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: spring 2019

April 5 – 12:30pm
VICKY NGUYEN, Johns Hopkins University
April 12 – 12:30pm
LYDIA BOUROUIBA, MIT
April 19 – 12:30pm
CHIARA DARAIO, Caltech
April 26 – 12:30pm
DANIEL GOLDMAN, Georgia Tech
May 3 – 12:30pm
LANCE COLLINS, Cornell University

events: fall 2019

September 13 – MAE Research Day
September 27 – 12:30pm
LEIF RISTROPH, NYU
October 4 – 12:30pm
JULIA MIKHAILOVA, Princeton University
October 18 – 12:30pm
RADHIKA NAGPAL, Harvard 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

MAE news

MECHANICAL AND AEROSPACE ENGINEERING

School of Engineering and Applied Science
PRINCETON

Spring 2019

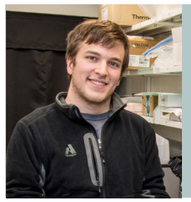
Dear Friends of MAE

The academic year to date has been a blur! The buzz of courses, seminars, visitors, and co-curriculum activities makes every week educational and exciting. Also, the fall semester traditionally ends with exams in January but the Princeton faculty voted in the fall to bring this tradition to an end so that Princeton's calendar is (finally) aligned with all of our peer institutions. The new academic-year calendar will take effect in Fall 2021. There are many exciting research accomplishments in MAE, including new laboratories in environmental fluid mechanics (Professor Luc Deike), flying robots (Professor Ani Majumdar) and bioengineering (Professor Daniel Cohen) that are now filled with graduate students, undergraduate students and lots of activity. In November we lost Emeritus Professor Harvey Lam who had long been an intellectual mainstay of the Department. Harvey and his family have also been generous supporters of many MAE activities, including summer research internships for undergraduates. Long-time MAE faculty member Jeremy Kasdin, one of the country's expert in engineering space telescopes moves to emeritus status this summer and will become the inaugural Professor of Engineering at the University of San Francisco. So there is much happening and we remain committed to our goals of creating and supporting a world-class environment for education and research. Do visit us if you are in the area.

With best regards, Howard Stone

In this issue...

student spotlight



Diego Fierros
Bringing Engineering to the World Stage

Diego Fierros knew he wanted to be a scientist early on. "As a kid, I loved television shows like 'MythBusters' and 'How It's Made,'" says the senior majoring in mechanical engineering. "By watching the Discovery Channel, I learned what engineering was in an ideological sense—which is taking the world into your hands and changing it for the better. That really spoke to me."

Diego pursued his interest in science during middle and high school, even spending a summer as a high school researcher on the Villanova University Autonomous Surface Vehicle Team. They competed in the AUVSI Roboboat competition, and later in the international RobotX competition. Diego gained an appreciation for the work that goes into designing and building robotic systems.

He also discovered another passion as a teen: technical

...continued p. 2

grad program info

IN 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 which culminates with 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, robotics, biomechanics, 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

Professor Clancy Rowley
A Journey from Student to Teacher

Like the rotational flows he studies, in many ways, Professor Clancy Rowley's career has come full circle. Nearly three decades ago, he was a freshman at Princeton tinkering around in the machine shop. He fell in love with fluid mechanics, and subsequently research, during a course and internship with Professor Alexander (Lex) Smits.

For the past 17 years, Professor Rowley has had the opportunity to inspire students in the very same place where he studied. "I remember getting nostalgic my senior year and thinking it would be a dream to come back as a teacher someday," he recalls. While many of the buildings have

changed, the guiding principles of what it means to be a Princetonian—innovation, curiosity, and imagination—still roam the Ivy-covered campus.

"The most inspiring thing about teaching is explaining a subject I love to students who know nothing about it. I have the privilege of watching them fall in love too," he says. "It is like show and tell—I feel like I am showing students my favorite toy."

Professor Rowley's favorite project is teaching students to program a mechanical arm that can balance an inverted pendulum. "If you figure out the right mathematical model, you can design a computer control system that does it for you," he explains. "It is a light bulb moment for students."

Before he joined the faculty at Princeton, Professor Rowley completed a PhD at the California Institute of Technology, specializing in dynamics and control systems. Experimental capabilities have improved so dramatically that researchers are often left with gigabytes of data to sort through.

Professor Rowley looks for ways to sift through the noise, developing data-driven models that pare down large data sets and extract key features. These models also have broader applications for developing methods to control fluids that could help reduce the drag on an aircraft to save fuel or develop more energy-efficient combustion engines.

"Problems I know how to solve are boring," he says. "The tough problems, well, those are the fun ones. They are the reason why I still love research after all this time." ¤

student spotlight *continued*

theater. Diego describes technical theater as everything on stage that does not require performers, such as lights and sound.

"My specialty is sound design—setting up speakers in the performance space, programming the soundboard, and making sure that every actor's microphone is working properly," he says. "Plus, I mix in the music from our pit orchestra so that every sound is balanced in the theater. My goal is for the audience to hear every line and have the best possible time at our shows."

Diego's love of theater carried over from high school to Princeton, where he became a member of the Triangle Club—America's oldest touring college musical-comedy theater group. He uses advanced hardware to create and adjust a live theater soundscape.

He is also studying for certificates in Computer Science and Robotics and Intelligent Systems. One of his courses involved authenticating and repairing two antique Triumph motorcycles. In another project, Diego participated in the Fluid Mechanics Transport Phenomena Group, where he used PTC Creo design software to develop laboratory equipment such as a sensor test bench and a wind tunnel pitot traverse.

Diego worked as an intern in the Siemens Corporate Technology Future of Automation Lab. He had the opportunity to learn practical robotic programming using the Robotic Operating System and Linux while collaborating with a team of researchers to develop an autonomous robotic farming system.

Recently, he also joined Professor Daniel Cohen's bioengineering lab and is studying how the shape of a wound affects how fast it heals.

With graduation on the horizon, Diego is weighing his options for the future. Robotics, he says, has the potential to improve society. However, he also hopes to continue his involvement in technical theater. Whether it is a robot or a performance, there is no doubt Diego will find a way to make any project come to life. ¤

a word from the lab

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

Estella Yu
Admiring Fluids and Separating Particles

Estella Yu has been drawn to the beauty of fluid mechanics ever since she saw a video demonstration from the famous physicist G.I. Taylor on hydrodynamic reversibility in viscous fluids. "The way fluids move you would think they are disorganized, but it amazes me how we can use physics and mathematics to explain the structure behind this seeming randomness," she says.

At Princeton, Estella is working on a new particle separation method, which uses a bubble interface to sort particles into different sizes. Estella stumbled onto the phenomena by accident. She was working on another project when she found particles were sticking to an interface.

Traditionally, researchers have used centrifuges or membranes to separate particles, but they often differentiate poorly or clog. This is the first time researchers have used an interface. "By controlling the flow speed, the film thickness can be easily tuned. With this technique we can separate a wider range of particles and lower laboratory costs without modifying the set up," says Estella, a fourth-year graduate student in MAE.

These particle-coated bubbles have potential applications for medical devices such as drug encapsulation and diagnostic ultrasounds. Estella is also applying this technique to separate soft particles, droplets and, potentially, cells. ¤

Aric Rousso
Preparing for Takeoff

Aric Rousso is both amazed and terrified every time he steps onto an airplane. But it is not the bird's-eye view that excites him—it is watching how the plane functions. "

Today, as part of the Advanced Combustion and Propulsion Lab, Aric is trying to improve the way people travel on Earth and explore beyond. Aric studies plasma-assisted combustion, a relatively new field of technology, which he believes will someday improve engine efficiency, enhance fuel lean combustion, and reduce emissions.

In particular, he is exploring the chemical kinetics and reaction pathways in plasma-assisted combustion experiments of liquid fuel surrogates like n-heptane. Using this data, he is assisting in the development of models that can accurately predict these plasma-fuel interactions.

"The more you learn about planes, the more you realize it is incredible they ever leave the ground for the sheer number of things that have to go right every flight," says Aric, who is a fourth-year PhD student in MAE. "My hope is that what we learn will be used in the future to design an engine that reduces carbon and other pollutant emissions, as well as improves efficiency and power-to-weight ratios." ¤

Christopher Galea
Math and Physics as a Work of Art

Christopher Galea loved to draw cartoons as a child. Today, the PhD student sketches models for his research.

In the lab, he is developing a combined laser-microwave diagnostic, Radar REMPI (resonance-enhanced multi-photon ionization) technique that has the ability to remotely measure properties of a gas or plasma with high temporal and spatial resolution. It also has the potential to measure the density of neutral atoms—the goal is to characterize the background pressure all around a Hall thruster in a ground test chamber. ¤

awards and honors

Luc Deike
receives NSF Career Award

Ani Majumdar
receives Amazon Research Award

Yiguang Ju
receives International Prize of Combustion Society of Japan

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