, really address hard questions."

Since arriving at UConn in 2016, Fuller has built cybersecurity into the second-biggest concentration in UConn's Computer Science & Engineering department. Six years ago, the program had no courses. Now, it has a core curriculum of about 10 courses taken by the program's 200 active undergraduate students, and available as electives to about 900 CSE students in other majors.

Benjamin Fuller
Assistant Professor of Computer Science & Engineering
Grant Amount: $506,000
Cryptographic Authentication from Biometrics

The opening of Altschuler Cybersecurity Lab in 2019 through a $1 million gift from Electrical Engineering alumni, brothers Samuel '50 and Stephen Altschuler '54, marked another milestone and added UConn's first cyber security lab dedicated to hands-on learning. Fuller hopes to eventually make cybersecurity a major within CSE.

Now married with a one-and-a-half-year-old daughter, he has little time for weightlifting these days. Instead, he occupies himself with weighty questions ranging from how to improve privacy protections in the collection of census data and No-Fly List security risk assessments, to making Connecticut's electronic voting system more safe, secure, and cost-effective.

Fuller is a member of the Connecticut Advanced Computing Center (CACC), which leverages the synergies of the Center for Hardware and Embedded System Security and Trust (CHEST), Comcast Center for Security Innovation (CSI), and UConn's Center for Voting Technology Research (VoTeR) Center to investigate, develop, promote and nurture the best hardware and software-based security practices for defense and commercial applications.

"The biggest thing it provides is long-term predictability which is important to address big research questions. With a five-year award you can really support PhD students, really address hard questions."

Walter Krawec: A Quantum Realm of New Developments

By Christie Wang
Office of the Vice President for Research

The new quantum realm in cryptography is still in its infancy, but assistant professor of computer science and engineering Walter Krawec is optimistic about its real-world application in the upcoming decades.

Krawec is working to develop hybrid classical-quantum approaches to create new methods for secure communication between parties.

"The idea is that you can get a secure channel between you and me or any party without having to rely on making computational assumptions for security," said Krawec. "The only assumption you have to make is that the laws of physics apply."

Modern cryptosystems currently use public-key cryptography to establish secure connections. Information is encoded in classical bits of either zero or one. With quantum cryptography, there are more ways to 'hide' information on a single quantum bit, or qubit, since qubits can be a superposition of both one and zero.

Walter Krawec
Assistant Professor of Computer Science & Engineering
Grant Amount: $506,000
Cryptographic Authentication from Biometrics

"The idea is that you can get a secure channel between you and me or any party without having to rely on making computational assumptions for security. The only assumption you have to make is that the laws of physics apply."

Professor Walter Krawec has taught computer science at UConn since 2017.

However, there is an inherent uncertainty in quantum mechanics. Krawec's research delves into this classical-quantum uncertainty relation by promoting current classical methods to quantum methods in new combinations.

"There's more than one way to do things," said Krawec. "There are ways you can do things classically, but there's also this new quantum realm with a lot of really interesting recent developments. And I think people are going to see more and more of it."

Krawec's research will be well-funded. He is one of 11 UConn faculty members to receive a 2022 Early Career Development (CAREER) Program Award from the National Science Foundation. The award comes with five years of funding for research. He is one of seven professors from the School of Engineering to receive the award this year.

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Georgios Matheou: The Art of Clouds

By Matt Engelhardt
Research Communications Coordinator

Mechanical engineering professor Georgios Matheou has spent his career with his head in the clouds. As a result, science has a greater understanding of climate.

Georgios Matheou

His research into clouds has brought him from the famous Jet Propulsion Laboratory at Caltech to UConn as a professor in the School of Engineering.

This year, Matheou's research drew the interest of the National Science Foundation, which selected him as a recipient of an Early Career Development Program award. He is one seven professors from Engineering to earn the award during the 2021-22 academic year.

Matheou has been researching the role of clouds in the Earth's climate systems, especially as temperature continues to rise across the globe. The NSF will fund Matheou with more than $425,000 over the next five years for his work in understanding the cloud-climate feedback.

He will utilize a large eddy simulation (LES), a powerful tool that simulates the spatial development of cloud transitions. Matheou will run simulations of clouds in the atmosphere, varying types and other factors. The goal is to better understand the cloud-climate feedback – in which warming begets more warming as the result of clouds transitioning from stratocumulus to cumulus clouds.

Among other experiments, Matheou will vary carbon dioxide concentration to study changes in the cloud transition as climate warms.

Georgios Matheou
Assistant Professor of
Mechanical Engineering
Grant Amount: $425,395

Understanding Low-Cloud Feedbacks Using Large-Eddy Simulation of Spatially Developing Cloud Transitions

Beyond the implications the research has on climate and global warming, Matheou's work has artistic value. The LES creates realistic and beautiful models of clouds, which will be captured as images and animations through a partnership with the VisLab at the National Center for Atmospheric Research. UConn's William Benton Museum of Art will host an exhibition of the images, which will also be viewable in an online gallery.

While eager to continue his research, Matheou is excited about the arts collaboration as well as the teaching component of the CAREER award. When he was at JPL, he missed interacting with students and working with them to understand the fundamental role that clouds play in climate.

UConn offered an opportunity where he could continue his research and teach. He came to Storrs in 2017, finding a welcoming environment in the School of Engineering and students eager to learn.

"We have great empirical knowledge based on our experiences, especially in engineering, and we can further expand our knowledge through formal learning to solve problems in science and engineering," Matheou says.

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Kristin Morgan: A Passion for Biomechanics

By Loretta Waldman
Special to the OVPR

Kristin Morgan says it was her involvement in sports that ignited her interest in studying how athletes move. Growing up, she spent weekends watching her dad run races, her brother play basketball, and played soccer herself. Then while earning her master's degree at Virginia Commonwealth University, she realized she could combine her passion for sports and engineering. There she used triaxial accelerometers to measure fatigue in athletes and became hooked.

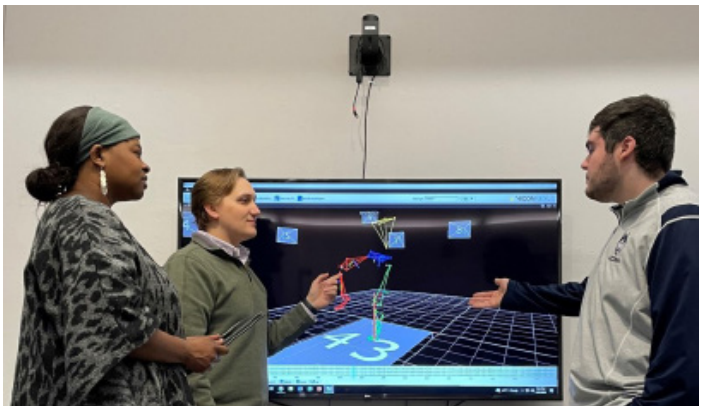
What the assistant professor of biomedical engineering did not grasp back then is the value and therapeutic potential of gait analysis beyond sports. In the years since, she has come to see gait as a powerful diagnostic tool and has developed uses for it that have surprised even her.

At UConn, she and her team are engaged in three studies focused on the development of new metrics for quantifying optimal gait dynamics, implementation of a novel rehab protocol, and comparing gait differences associated with physical impairments and cognitive impairments, such as Parkinson's and Huntington's disease, and stroke.

For yet another project funded by the U.S. Navy's Office of Naval Research, Morgan and her team have developed a wearable device to detect normal and abnormal walking patterns, including those associated with fatigue. The goal of the project is to develop an algorithm that can predict from someone's walking patterns if they are at risk of getting injured and what the injury might be.

"Gait is the universal tool," says Morgan. "It is much bigger than sports. That's why we are so passionate about it. You can catch disorders early and possibly stop their progression."

Morgan's pioneering work to improve gait rehabilitation in individuals with neuromuscular dysfunction was recently recognized with a 2022 Early Career Development (CAREER) Program Award from the National Science Foundation. The award comes with five years of funding for research and provides a foundation on which she can build her program.



Kristin Morgan works with students at UConn's first gait lab, which will be supported through the CAREER grant.

When she arrived at UConn in 2016, Morgan said she and her team scavenged equipment and resources and, through trial and error, collaborated to help set up UConn's first gait lab. UConn has since made a substantial investment in the facility. The additional CAREER Award will support its continued viability and Morgan could not be more thrilled.

"Six years in, we are being recognized for our work; recognized for our ideas," she said. "We have a whole group of doctoral and undergraduate students. It's really exciting. I am pinching myself, really."

Kristin Morgan
Assistant Professor of
Biomedical Engineering
Grant Amount: $513,501
Scientific Investigation of Motor Learning to Improve Gait Rehabilitation in Individuals with Neuromuscular Dysfunction

Anna Tarakanova: Elastins and Aging

By Loretta Waldman
Special to the OVPR

Elastin is an essential structural protein that gives the skin, heart, blood vessels, and other elastic tissues in the body the stretchy quality they need to function. During aging and with chronic, often age-related illnesses such as diabetes, cardiovascular disease, and osteoarthritis, elastin can degenerate, causing a decline in normal function.

Many questions surround the complex physiochemical changes to elastin that occur with aging and age-related diseases – questions that are at the heart of research being undertaken by UConn Assistant Professor of Mechanical Engineering Anna Tarakanova and recently recognized with a 2022 Early Career Development (CAREER) Award from the National Science Foundation.

"At the molecular scale, there is a large number of physical and chemical modifications that occur that drive this mechanical degeneration over time," Tarakanova says. "Because they are numerous and act in parallel, it's difficult to deconstruct which triggers impact mechanics and to what degree. If we can understand the mechanism, we can begin to think about novel therapies to target aging and aging-associated diseases."

Tarakanova is an assitant professor within the the department of Biomedical Engineering, a shared department in the schools of Dental Medicine, Medicine, and Engineering.

Anna Tarakanova
Assistant Professor of
Mechanical Engineering
Grant Amount: $600,074

Unraveling Mechanisms of Mechanical Degeneration in Elastin with a Validated Digital Twin

Anna Tarakanova was a co-organizer of the 2020 Women in STEM Frontiers in Research Expo.

Tarakanova and her team are working to establish a high-fidelity modeling framework for both healthy and degenerated elastins as a kind of tool to resolve the different pathological stressors that impact biological function and mechanics of elastic tissues from the nanoscale. Another component of the work is to identify coupling effects of concurrent mechanisms and how they contribute to the loss of elastin's function, particularly the loss of mechanical function.

Tarakanova joined the faculty at UConn in August of 2018 and holds a bachelor's degree in Applied and Engineering Physics from Cornell University and a master's degree and Ph.D. in computational mechanics from the Massachusetts Institute of Technology. Beyond her research, she plans to use her CAREER Award funding to create activities and events to engage and support undergraduate and graduate students, especially those from underrepresented groups.

The effort is an outgrowth of her teaching, she says, and will include a reboot of a Women In STEM Frontiers in Research Expo she co-organized with Qian Yang, assistant professor of Computer Science and Engineering, in January of 2020. The one-day conference introduced undergraduate and graduate students to women professors at UConn and allowed professors to engage, network, and build relationships with students and connect them to research opportunities.

Sophie Wang: Manipulating Molecular Parameters

By Anna Zarra Aldrich
Office of the Vice President for Research

With her recently awarded CAREER grant, Xueju "Sophie" Wang, assistant professor of materials science and engineering, will work on manipulating smart materials at the molecular level to design materials and structures that can morph under certain conditions using liquid crystal elastomers as an example. This can enhance what the materials are able to do and what they can be used for.

"There is a missing link between interactions at the molecular level and the material and structural level," Wang says.

Wang will manipulate molecular parameters such as the crosslinking density, the ratio of different chemical compounds, and molecular alignment for liquid crystal elastomers.

Liquid crystal elastomers are polymer networks containing liquid crystal molecules that can change their shape and therefore functionalities by responding to stimuli like heat. They have applications for biomedical devices, such as artificial muscles, and soft robotics, which are made of compliant rather than rigid materials.

Changing the parameters at the molecule level in liquid crystal elastomers can make the material harder or softer and morph into desired shapes under different circumstances like temperature changes or changes in the load they need to bear.

"Although people have been working in the field for the past few years, there are a lot of problems we need to address before bringing this smart material from the workbench to another level with applications," Wang says.

Xueju "Sophie" Wang
Assistant Professor of
Material Science and Engineering
Grant Amount: $546,813

Mechanics of Active Polymers and Morphing Structures: Determining the Role of Molecular interactions and Stiffness Heterogeneity on Reversible Shape Morphing

Wang will also develop an overarching educational program "Morphing Beyond Imagination" to introduce this ever-growing field to the public and students.

One facet of this effort will involve teaching elementary school students about how the materials scientists like Wang design imitate natural wonders like morphing and color-changing octopuses or flowers.

Wang will also host high school teachers in her lab and work with them to develop curriculum for their students.

A third part of the educational initiative will involve the creation of undergraduate and graduate laboratory courses to spark interest in the field of materials sciences.

"Although people have been working in the field for the past few years, there are a lot of problems we need to address before bringing this smart material from the workbench to another level with applications."

Hongyi Xu: Bridging the Gap Between Materials

By Loretta Waldman
Special to the OVPR

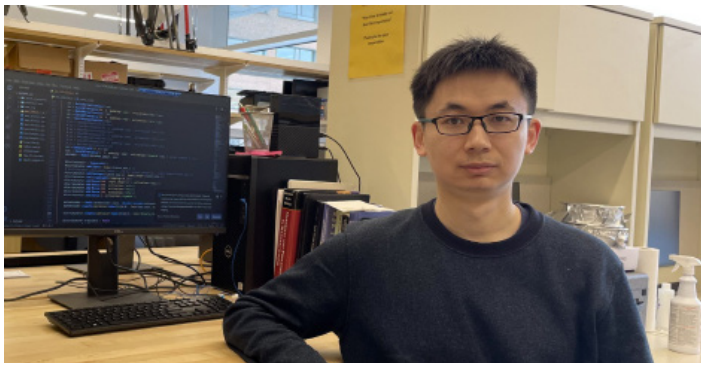
To sum up his research in mechanical design, Hongyi Xu begins by explaining what it isn't.

It's not about designing a machine or product, says Xu, an assistant professor of mechanical engineering at UConn. It isn't exactly a design, either. It's a methodology that helps engineers tailor the microstructural properties of a material to optimize physical characteristics associated with performance such as stiffness, durability, or impact absorption.

Generally, mechanical engineers focus on one of two aspects of materials formation - stochastic (naturally occurring) or deterministic (manmade). Xu's research focuses on bridging the gap between the two, a novel approach that has earned him a 2022 Early Career Development (CAREER) Program Award from the National Science Foundation.

Xu began his research in the design of microstructural materials while earning his Ph.D. at Northwestern University. After graduating, he worked for five years at Ford Motor Company research center, where he led and participated in research projects spanning vehicle light-weighting, and the impact safety of Lithium-ion batteries, to the mechanical properties of carbon fiber in relation to crashworthiness. While Xu's work at Ford focused on stochastic structures, the experience gave him the opportunity to explore 3-D printing and create deterministic structures.

Hongyi Xu
Assistant Professor of Mechanical Engineering
Grant Amount: $536,740
Bridging the Gap Between Deterministic and Stochastic Structures for Mixed Stochasticity



Hongyi Xu believes his research can benefit small businesses and manufacturers.

Since arriving at UConn in 2019, Xu has begun working on a program that will allow engineers to link the two by creating a digital model of a pattern on the spectrum between stochastic and deterministic structures.

Mathematical formulas currently used by engineers create either stochastic or deterministic structures, but there is little overlap.

Connecting the two opens the door to virtually endless structural options. With a prosthetic, for example, the stiffness might be periodic and the impact energy absorption stochastic, but when the different patterns are brought together, you get the best of both. The combination of structures could also lead to more effective designs for battery storage and capacity or generate materials that make the frame of a car safer for drivers and passengers.

Xu says his CAREER award will help give him the visibility he needs to attract more students, collaborators, and funding "to do something even bigger." He also plans to conduct outreach through the Connecticut Small Business Development Center at UConn to narrow the resources gap that puts small businesses and manufacturers at a competitive disadvantage with larger companies.

Xu is also developing new courses at UConn and for a Science, Technology, Engineering, Arts and Math (STEAM) project for K-12 students in underrepresented minority schools.

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