

**BOSTON  
UNIVERSITY**

# **ELECTRICAL & COMPUTER ENGINEERING**

**2024 IMPACT REPORT**



## MOVING FORWARD

At BU ECE, we know the pace of our technology-infused world never decelerates, so neither do we. The past academic year has seen ever-increasing growth and change, as our researchers continue to push boundaries from the nanoscale to the global, and the theoretical to commercial applications. I'm proud to share accomplishments ranging from FDA approval for a new optical biomedical device, CAREER awards for trustworthy AI training and tiny cybersecure sensors, and a silicon photonics pioneer now poised at the forefront of emerging industry trends. Read on for these and more, as we continue to steam ahead!

-W. Clem Karl, Chair

# The Freedom to **DISCOVER:**

## BU'S NEW PRESIDENT HAS A VISION FOR AN IMPACTFUL FUTURE.

"I want [BU] to be an intellectual destination," asserts **President Melissa Gilliam**, who touts the College of Engineering and the Faculty of Computing and Data Sciences for leading the way towards a convergent, collaborative approach, leveraging BU's strong global reputation and prime location among industry and academic partners to make the University a powerhouse of change and innovation.



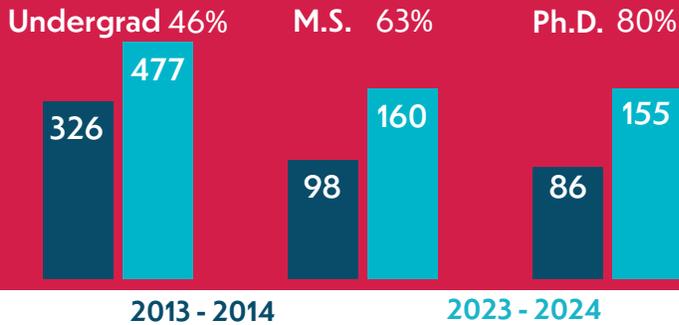
# DEPARTMENT AT A GLANCE

## MAJOR FUNDING

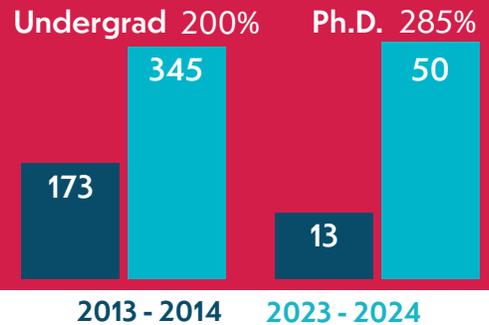
- \$12M** National Science Foundation
- \$11M** National Institutes of Health
- \$4M** National Aeronautics & Space Administration
- \$9M** Dept. of Defense
- \$1.4M** Dept. of Education
- \$6M** Other Sources



## ACADEMIC GROWTH



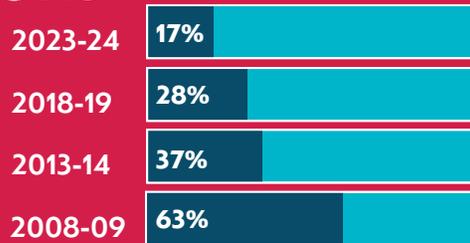
## CE PROGRAM



## SELECTIVE ADMISSIONS

selectivity increased over **~4x** over 15 years

% undergraduate engineering applications accepted:



## NEW FACULTY SPOTLIGHT PHOTONIC AI

BU ECE's newest Assistant Professor, **Tianyu Wang**, integrates photonics with neuro-morphic computing to better understand the human brain ... at the speed of light.



## BRINGING THE BRAIN INTO FOCUS:

**\$2.5M from the Chan-Zuckerberg Initiative** for unprecedented neural visualization.

Professor Tianyu Wang and colleagues from Yale and Cornell are developing a new type of light source that will significantly increase the speed and depth of neuronal imaging.



## ILLUMINATING THE INTERIOR:

Dogged pursuit of improved chemical microscopy published in **Nature Communications** and **Science Advances**

Professor Ji-Xin Cheng and collaborators, including Professor Lei Tian, are pushing the detection limit of vibrational imaging via photothermal microscopy, for material and life science applications.



## SEEING AROUND CORNERS:

**Nature Communications** publishes non-line-of-sight imaging breakthrough.

Professor Vivek Goyal's fast, novel method has applications for the military and for improved vehicular safety.

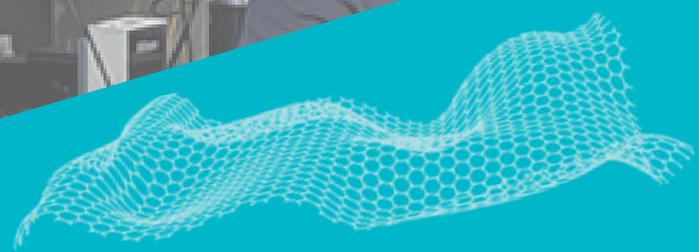
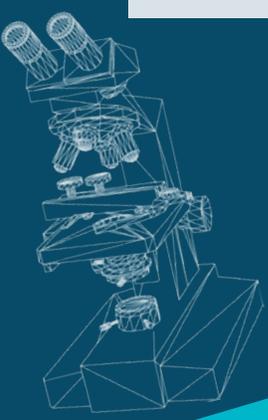


LEADING THE FIELD IN  
**Optics &**

## LIGHTSPEEDING AI

Silicon photonic technology showcased at last year's **White House Demo Day** holds the key to AI's data bottleneck crisis.

**Professor Milos Popovic** is a longtime silicon photonics pioneer and evangelist; now Ayar Labs, the company he co-founded, is at the forefront of industry efforts towards efficient, high-bandwidth data processing for the advancement of AI technology.



## FDA APPROVAL FOR CANCER SCREENING:

New device could cut the number of undetected skin cancers in half.

Optical techniques pioneered by **Professor Irving Bigio** power DermaSensor, a diagnostic device recently cleared by the FDA, with potential for life-saving results.

## ENVISIONING BETTER NIGHT VISION

**Professor Luca Dal Negro's** research, supported by a \$630K contract with Physical Sciences, Inc, will contribute to DARPA's "Envision" program, engineering novel planar optics and materials for enhanced direct-view night vision systems.

# Photonics

## BIOLOGICAL RESEARCH AT LASER SPEED:

Neurological investigation with pulsed lasers, featured **on the cover of Analytical Chemistry**.

**Professor Michelle Sander** and her research group used short-wavelength pulses to examine axons in their natural environment, offering a deeper insight into brain structure.





**AI, BUILT BETTER:**

**NSF CAREER Award**

supports research to improve the accuracy and trustworthiness of automated systems via more effective training.

**Professor Wenchao Li's** research enhances Imitation Learning, a major AI training method, with mathematical models which can compensate for weaknesses in expert (human) inputs.

**INNOVATIONS WITH IMPACT**

# AI & Machine

**AI for PERSONALIZED PATIENT CARE:**

A data-driven methodology achieves **70% additional reduction** in systolic blood pressure than standard of care.

A clinically-validated algorithm developed by **Professor Yannis Paschalidis** provides individualized treatment recommendations based on patient data.



**AI for TRAFFIC SAFETY & EFFICIENCY:**

Under the auspices of the **Red Hat Collaboratory**, BU researchers are optimizing traffic patterns in one small Swedish town--and eventually, all over the world.

**Professor Christos Cassandras** is collaborating with industry and municipal partners to develop a globally impactful open-source platform to make traffic light systems smarter and reduce congestion.



# Red Hat

## AI via INDUSTRY PARTNERSHIP:

**The Red Hat Collaboratory**, BU's unique partnership with one of the world's leading providers of open-source software, provides funding for AI-based, ECE-faculty-helmed projects - and career-building opportunities for ECE students.

## AI and BEYOND:

### BU's **Center for Computing & Data Sciences**

ECE faculty and students are involved at every level of this interdisciplinary community of scholars, making their mark .

... on data-driven solutions to societal challenges, AND on the Boston skyline.

# Learning

## AI ALLIANCE:

Mass Open Cloud among **founding members** of initiative to advance open, responsible AI.

**Professor Orran Krieger**, director of MOC through BU's Hariri Institute, celebrated the inception of the AI Alliance, launched by IBM and Meta, and bringing together an international community of leading technology developers, researchers, and adopters.





### EFFICIENT AND SECURE:

**NSF** and **Red Hat** support advances in hardware-based encryption critical to the future of cloud computing.

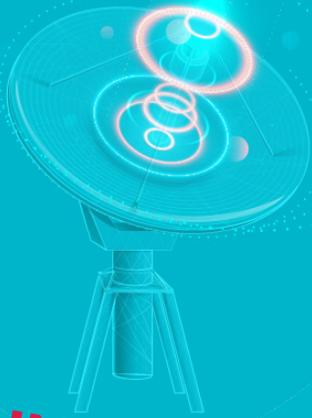
**Professor Ajay Joshi** and his research group are working to address a cloud computing quandary: how can we improve computational efficiency without sacrificing security?



### MINISCULE HARDWARE, MAXIMUM IMPACT:

**NSF CAREER AWARD** to support groundbreaking work in the emerging field of **CyberSecure Biological Systems (CSBS)**

**Professor Rabia Yazicigil** specializes in low-power, custom micro-scale integrated circuit design, purpose-built for a growing variety of applications from communications to synthetic biology.



### THE POWER OF LIGHT:

A DoD-backed **NSF Future of Semiconductors grant** and an industry-leading company working at the cutting edge of chips tech.

**Professor Miloš Popović** is leveraging more than a decade of pioneering work in electronic-photonic integrated circuits to address our society's insatiable appetite for more data processing capacity.

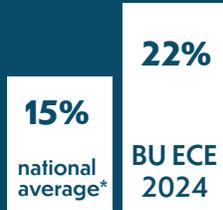
CHIPPING IN TO ADVANCE CHIP TECHNOLOGY

# Semiconductors

AY 2023/24  
ENROLLMENT

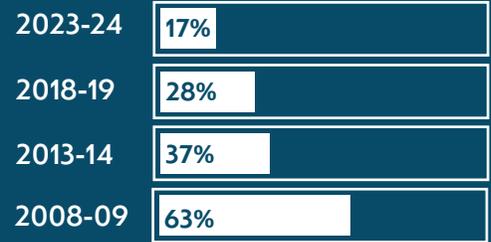
B.S.	477
M.S.	160
PH.D.	155

AVG #OF ECE B.S. DEGREES  
AWARDED TO WOMEN



\*2021 ASEE report

SELECTIVE  
ADMISSIONS



% engineering undergraduate applications accepted

ACADEMICS AT-A-GLANCE

SOLID-STATE STAR:

Qijun Liu (ECE PhD'24) was named a "Rising Star" by the **IEEE Solid-State Circuits Society** at ISSCC 2024.

Liu presented a paper and live hardware demonstration of a high-throughput droplet microfluidic device embedded with custom CMOS sensors for luminescence sensing and impedance spectroscopy.



CELEBRATING

# Student Success

GREEN MACHINE:

Graduate student Jonathan Miller and his team won first prize in the 2024 Dean's Imagineering Competition for their device, which **harvests electricity from algae**. Miller plans to use the award to continue pushing this research towards a green future.



# NEWLY-MINTED SOCIETY FELLOWS

## NATIONAL ACADEMY of INVENTORS

**Professor Miloš Popović**  
for pioneering work on  
photonic integrated  
circuits.



## JOHN SIMON GUGGENHEIM MEMORIAL FOUNDATION

**Professor Vivek Goyal**  
for groundbreaking work in  
computational imaging.



## OPTICA

**Professor Roberto Paiella**  
for outstanding contributions  
to the development of novel  
optoelectronic devices  
based on quantum-confined  
systems and photonic  
nanostructures.



# Faculty Honors

## TEACHING INNOVATION AWARD

**Professor Bobak Nazer**  
Boston University's Gerald and Deanne Gitner  
Family Award for Innovation in Teaching with  
Technology, for his "flipped classroom" model.

PROFESSOR JI-XIN CHENG:  
OPTICAL ACCOLADES

■ **AMERICAN CHEMICAL SOCIETY**  
DIVISION OF ANALYTICAL CHEMISTRY  
SPECTROCHEMICAL ANALYSIS AWARD

For pioneering work in chemical imaging.

■ **SPIE BIOPHOTONICS**  
TECH INNOVATOR AWARD

for the invention and commercialization of mid-infrared photothermal microscopy for cellular imaging, now distributed to research labs around the world.

AMERICAN for  
ASSOCIATION the  
ADVANCEMENT  
of SCIENCE

Professor Siddharth  
Ramachandran

for cutting-edge contributions to the generation, control, and propagation of singular states of light.



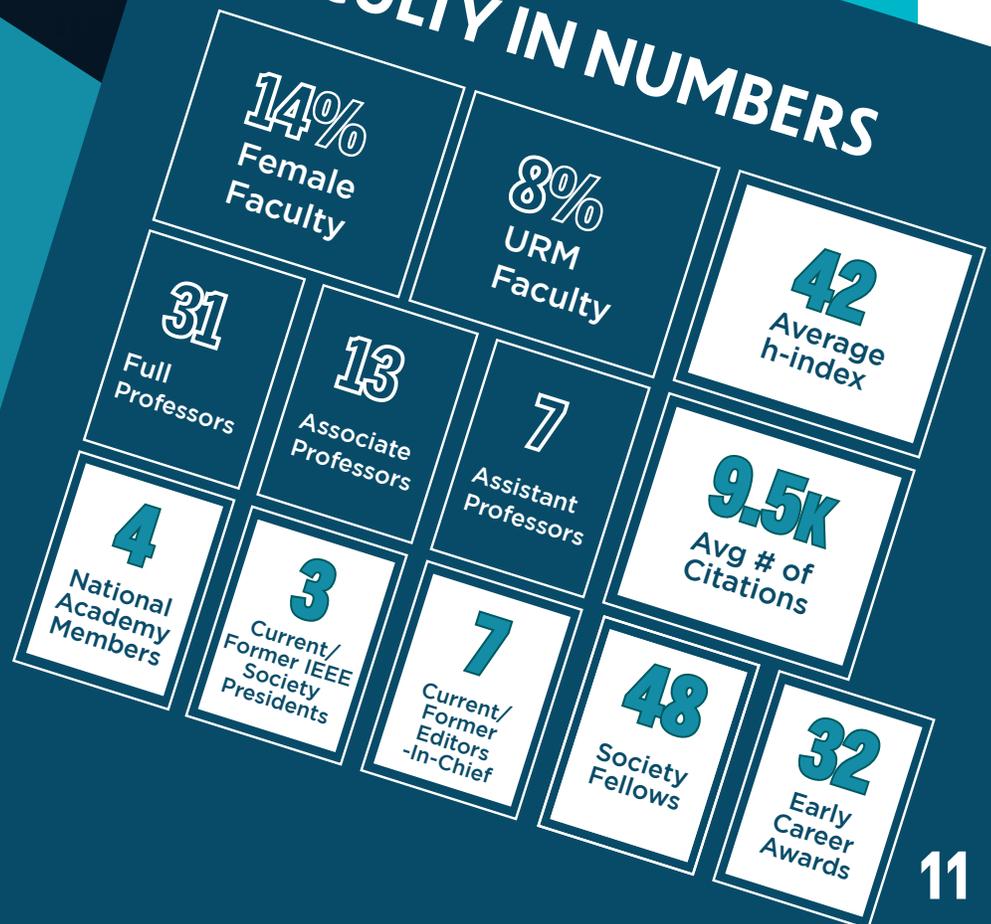
**OPTICA'S**  
NICK HOLONYAK  
JR. AWARD

Professor Emeritus and Distinguished Professor of Photonics and Optoelectronics  
**Theodore Moustakas**



in recognition of pioneering contributions to nitride semiconductor materials.

**FACULTY IN NUMBERS**



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## AI and Medicine: Rigor Over Hype

Associate Professor **Archana Venkataraman's** research is dedicated to **using AI tools to revolutionize clinical neuroscience**, with a particular focus on pervasive and debilitating neurological conditions. She emphasizes the importance of strategically combining bio-medical data with existing scientific knowledge to provide the most effective and transformative results, a scientifically rigorous and nuanced approach which she contrasts with "throwing GPT at every problem under the sun." Funded by the **NIH**, her group has leveraged AI's capacity to process and analyze high-volume brain scan data to predict language impairments in stroke patients and detect and localize epileptic seizures, among other breakthroughs.

