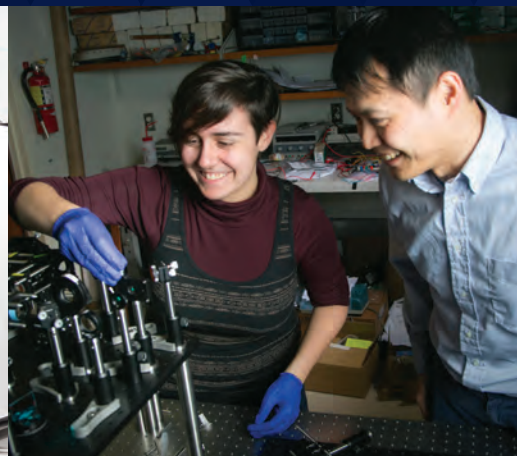
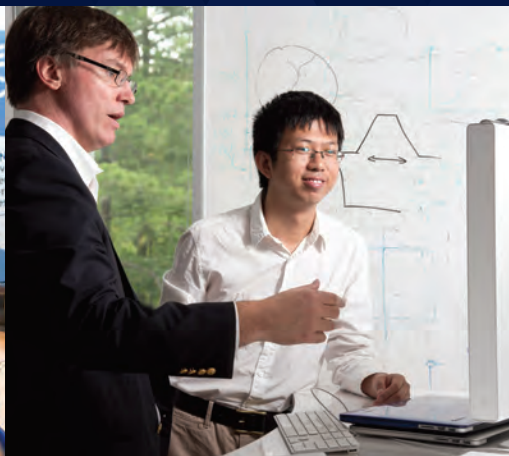


# THE DUKE ENGINEERING PHD

DOCTORAL DEGREE PROGRAMS THAT  
**CULTIVATE** ENGINEERING LEADERS



## WELCOME FROM THE ASSOCIATE DEAN FOR PHD EDUCATION



**D**ear friends,

Our world faces great challenges, and the engineer with advanced training is uniquely positioned to provide the expertise and leadership needed to develop and deploy solutions to those challenges for the good of our society.

At Duke Engineering, we have created a thriving, rigorous, supportive and interdisciplinary environment in which we cultivate engineering leaders.

We aim to educate the whole person. Our PhD students receive exceptional technical training and mentorship from our world-class faculty. In our laboratories, they become true collaborators in groundbreaking research. They co-invent new technical solutions, develop entrepreneurial skills and even become company founders.

On our campus, they have the advantage of programs dedicated to enhancing their interpersonal and leadership, teamwork and communications skills—preparing them for career success in academia, industry and in the public and nonprofit sectors.

We are proud of the impactful leaders we have trained here at Duke and invite you to learn more about our vision for engineering doctoral education in the pages that follow.

### **JENNIFER L. WEST**

Associate Dean for PhD Education  
Fitzpatrick University Professor of Engineering  
Duke University Pratt School of Engineering  
Member, National Academy of Engineering  
Member, National Academy of Inventors

*At Duke Engineering,  
we have created a  
thriving, rigorous,  
supportive and  
interdisciplinary  
environment in  
which we cultivate  
engineering leaders.*

# ENGINEERING LEADERS

DUKE'S PRATT SCHOOL OF ENGINEERING IS A LEADING ENGINEERING SCHOOL EMBEDDED IN ONE OF THE WORLD'S TOP RESEARCH UNIVERSITIES.

## DUKE ENGINEERING

**6** Major Externally Funded Research Centers  
*1M+ in external funding for 3+ years*

**112** Tenure-Track Faculty (FY18)

**\$70.8M** Annual Research Expenditures (FY18)

**↑ 84%** Growth in Research Expenditures over the past decade

**#26** Graduate Engineering Program  
*(U.S. News & World Report, 2019)*

### Specialty Rankings:

Biomedical: #4  
Environmental: #11  
Computer: #17  
Electrical: #25  
Mechanical: #28  
Materials: #30

**#11** in faculty research productivity among U.S. engineering schools  
*(Academic Analytics, 2018)*

#3 in computer engineering  
#6 in electrical engineering  
#8 in biomedical engineering  
#14 in environmental engineering  
#15 in mechanical engineering  
#17 in civil engineering

## OUR PHD PROGRAM

**15.6%** 5-year average admissions selectivity

**549** enrolled PhD students, 2018-2019 academic year

**↑ 22%** Growth in PhD enrollment over the past five years  
*(No. of PhD students in 2014-2015: 449; in 2018-2019: 549. Also, 2018-2019 enrollment is 12 percent greater than the year before.)*

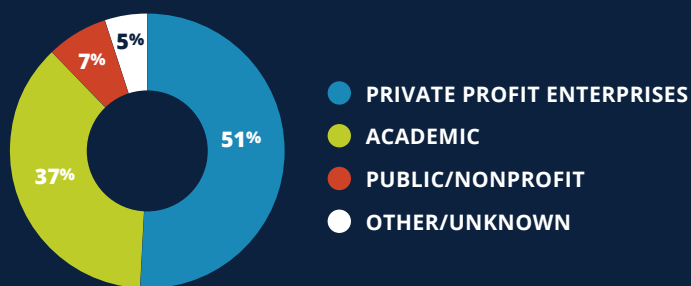
**115** Engineering PhDs conferred, 2017-2018 academic year

**↑ 53%** Growth in the number of Engineering PhDs conferred at Duke over the past 5 academic years

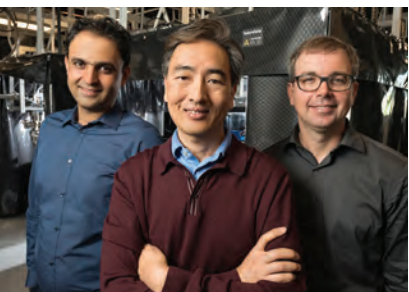
**15.6%** current engineering PhD students who have received NSF and major fellowship awards

## 15-YEAR CAREER PATHS FOR PHD GRADUATES

Data reflect current positions for engineering PhD alumni who graduated between 2004 and 2018.







# HIGH-IMPACT RESEARCH, WORLD-CLASS FACULTY

## Academic Departments

- Biomedical Engineering
- Civil & Environmental Engineering
- Electrical & Computer Engineering
- Mechanical Engineering & Materials Science

## Major Research Centers

1M+ in external funding for 3+ years

## Environment

- CEINT: Center for Environmental Implications of Nanotechnology (NSF/EPA)
- CAMMS-Environmental Sensing: Applied Computational Ion Spectrometry Center (ARPA-E DOE)

## Materials Science

- Center for Materials Genomics (MURI, ONR)

## Metamaterials

- CMIP: Center for Metamaterials and Integrated Plasmonics (Acoustic Metamaterials MURI, ONR)

## Quantum Computing

- EURIQA: Error-corrected Universal Reconfigurable Ion-trap Quantum Archetype Program (IARPA/ARO)
- STAQ: Software-Tailored Architecture for Quantum co-Design (NSF)

## Graduate Research Training Programs

Grant-funded multi-year programs

- Center for Biomolecular and Tissue Engineering (NIH)
- Medical Imaging Training Program (NIH)
- Integrative Bioinformatics for Investigating and Engineering Microbiomes (NSF)
- International Partnership Program in Water and Commerce (NSF)

**D**uke Engineering is a leader in defining and advancing high-impact fields that tie to grand challenges for engineering and society. With faculty ranked among the **top 15 in the nation in research productivity** (*Academic Analytics*), our external research funding has more than doubled in the past decade, and we currently rank **#8 among top U.S. engineering schools** in research expenditures per faculty member (*U.S. News*).



## INTERDISCIPLINARY IN EVERY ANGLE: HORIZONTAL AND VERTICAL TEAMS

**INTERDISCIPLINARY RESEARCH** is more than a buzzword at Duke. It is integrated into our culture. It ignites creativity and brings more viewpoints to finding the solutions to challenges.

Duke Engineering has deep vertical integration—while home to four academic departments, the broad research themes of the Pratt School of Engineering cut across departmental boundaries. To facilitate this cross-pollination, many of our faculty have joint or secondary appointments in more than one engineering department or in Duke's schools of medicine, environment and arts and sciences.

Horizontal interdisciplinary integration is a major focus at Duke. For example, the Information Initiative at Duke

(iiD) brings together Big Data experts from engineering, mathematics, computer science, medicine and other disciplines, and at faculty, graduate and undergraduate levels to tackle complex problems together. The iiD's Data+ and Data Expeditions programs give PhD students opportunities to help lead these teams.

As well, Duke's Bass Connections program provides funding and guidance for major interdisciplinary research projects—and not only brings together experts from different fields, but from across the ranks of faculty, graduate students and undergrads.

**MORE AT:**  
[BASSCONNECTIONS.DUKE.EDU](http://BASSCONNECTIONS.DUKE.EDU)  
[BIGDATA.DUKE.EDU](http://BIGDATA.DUKE.EDU)



*"I chose Duke because of its research resources and its atmosphere. My advisor is an authority in computational mechanics, and our research style is unique—we are only interested in conquering the difficulties that block further developments in our field. The work in our group usually has strong impact after publication."*

—**YINGJIE LIU**, PhD STUDENT,  
STUDIES WITH MEMS  
PROFESSOR JOHN DOLBOW

## INTERDISCIPLINARY RESEARCH THEMES



Data Science, Advanced  
**COMPUTING &**  
Intelligent Systems

We are developing and deploying the power of computing to design autonomous systems, improve communications and information systems, glean valuable insights from massive datasets, detect disease and improve health, and enhance security in both cyberspace and the real world.



**MATERIALS**  
Discovery &  
Development

Our research includes discovering and developing materials with desired structures and properties for diverse applications in areas such as health, computing, energy and security.



Personal,  
Environmental &  
Population **HEALTH**

We are deeply engaged in improving the health of humans and our environment—from understanding disease at the molecular and genetic level, to developing technologies to improve global health, to exploring connections between human health and environmental quality. A hallmark is extensive collaboration with leading Duke physicians and scientists.



Resilient Systems  
& the  
**ENVIRONMENT**

From earthquakes to financial crashes to the impacts of climate change and manmade materials, the world is full of uncertainties. Duke Engineering researchers are finding new ways to assess risk, inform decision-making and engineer safer, more resilient systems to create a more secure, sustainable future.



# COMMUNITY AND OPPORTUNITY

**D**uke Engineering expands opportunities for PhD students with distinctive resources—from expert advice on writing and speaking effectively, to guidance on patenting innovations and founding companies. And, our lively and close-knit campus community encourages students to develop personally as well as professionally.



*“Coming here as a first-year PhD student, I really didn’t know what to expect. Fortunately, there were a bunch of kind and generous students, faculty and staff in our department who helped me out with classes, research, where to find housing. There is a really strong community within our department.”*

—DAVID RAUDALES,  
STUDIES MATHEMATICAL  
MODELING OF ACOUSTICS  
WITH MEMS ASSOCIATE  
PROFESSOR DONALD BLISS

## CREATING COMMUNITY

### PhD Student Leadership and Representation

Duke’s student-led Engineering Graduate Student Council (EGSC) organizes social events and community service opportunities, spurs interdisciplinary collaboration and promotes diversity and inclusion. Events include regular Friday afternoon “Pratt Chat” socials on the Harrington Engineering Quad, an annual scientific image competition, food crawls and movie nights. The group is committed to engaging with the Durham community through service, including Habitat for Humanity projects. Department-based graduate student clubs also represent the interests of graduate students and create strong bonds between students and faculty within disciplines.

### Strengthening Community and Raising Awareness

The Office of Diversity and Inclusion in Engineering serves as a resource and support for all engineering graduate students. Through community-building activities, training, workshops, and town hall meetings, the office serves as a liaison between students and Duke Engineering leadership—strengthening our academic environment in which students from all backgrounds not only succeed, but thrive.

## DEVELOPING PROFESSIONALLY

### PhD Plus

Duke Engineering’s PhD Plus program deepens the value of doctoral studies with a year-round program of workshops, seminars and special events designed for high-impact professional development. Seminar topics have included “Tools for Stress Reduction” and “Leadership in the Lab and Beyond”—all taught by expert speakers. Annual practicums provide a deep look into the latest project management techniques, developing your personal brand, and more.



## DUKE ENGINEERING INNOVATION



In a record year for Duke University innovation, 2017-2018, Duke Engineering tallied:

5

Startups

91

Invention Disclosures

11

License/Option Agreements

32

Issued US Patents

22

Duke graduate students listed as co-inventors on those US patents





### OPPORTUNITIES FOR SERVICE

- Community outreach through the EGSC and Graduate and Professional Student Council
- **DukeEngage** offers summer opportunities to help communities in the United States and abroad

## BUILDING ENTREPRENEURIAL CONFIDENCE

### Entrepreneurship @ Duke Engineering

Provides advice, one-on-one coaching and coordinates workshops that bring industry experts to campus to examine in detail the challenges of founding a company. The program is led by Bill Walker, a Duke biomedical engineering PhD grad who went on to found successful biotechnology companies, and Steven McClelland, a Duke Engineering alum and former Silicon Valley tech executive. They serve as dedicated mentors and advisors for students and faculty.

### DEEP SEA

Combining a graduate degree in engineering with a year of funding to launch a startup, the Duke Engineering Entrepreneurial Pipelines Startup Entry Accelerator (DEEP SEA) offers real opportunity for ECE graduate students to pursue their entrepreneurial dreams.

### BRiDGE Internships

Duke's Bioengineering Research Initiative to Develop Global Entrepreneurs (BRiDGE) provides access to 2,000 square feet of lab and office space to more than a half-dozen faculty startups in a redeveloped industrial building in downtown Durham, N.C. Engineering graduate students can take advantage of summer internships with a focus on learning entrepreneurial skills.

### Design Health Fellows

This interdisciplinary partnership between the Duke Heart Center, Duke Clinical Research Institute and Duke Engineering assembles teams to actively identify, validate, prioritize and create real-world solutions that improve health care. The competitive program, open to Duke Engineering graduate students, is a nine-month extracurricular experience.

## STRENGTHENING COMMUNICATION SKILLS

### Graduate Fellowship Submission Support

Averaging more than 13 new recipients of National Science Foundation and other prestigious Graduate Fellowships each year, Duke Engineering has become the choice of top students. We assist students with fellowship submission, and in their general professional development, through structured six-week application writing workshops taught each semester.

### Graduate Communications Support

Duke Engineering's four professional communications coaches offer courses, group sessions and one-on-ones on communications topics important to professional

development—from small talk to academic writing to public presentations and degree defense. The team also conducts seminars on intercultural awareness and communication—key skills in Duke's rigorous team-based learning environment.

### Other Communications Skills Resources:

- Toastmasters International—Graduate students may join Duke Engineering's club, in which members improve public speaking confidence and learn leadership skills
- Teaching Assistant Training



# A TERRIFIC LOCATION

**O**ur global reach begins on the Duke campus in Durham, North Carolina—a vibrant, growing city known for tech, entrepreneurship and quality of life.

## AFFORDABLE COST OF LIVING

Durham, NC, regularly appears on lists of the best US cities for the latest trends in the arts, cuisine and music. We're within easy reach of major East Coast cities, but with a far lower cost of living—more than 40 percent less expensive than Boston and New York. Living in our region costs about 60 percent less than California's Bay Area.



**DUKE  
UNIVERSITY**  
DURHAM, N.C.

## ENERGETIC ECONOMY

#1

Best Mid-Size City for Jobs  
(Forbes)

## COMFORTABLE CLIMATE

220

sunny days a year, average  
daily high temperature  
70.2°F (21.2°C)

## SUPER SMARTS

#4

Most Educated US City  
(WalletHub)

## AMAZING ARTS

Most Vibrant Arts City, among  
medium-sized communities  
(National Center for  
Arts Research)





## GROWING FACILITIES

Duke Engineering today occupies 311,321 net square feet in 14 buildings on and off campus—growing by 80,000 square feet in just the last five years.

Specialized facilities include the Shared Materials Instrumentation Facility (part of the NSF-funded Research Triangle Nanotechnology Network), virtual environments, and the Innovation Co-Lab makerspace.

Plus, construction is under way on a 150,000-gross-square-foot engineering building, which will feature interdisciplinary research neighborhoods dedicated to Health Innovation, Computing & Intelligent Systems, and Environmental Health when it opens in late 2020.

Opening in late 2020, a new 150,000-square-foot engineering building will be a transformative space to advance engineering education and research at Duke. *Illustration: Bohlin Cywinski Jackson and Michael McCann*

## GROWING REGION

We're located in the Research Triangle region of North Carolina, consistently rated as one of the nation's fastest-growing, and near Research Triangle Park (RTP), the world's largest research park with 200+ tech companies.



*"When I go to downtown Durham, I notice how everything is local, the shops are local. There's a real pride here in being local, and having a local source. It's amazing, and I think this very unique to this area. And, it's part of why students love being at Duke."*

— **TRISHA DUPNOCK**, STUDIES  
WASTE-TO-ENERGY SOLUTIONS WITH  
CEE PROFESSOR MARC DESHUSSES





# SUCCESSFUL OUTCOMES

**D**uke Engineering PhD graduates go on to diverse careers, ranging from academic faculty positions, to research & development positions in industry or medical centers, to product development in both established and start-up companies. You'll find a strong network of Duke Engineering alumni in leading roles across the United States and around the globe.



## KEVIN LANTZ, PhD

### Intel

Engineering Manager, Product Development Engineering  
2011 Duke PhD Graduate—Electrical and Computer Engineering

*"Duke felt like the right fit for me from the moment I stepped on campus."*



*Kevin Lantz works at Intel's high-volume fabrication site in Arizona, where he manages a team of engineers who are responsible for technical supply chain management for all the products made by the semiconductor manufacturer.*

### Why did you select Duke for your PhD?

I visited quite a few schools. When I visited Duke for the first time I was struck by the beauty of the campus and the local area. I was drawn to the smaller size of the research groups in the ECE program, and the welcoming attitude of all the students and faculty we met. Duke felt like the right fit for me from the moment I stepped on campus.

### What were the most valuable parts of your Duke PhD experience?

I will always cherish the support and mentorship provided by my advisor, ECE Professor Adrienne Stiff-Roberts. She was invaluable in helping me develop my skills as a researcher and data scientist, which have been critical to shaping my success.

### How has being a Duke Engineering graduate helped you during your post-graduate career?

Duke is a prestigious university, and the Pratt School of Engineering is a well-known and well-respected within the semiconductor industry. Duke provided me with an excellent doctoral education and experience that made me competitive in looking for my first role after graduate school.

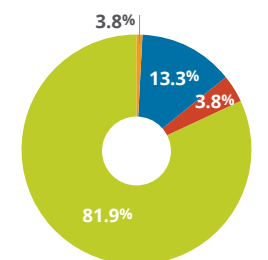


### EMPLOYERS OF DUKE ENGINEERING PhD GRADUATES

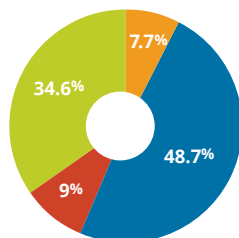
- Duke University
- Intel Corporation
- General Electric
- Apple
- US Navy
- Becton Dickinson & Company
- Stanford University
- US Food and Drug Administration
- Massachusetts Institute of Technology
- McKinsey & Company

*For graduates awarded PhDs between 2004 and 2018.*

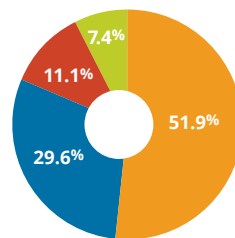
## DUKE ENGINEERING GRADUATES IN FACULTY OR POSTDOC POSITIONS



GRADUATED LESS THAN 5 YEARS AGO



GRADUATED 5 TO 10 YEARS AGO



GRADUATED OVER 10 YEARS AGO

- TENURED
- TENURE TRACK
- NON-TENURE TRACK
- POSTDOC

For graduates awarded PhDs between 2004 and 2018.

### LUCINDA CAMRAS, PhD

#### Camras Vision

Chief Scientific Officer

2013 Duke PhD Graduate—Biomedical Engineering

*"At Duke, I made very valuable connections."*



Lucinda Camras began working in a glaucoma research lab at 16. With her father, she created the Camras Shunt, a device designed to improve the success rate of glaucoma surgery by relieving eye pressure. While a biomedical engineering PhD student at Duke University, she co-founded Camras Vision. She has seven patents issued or pending and has received over \$3 million in grants from the National Science Foundation and National Institutes of Health to support her work.

#### Why did you select Duke for your PhD?

At the time, Duke had around 15 faculty working on glaucoma research, making it one of the largest representations in the field. I was accepted into the lab of BME Professor Fan Yuan. I completed my PhD research on a different topic and kept working on my device separately. But, while at Duke, I made very valuable connections.

#### How did you meet your business team members at Duke?

I worked with Bruce Klitzman, Sanjay Asrani, and Rand Allingham, who had developed a modification on an existing shunt, and together we applied for SBIR/STTR NIH and NSF grants to fund the further development of my device. Also, I met Robert Alfaro, a business student, through the Program for Entrepreneurs (P4E) course at Duke. Together, we co-founded our start-up company, named to honor my father: Camras Vision.

#### What advice do you have for a PhD student thinking of starting a company?

Your network is so important. Meeting people and creating relationships is a shockingly large part of getting a job. You will be surprised how eager people are to help if you are willing to take the time to build a relationship.

### MUYINATU "BISI" BELL, PhD

#### Johns Hopkins University

Assistant Professor of Electrical and Computer Engineering

2012 Duke PhD Graduate—Biomedical Engineering

*"Join a lab that has a history of innovative research and outstanding productivity."*



In addition to her assistant professorship in ECE, Bisi Bell holds a joint appointment in biomedical engineering at Johns Hopkins. She conducts research in medical imaging, with a focus on novel ultrasound and photoacoustic technology. Her lab is building the next generation of imaging systems to improve patient outcomes.

#### Why did you select Duke for your PhD?

Because of the outstanding research environment. The lab of my advisor, BME Professor Gregg Trahey, was the top hit in my keyword search when I started to consider graduate school: cancer, imaging, ultrasound, mechanics. Plus, I had just lost my mother to cancer. I wanted to do something in the area of earlier detection that would also integrate my various passions at that stage of my life.

#### How has being a Duke PhD graduate helped you during your career?

In many ways—but importantly I was in the NIH-funded Duke Medical Imaging Training Program, where I learned a great deal and performed hands-on assignments involving many modalities. I am well-equipped to teach the medical imaging systems course at Johns Hopkins.

#### What advice would you have for students considering Duke for their PhD in engineering?

I believe that the PhD experience is most beneficial when students connect with a program and research lab that best aligns with their passions. It's also important to join a lab that has a history of innovative research and outstanding productivity. There are many opportunities at Duke to meet these two criteria.





PRATT SCHOOL *of*  
**ENGINEERING**

**OFFICE OF PHD EDUCATION**  
305 TEER ENGINEERING BLDG.  
BOX 90271  
DURHAM, NC 27708-0271

EXPLORE  
OUR PROGRAMS  
AND APPLY:

[PRATT.DUKE.EDU/PHD](http://PRATT.DUKE.EDU/PHD)

JOIN OUR  
MAILING LIST:

[APPLYGP.DUKE.EDU/  
REGISTER/ENGINEERING](http://APPLYGP.DUKE.EDU/REGISTER/ENGINEERING)

