PRINCETON UNIVERSITY

Mechanical & Aerospace Engineering
Engineering Quad - D Wing
Princeton University 08544

Visit **mae.princeton.edu/about-mae/events** for event updates and location information. Events are free and open to the public.

Newsletter Editor: Carolyn Sayre

events: fall 2018

October 26 – 12:30pm
NICOLE SHARP, FYFD

November 9 – 12:30pm
AMY LAVIERS
University of Illinois at Urbana-Champaign

November 16 – 12:30pm
JOHN BROPHY, JPL, NASA

November 30 – 12:30pm
Crocco Colloquium – "Biofuels for Transportation"
PROF. KATHARINA KOHSE-HÖINGHAUS
University of Bielefeld

December 7 – 12:30pm
PATRICIA SCHUSTER, University of Michigan,

events: spring 2019

February 15 – 12:30pm
V. REGGIE EDGERTON, UCLA

February 22 – 12:30pm
ANYA JONES, University of Maryland

March 29 – 12:30pm
Baetjer Colloquium
MOLLY STEVENS, Imperial College London

April 5 – 12:30pm
VICKY NGUYEN, Johns Hopkins University

April 12 – 12:30pm
LYDIA BOUROUIBA, MIT

April 19 – 12:30pm
CHIARA DARIAO, Caltech

May 3 – 12:30pm
LANCE COLLINS, Cornell University

Bridge Program

The MAE Bridge Program is a two-year opportunity for students to gain research exposure and enhance course work to strengthen preparation for pursuing a graduate degree in Mechanical or Aerospace Engineering at a U.S. graduate school. Applicants from groups in the United States who have traditionally been underrepresented in engineering, including women, are strongly encouraged. The course of study is tailored to the needs and background of each participant. Typically, the emerging scholar will take two courses per semester and carry out research with an MAE faculty advisor. Participants will receive an official transcript at the end of the program. This post-baccalaureate program includes mentoring and support for professional development and career path advice on graduate school applications. https://mae.princeton.edu/research-areas-labs/bridge-program

MAEnews

MECHANICAL AND AEROSPACE ENGINEERING

School of Engineering and Applied Science
PRINCETON

Fall 2018

Dear Friends of MAE

A new academic year is upon us and the department, SEAS and University have woken up from the mini-slumber that marks the end of summer. We welcome 19 new graduate students and are looking forward to new classes, new projects and to working with students. With this newsletter we share with you a glimpse at some of the activities of our talented undergraduate and graduate students. Also, we highlight a special award received by Professor Emeritus Irvin Glassman, which culminated in a joint party celebrating his 95th birthday where many friends and colleagues from around the U.S. and the world joined him in Princeton. We welcomed Patricia Falcone '74 (chair of the MAE Advisory Council) to campus during which time she met with students and gave a talk on engineering and national security. The semester promises to be busy, educational and fun!
Do visit us if you are in the area.

With best regards, Howard Stone

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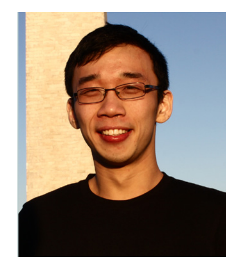
student spotlight



Fred Zheng
From Rube Goldberg Machines to Robotics

Fred Zheng is not the kind of student to stoke envy among his peers. As a high school Science Olympian, he sourced household materials to help his team build an elastic glider. Not only did it soar, it beat out competitors working with expensive polymers and project kits.

Now, as a junior in MAE, he is working with classmates to build a search-and-rescue robot for design class. When Fred is not heads-down working on problem sets, he is learning new routines and rehearsing with his campus break dancing group.

"One of the coolest things about MAE is our projects are all tangible things with real-world applications that we get to make with our own hands," he explained. "When I tell people in other majors what we are working on, they can't believe it."

...continued p. 2

grad program info

JOIN OUR PhD PROGRAM

All PhD students are **fully supported** with tuition and a living expense stipend during the entire program. A First Year Fellowship covers tuition and stipend in year one. The remaining years of the program are fully funded through a combination of teaching and research support provided by the student's adviser.

As a candidate for the doctoral program, the student, in consultation with a faculty adviser, develops an integrated program of study in preparation for a comprehensive general exam, which is normally taken in January of the second year. Subsequent to passing the exam, the student prepares a dissertation showing technical mastery of their chosen field and contribution to the advancement of knowledge, followed by a public presentation of the material.

Princeton's Department of Mechanical and Aerospace Engineering has played a leading role in propulsion, combustion, aerospace dynamics, and fluid dynamics over the past half century. In recent decades the Department has extended its reach as a leading presence in dynamics and control, applied physics, and materials science. By exploiting its multi-disciplinary character and stressing science and engineering fundamentals, the Department seeks to educate the very best students – undergraduate and graduate - for future positions of leadership in areas of rapidly evolving technology.

GET MORE INFO
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Jill Ray, Graduate Administrator, jfray@princeton.edu

mae.princeton.edu

faculty spotlight

Daniel Cohen
Can We Herd Cells like Sheepdogs Herd Sheep?

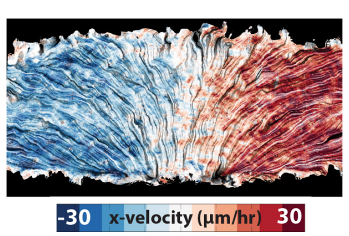
It is Friday night and Professor Daniel Cohen is giving a talk. But instead of a lecture hall, the venue is a nightclub. "I care about the history of how we came to know and do the things that we do today—and I enjoy sharing those tales with the public," says Professor Cohen, PhD, Assistant Professor in MAE. Take, for example, biomaterials and tissue engineering, which evolved from 4,500-year-old Egyptian fiber scaffolds and medieval fracture fixators to modern organs-in-a-dish.

Merging insights from these histories with modern engineering, Professor Cohen's work focuses on developing new engineering tools to control tissues. Specifically, his lab is trying to develop approaches that take advantage of the collective or 'swarm' nature of tissues.

A scene from the history of biomaterials and rhinoplasty

"These behaviors can't be explained by understanding one cell, but rather by understanding the collective," he explains. If scientists can manipulate them, it would allow them to build new tissues, heal wounds, or better understand cancer.

Professor Cohen's lab uses an approach he calls "swarm engineering" to control these cellular collective behaviors. "The movie Babe is a great allegory for modern swarm engineering," he says. "You have a traditional herding model that is disrupted by a non-traditional agent, the pig."



The flow pattern within a tissue induced by one of our bioelectric cell herding tools

In the case of Professor Cohen's research, pigs and sheepdogs are replaced by bioelectric tools that can literally herd groups of living cells, or artificial objects that can infiltrate into tissue because cells mistake them for real cells. The bioelectric controls they are building give the cells a sort of compass signal and direct their motion—move left, go right, make a U-turn, and swirl around.

Now take that idea one step further. What if we could control those cells from the inside out by sneaking a secret agent into the population?

"You basically have a 'wolf in sheep's clothing' sitting in the population that tricks the tissues into responding a certain way," says Professor Cohen. "This has exciting possibilities for controlling tissue growth and improving biomedical implant integration." All we have to do, he says, is find our very own Babe. ◘

The world's smallest living dinosaur (1.5 cm)

student spotlight *continued*

Fred grew up with a passion for making things. He recalls building Rube Goldberg devices—machines designed to execute simple tasks with intentionally excessive complexity—all for the joy of building something with his hands. His home became a staging ground for elaborate contraptions where a line of dominoes would trigger a marble to roll down a track to set off another twenty steps before completing a simple goal of flipping a light switch.

"What really drove me to pursue mechanical engineering is how great it feels when you see the finished product," says Fred.

Like many scientists and engineers, Fred's early curiosity came from within. However, legions of supportive teachers encouraged him to pursue his curiosity. "I have been lucky to have amazing teachers that have steered me toward STEM fields and encouraged my interest every step of the way," he says.

Fred looks forward to immersing himself in robotics and closely related computer science topics during his senior year as he works toward a certificate programs in Robotics and Intelligent Systems and Applications of Computing.

"One of the reasons I selected MAE is because it is an interdisciplinary major," he explained. "Not only do I get to work with my hands and actually build things, but I also get to learn more about the software and technology powering mechanical engineering innovations."

Ideally, Fred says he would love to work at a company that makes virtual reality or augmented reality goggles so he can apply what he has learned from both mechanical engineering and computer science.

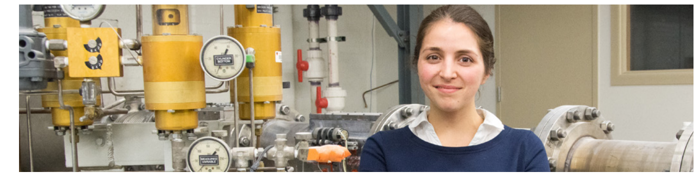
In fact, Fred has already begun to test the job market waters with an internship at a local startup focused on artificial and machine learning for financial markets.

"I'm still learning the ropes and the future is kind of up in the air, but I'm excited to see where it takes me," he explained. ◘

a word from the lab

APPLIED PHYSICS ◘ DYNAMICS & CONTROLS ◘ FLUID MECHANICS ◘ MATERIALS SCIENCE ◘ PROPULSION & ENERGY SCIENCES

Katherine Kokmanian
A Well-Rounded Approach to Engineering



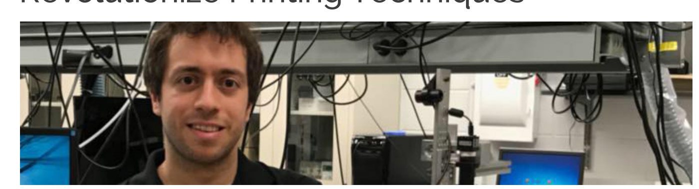
As a young student Katherine Kokmanian was once told that all engineers are builders. However, she soon realized that engineering means so much more—it is creating, testing, questioning, and theorizing. Now, the third-year PhD student in MAE is trying to inspire a new generation of elementary-school students about opportunities in the field as part of an outreach course.

Katherine's versatile approach has been an asset to the Fluid Mechanics Transport Phenomena Group at Princeton. Her work focuses on supersonic flows, which, as the name suggests, travel faster than the speed of sound. The biggest application for her research is in rockets and supersonic jets.

She is developing nanoscale sensors that can measure the velocity and turbulence of these supersonic flows. "There are some measurements that already exist for supersonic flows, but they are not highly resolved statistics," says Katherine. "The goal of these sensors is to provide more accurate measurements of what to expect when something is flying at supersonic speeds."

The irony of ending up in a hands-on experimental lab is not lost on Katherine. But as she likes to tell those students, you never know what you will end up being good at until you try. ◘

Emre Turkoz
Answering Fundamental Questions to Revolutionize Printing Techniques

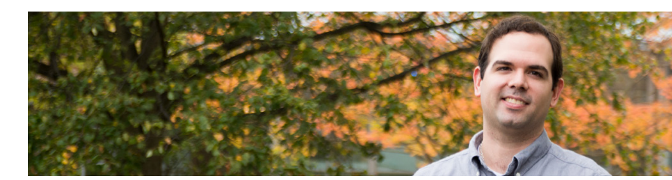


Engineers have long toiled with printing techniques. Long before televisions and computers existed in every home they used these techniques to print ever-smaller lines to build ever-smaller circuit boards. This allowed computers to shrink from the size of a room to the size of a placemat.

Today, Emre Turkoz, a graduate student in fundamental fluid dynamics, focuses on converting lab techniques for printing complex materials into real-world manufacturing processes. His team is exploring fundamental questions about how the jets of complex fluids break into tiny droplets to form small lines and create even tinier circuit boards.

Specifically, Emre is exploring printing a silver paste that is used in the fabrication of solar cells and other small electronics using a nozzle-less printing technique that makes tiny lines. Eventually, this technique could be used with an array of fluids to create circuit boards so small that they are almost invisible or small pixels that would allow screens to display extremely high-resolution images. "At first, I didn't care what type of a problem I was solving, I just wanted a challenge," says Emre. "After studying for a while, I realized that I wanted to solve problems related to fundamental fluid dynamics." ◘

Anthony Savas
Taking Control of Networked Multi-Agent Systems



For Anthony Savas bowling and mathematics have always been an integral part of life. Today, as a PhD candidate in the Dynamical Control Systems Laboratory, he continues to roll strikes. His work focuses on developing distributed algorithms for a group of autonomous agents with limited and noisy inter-agent communications, such as sensor-equipped mobile robots. He focuses specifically on distributed estimation of signals that are motivated by problems, including environmental monitoring and assessment after a disaster. ◘

awards

Irvin Glassman
receives 2018 Daniel Guggenheim Medal

Ani Majumdar
receives Google Faculty Research Award

Howard Stone
receives G.I. Taylor Medal of the Society of Engineering Science

Szymon Suckewer
receives Alfred Nelson Marquis Lifetime Achievement Award

For full stories, visit: http://mae.princeton.edu/about-mae/spotlight