STEVENS INSTITUTE *of* TECHNOLOGY

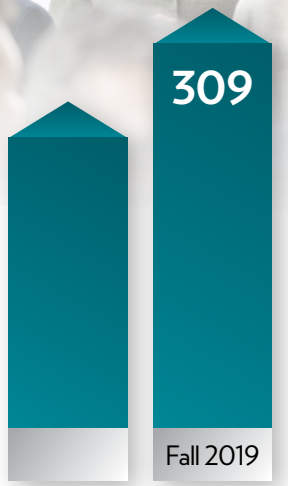
A University on the Rise

FACULTY GROWTH, RISING RESEARCH PROFILE • WINTER 2020

Talented New Faculty for Complex New Challenges

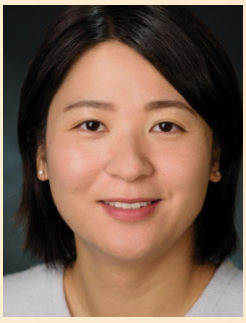
In response to enrollment growth and to advance its ambitious research agenda, Stevens Institute of Technology has increased its faculty size by 34% since 2011 — bringing the current full-time faculty cohort to 309. In the last two years alone, 54 dedicated teachers, researchers and scholars have joined our faculty in diverse fields ranging from artificial intelligence and machine learning to cybersecurity, financial technologies, sustainability, quantum science and engineering, and technology-infused arts and social sciences disciplines. Fueling our research engine, these faculty have also been recognized with prestigious awards and honors including National Science Foundation CAREER Awards, selection as Fellows of prestigious professional societies, research funding from organizations such as the Carnegie Corporation of New York, and partnerships with a wide range of companies such as Accenture, Bell Labs, Google, IBM and UBS. Some representative examples of Stevens' accomplished faculty appear in the following pages.

54
New faculty hired in two years



Full-time faculty

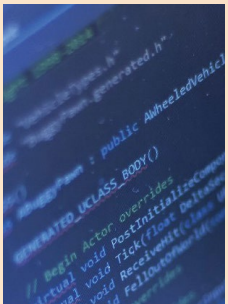
SCHOOL OF SYSTEMS & ENTERPRISES



LU XIAO

Software Architecture

Dr. Xiao's research centers around software engineering, with a particular focus on software architecture modeling and analysis. Her work models, analyzes and monitors software architecture in order to ensure both high quality and low costs in the software development life cycle. Recently, Xiao has been contributing to the construction of a community-wide architecture research infrastructure. In another ongoing project, she aims to build a novel architecture-modeling framework that bridges the gap between software architecture and testing.



PHILIP ODONKOR

Smart Cities, Sustainable Energy

Dr. Odonkor's research is focused on enabling smart cities by deriving actionable insights from and with data in order to address theoretical and practical challenges in the areas of energy efficiency, smart mobility and citizen health. His data-centric research approach employs myriad computational tools, from design optimization to machine learning, to uncover hidden trends within a variety of data streams and leverage them to guide the decision-making process for cities. Prior to joining Stevens, Odonkor served as a doctoral research intern at Hitachi Big Data Labs, where he applied his understanding of deep reinforcement learning techniques toward optimizing industrial applications.

SAMANTHA KLEINBERG

Artificial Intelligence, Diabetes Care, Nutritional Monitoring

Dr. Kleinberg develops artificial intelligence to provide personalized information patients can use to take more active roles in managing their own health. By combining computational work with the human elements of decision-making, she works to give patients better tools with which to collaborate with clinicians in the planning of treatments, diet and exercise. She has also developed wearable systems for nutritional monitoring and data collection.

For one project, supported by the National Institutes of Health, Kleinberg will collaborate with New York University in investigations focused on pregnant mothers at risk of gestational diabetes. Using patient-generated health data collected by such means as wearable activity monitors and meal-logging imagery, the team aims to identify risk factors and early-intervention targets.

Kleinberg is also developing computational tools to better personalize care for diabetes patients. Supported by the National Science Foundation, the work will include the creation of training modules to educate clinicians about ways in which patient beliefs influence decisions. Separately, the NSF renewed support of Kleinberg's ongoing investigations of causal inference, which support the development of more useful artificial intelligence for healthcare applications.

GIUSEPPE ATENIESE

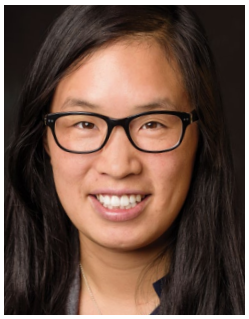
Artificial Intelligence, Blockchain, Cybersecurity, Privacy

Dr. Ateniese is a leading national expert on cryptography and financial technologies who taps the power of artificial intelligence (AI) in his research to deeply explore privacy and cybersecurity issues relevant to us all.

For one project, his team built an AI-powered system that cracks passwords with greater frequency than the best known hacking tools. The technology, known as PassGAN, works by scouring large volumes of existing human passwords and learning common rules and patterns, including some previously unknown. The PassGAN system can approach a set of passwords, cracking more than half on the first attempt. The system can also be reverse-engineered to help test and harden passwords.

In another project, Ateniese demonstrated how AI could be utilized by rogue actors to create powerful breaches of our private personal or financial data. Using an AI system known as a generative adversarial network, his team was able to guess private images from locked phones even without accessing them. The work was featured in *The Wall Street Journal*.

Working with Accenture, Ateniese also prototyped a remarkable innovation of blockchain technology: the first known method of editing the blockchain while preserving the technology's fundamental cryptographic features and retaining a permanent record of alterations to the ledger.

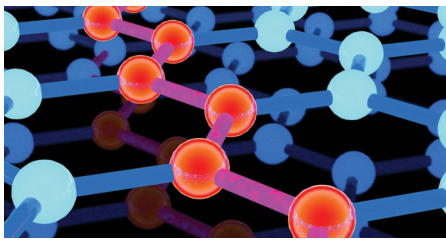


STEPHANIE LEE

Crystal Engineering, Renewable Energy Technologies

Dr. Lee develops novel materials and sustainable energy technologies by leveraging crystal engineering and other methods.

Working with an emerging class of soluble materials that can convert light into electricity, her team is creating thin, flexible, printable solar panels that can be rolled up, transported and installed remotely. Her group focuses on engineering the processing of materials at ambient temperatures and pressures from inks, using continuous deposition methods such as roll-to-roll coating — a significant upgrade over existing silicon-based solar panel materials, which are heavy, brittle and must be manufactured at high temperatures.



To fashion the panels, Lee's group has developed a strategy to use nanoconfining scaffolds that guide crystallization of the materials into nanowire arrays optimized for light absorption and current flow. This process is faster, more efficient and less expensive than current silicon panel manufacturing technology and could result in lower-cost solar technologies requiring less space and energy for manufacture worldwide.

The research is supported by the National Science Foundation, including a prestigious NSF CAREER Award.

MUHAMMAD HAJJ

Energy Harvesting, Fluid Dynamics

Dr. Hajj is director of the Davidson Laboratory, one of the nation's leading research facilities in computational and experimental marine and coastal hydrodynamics, as well as chair of the Department of Civil, Environmental and Ocean Engineering. He is an accomplished scholar in nonlinear dynamics, fluid mechanics, structural dynamics and fluid-structure interactions, working toward such applications as energy harvesting from fluid flows and structural vibrations; bio-inspired locomotion; and storm surge prediction. He has received support from the National Science Foundation, Office of Naval Research, Air Force Office of Scientific Research, U.S. State Department, NASA and industry.

NEGAR TAVASSOLIAN

Artificial Intelligence, Health Monitoring, Medical Imaging

Dr. Tavassolian uses artificial intelligence and engineering to develop innovative lightweight non-invasive devices to perform early, efficient diagnosis of medical conditions including skin cancer and heart disease.

In one effort, she is developing a device that could allow expectant mothers to monitor fetal heartbeats in real time. Using onboard gyroscopes, the device records vibrations in a mother's abdomen as an infant's heart beats. Data from an array of three distinct sensors are harvested and processed by specially designed algorithms to isolate the infant's heartbeat signal.

Tavassolian applies millimeter-wave radiation technology — similar to the technology used in cellphones and airport security scanners — to the challenge of skin cancer detection. In her lab, a team deploys and tests custom-built arrays of antennae to generate high-resolution images of biopsied tissue, identifying small tumors as accurately as lab-based testing. The technique leverages the reflectivity of cancerous cells and tumors, which is much higher than that of healthy skin cells. Tavassolian received an NSF CAREER Award to support the research; she will continue working to develop a handheld device for use directly on the skin, giving instant diagnostic readings.

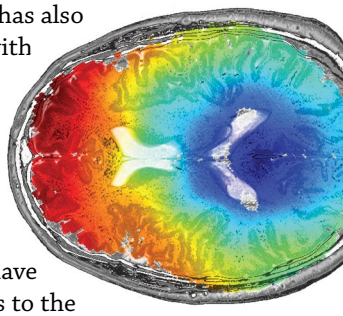
In addition, Tavassolian is testing heart monitoring systems integrating such technologies as AI, radar and wearable sensing to both portably monitor individual heartbeats and to non-invasively detect and monitor multiple patients' heartbeats simultaneously in the medical environment.

MEHMET KURT

Brain Biomechanics, Concussions

Dr. Kurt studies the biomechanics of the brain and skull, including the manner in which they move both while at rest and upon impact. Kurt's work informs helmet design and the development of technologies to diagnose concussions in real time and has been featured in *Wired*, among other media outlets.

Kurt has created award-winning visualizations of the brain showing how the brain moves slightly each time the heart beats. He has also synced brain tissue motions with those of veins and arteries, a new imaging method that could reveal weak spots in blood vessels that could one day develop into dangerous aneurysms.



Kurt and his collaborators have also revealed how side impacts to the head lead to rotational accelerations and mechanical vibrations concentrated in two regions of the brain, the corpus callosum and the periventricular region. By analyzing a combination of simulated and human data of brain movements that have led to concussions, this work demonstrated how the skull's geometry and the brain's gelatinous composition cause these regions to resonate at certain frequencies and receive disproportionate amounts of mechanical energy during impacts.

SCHOOL OF BUSINESS

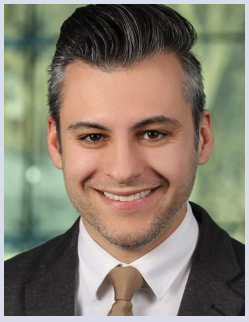
TED LAPPAS

Big Data, Business Analytics

Dr. Lappas leverages data mining techniques to investigate large-scale reputation systems and social media. He also develops scalable data mining and machine learning algorithms for business analytics.

For one project, his team analyzed more than 2.3 million online reviews of U.S. lodging properties in an investigation of rankings fraud. As few as several dozen falsely positive reviews can drive a property to top rankings, he found; planting positive content while also seeding competitors' content with falsely negative content is even more effective. More recently, Lappas studied the influence of user location on review content.

In collaboration with leading financial institutions, he also develops tailored technology solutions. Lappas is building a system for JPMorgan Chase that utilizes deep learning to analyze resumes and predict potential career paths, for instance. He also mines earnings call communications for UBS to predict performance and optimize client communications.



JORDAN SUCHOW

Cognitive Science, Computational Models

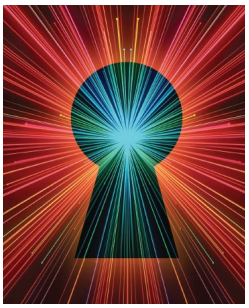
Dr. Suchow is a cognitive scientist who creates computational models of how we learn, remember and make decisions. As part of DARPA's Next Generation Social Science program, he builds tools and technologies such as a crowdsourcing platform that can run behavioral and social experiments at scale to understand emergent social phenomena such as culture, group formation and collective identity.

YUPING HUANG

Optics, Photonics, Quantum Communications

Dr. Huang develops scalable, room temperature quantum optic technologies and systems for personal and institutional communication and security.

In 2018, Huang's team constructed and demonstrated the nation's first hybrid quantum communications network on a university campus, integrating specialized laser hardware and leveraging quantum properties to connect and provide security across three distinct physical nodes. In addition, he has demonstrated the use of quantum applications to ensure unbreakable network security during such operations as the unlocking of devices using facial recognition software.

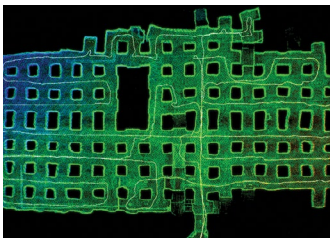


Huang is also working to develop an integrated microchip capable of creating entangled photons that can securely transmit and carry large quantities of information across long distances under challenging weather and visibility conditions.

BRENDAN ENGLOT

Artificial Intelligence, Autonomous Vehicles, Robotics

Dr. Englot develops artificial intelligence, algorithms, optimization methods and control systems to assist robots in navigating complex environments that require interaction with surrounding objects and structures. His work is directly applicable to autonomous transportation, security and environmental monitoring.



Englot co-created a system to improve autonomous vehicles' ability to navigate in GPS-denied environments. Streamlined algorithms tailor their assumptions to ground vehicles, reducing computational time and power use while still performing with high accuracy.

In collaboration with MIT, Englot's team also developed the first terrain mapping application of the Bayesian generalized kernel inference algorithmic technique. By feeding LIDAR measurements into a learning model, the algorithm processes real-time data to predict surrounding terrain.

THERESA MACPHAIL

Epidemics, Public Health, Social Science

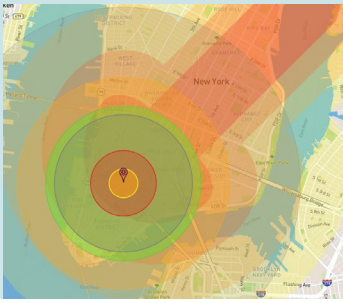
Dr. MacPhail's research centers on public health, the production of scientific knowledge, networks of expertise, information sharing and the experiences of epidemiologists, microbiologists, biomedical scientists and medical practitioners. Her current project explores the rise of allergies in the United States and China, examining ways individual and cultural understandings of allergies shape research paradigms and treatment options as well as the development and deployment of mobile applications, wearable sensors and other new technologies for allergy patients.

ALEX WELLERSTEIN

Civil Defense, Data Science, Nuclear History

Dr. Wellerstein is one of the nation's leading historians specializing in the history of nuclear weapons. His NUKEMAP visualization tool has received worldwide attention for its realistic, data-driven simulations of nuclear weapons detonations and has been experienced by more than 25 million users to date.

Wellerstein is co-primary investigator (with Stevens colleague Kristyn Karl) of the Reinventing Civil Defense Project, awarded significant support by the Carnegie Corporation of New York and the John D. and Catherine T. MacArthur Foundation. The project works to assess, sponsor, fund and co-create new forms of public communication about current nuclear threats and preparations that effectively inform society in a digital age.



Wellerstein has written frequently for *The Washington Post* and *The New Yorker* and has appeared on CNN and other top-tier national media outlets.

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