...WHAT IS ECE?
Electrical and Computer Engineers (ELECs) create, innovate and design technologies in robotics, computing, communications, electronics and automation. ECE uses hardware and software to create better, faster, safer technologies for things like cars, aircraft, computers, smart phones, and surgical robots.

...WHAT DO WE DO?
ELECs are a diverse, smart, creative group of problem-solvers who make cool things that change the world. Smartphones, GPS, cars, and even things like healthcare and national security would not exist as they do today without them. ELECs go on to work in every industry imaginable, including healthcare, space, energy, gaming, communications, entertainment, security, and aviation.

RESEARCH AREAS OF RICE ECE:

COMPUTER ENGINEERING (CE)
Computer Engineering is about designing, realizing and evaluating computing, communication and storage systems: making them fast, secure, reliable, and efficient. Our research covers the full stack of systems, from integrated circuits, VLSI, architecture to operating systems. We are particularly interested in emerging platforms and application domains, such as Internet of Things (IoT), machine learning, and healthcare.

NEUROENGINEERING (NEURO)
The brain is essentially a circuit. Neuroengineering is a discipline that exploits engineering techniques to understand, repair, and manipulate human neural systems and networks. Rice is uniquely positioned to lead this field thanks to the broad, interdisciplinary research performed in conjunction with the world’s largest medical center (Texas Medical Center), steps away from the Rice University campus.

PHOTONICS, ELECTRONICS, & NANODEVICES (PEN)
This field strives to improve understanding of the interaction of light and matter, along with the application of that knowledge to develop innovative devices and technologies. PEN has applications in energy and healthcare, among others.

DATA SCIENCE (DS)
Data Science is a growing field that integrates the tools and techniques involved in data acquisition, data analytics, and data storage to enable extraction of meaningful information from massive data sources.

SYSTEMS (SYS)
DSP/WIRELESS NETWORKING
Rice is a leader in Digital Signal Processing. Signal Processing is the analysis and transformation of signals in order to understand, simplify, or recast their structure. The understanding of how to analyze and restructure signals is applied to a wide range of areas, including: image and video analysis, statistical signal processing, and pattern recognition. Rice has unsurpassed capabilities to take wireless networking research advances from theory to at-scale field trials. Topics of study include information theory, massive MIMO, full duplex, autonomous drone networks, diverse spectrum access, and wireless security.
HOW TO use THIS GUIDE

This guide is organized alphabetically by faculty member with a brief description of their research. News from the Electrical and Computer Engineering Department (ECE) is interspersed throughout the booklet.

Many faculty’s work is interdisciplinary and covers multiple areas. Each faculty member has listed the area(s) that most pertains to her/his research and lists an email where you can contact them and communicate your interest.

Useful information
- You can request to attend one of the regularly scheduled research group meetings held by a particular faculty member;
- Some faculty have summer Research Experiences for Undergraduates (REU) available; and
- Continuing undergraduates and graduate students may take one 3-credit research course in the summer tuition free. This applies to courses like ELEC 490, 491, 590 and 591)

RESEARCH THROUGH: VIP Vertically Integrated Projects

The Vertically Integrated Projects (VIP) Program at Rice unites undergraduate education and faculty research in a team-based context. Undergraduate Rice VIP students earn academic credits, while faculty and graduate students benefit from the design/discovery efforts of their teams.

VIP at Rice extends the academic design experience beyond a single semester. Rice VIP teams are comprised of students from freshmen to graduate students, with a variety of majors and backgrounds.

VIP provides the time and context to learn and practice professional skills, to make substantial contributions, and experience different roles on large multidisciplinary design/discovery projects. Participation is through ELEC 491 and 591.

vip.rice.edu
Behnaam Aazhang*, J.S. Abercrombie Professor, Electrical and Computer Engineering
aaz@rice.edu
Research areas: Data Science; Neuroengineering; Systems
Dr. Aazhang's research interests are signal processing, information theory, and their applications to neuroengineering with a focus on developing minimally invasive and non-invasive real-time closed-loop stimulation of neuronal systems to mitigate disorders such as epilepsy, Parkinson, depression, and obesity. REU opportunities available**.

Athanasios C. Antoulas, Professor, Electrical and Computer Engineering
aca@rice.edu
Research areas: Computer Engineering; Systems
Dr. Antoulas is interested in large-scale dynamical systems, approximation, computation, and linear algebra.

Alessandro Alabastri, Texas Instruments Visiting Assistant Professor, Electrical and Computer Engineering
aa80@rice.edu
Research areas: Photonics, Electronics & Nanodevices
Dr. Alabastri’s research focuses on the theoretical investigation and computational modeling of complex nanostructures. He is particularly interested in light-to-heat conversion processes and in the engineering of photo-thermal effects for

Richard G. Baraniuk, Victor E. Cameron Professor of Electrical and Computer Engineering
richb@rice.edu
Research areas: Data Science; Neuroengineering; Systems
Dr. Baraniuk is the founder of OpenStax, providing free college textbooks! He is interested in multiscale, computational signal and image processing and open access, collaborative scholarly publication.

Palash Bharadwaj, Assistant Professor, Electrical and Computer Engineering
palash.bharadwaj@rice.edu
Research areas: Photonics, Electronics & Nanodevices
Dr. Bharadwaj is interested in light-matter interaction at the nanoscale, optical antennas, nanoscale energy transduction, plasmonics, spectroscopy and microscopy, and optoelectronics.

*Denotes VIP leading Faculty

ECE is Epilepsy Research
Epilepsy is the 4th most common neurological disease in United States, and many patients don’t respond well to traditional treatment like drugs. The Aazhang group is working to predict the onset of seizure.

**Research Experiences for Undergraduates. Research Experiences for Undergraduates (or REUs) are competitive summer research programs in the United States for undergraduates studying science, engineering, or mathematics.
Joseph R. Cavallaro*, Professor, Electrical and Computer Engineering & Computer Science
cavallar@rice.edu
Research areas: Computer Engineering; Systems
Dr. Cavallaro’s research impacts the development of the next generation of cellular mobile phones. He studies Wireless Communication Systems Architectures, VLSI Systems Design and Prototyping. **REU opportunities available.**

Gene Frantz, Professor in the Practice, Electrical & Computer Engineering (Signal Processing)
genef@rice.edu
Research areas: Systems
Gene Frantz is interested in entrepreneurship and intrapreneurship. He is an expert in Digital Signal Processing.

Fabrizio Gabbiani, Professor, Electrical & Computer Engineering
Professor of Neuroscience, Baylor College of Medicine
gabbiani@bcm.edu
Research areas: Neuroengineering
Dr. Gabbiani is interested in computational aspects of sensory information processing from the single cell to the network level.

Naomi J. Halas, Stanley C. Moore Professor, Electrical & Computer Engineering
Professor of Biomedical Engineering, Chemistry, Physics and Astronomy
halas@rice.edu
Research areas: Photonics, Electronics & Nanodevices
Dr. Halas’ group harvests solar radiation for energy applications and researches nanoparticle use in cancer therapy. She designs and fabricates optically responsive nano structures, nanophonotics, and plasmonics.

Reinhard Heckel, Assistant Professor, Electrical and Computer Engineering
reinhard.heckel@rice.edu
Research areas: Data Science; Systems
Dr. Heckel is interested in signal processing, statistics, and machine learning with a focus on developing algorithms and theory for space signal recovery, clustering of high-dimensional statistics, and convex optimization.

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**ECE is Solar Desalination**

Rice’s Center for Nanotechnology Enabled Water Treatment (NEWT) has developed an off-grid technology that uses energy from sunlight alone to turn salt water into fresh drinking water.

ECE Professor Naomi Halas leads NEWT’s nanophotonics research efforts.
Edward W. Knightly, Chair, Electrical and Computer Engineering, Lindsay-Sheafor Professor, Electrical and Computer Engineering, Professor, Computer Science
knightly@rice.edu
Research areas: Systems
Dr. Knightly is the founder of Technology for All, bringing tech to underserved areas. He is interested in wireless networks, urban-scale testbeds, clean-slate design, diverse spectrum access, multi-antenna systems, hardware platforms, high-performance protocol design, security, & performance evaluation. REU opportunities available.

Junichiro Kono, Professor, Electrical and Computer Engineering & Physics & Astronomy
kono@rice.edu
Research areas: Photonics, Electronics & Nanodevices
Dr. Kono's research results in increased understanding of quantum states. He's interested in condensed matter physics, optics and photonics, nanoscience and nanotechnology. REU opportunities available.

Edward W. Knightly, Chair, Electrical and Computer Engineering, Lindsay-Sheafor Professor, Electrical and Computer Engineering, Professor, Computer Science
knightly@rice.edu
Research areas: Systems
Dr. Knightly is the founder of Technology for All, bringing tech to underserved areas. He is interested in wireless networks, urban-scale testbeds, clean-slate design, diverse spectrum access, multi-antenna systems, hardware platforms, high-performance protocol design, security, & performance evaluation. REU opportunities available.

Caleb Kemere, Assistant Professor, Electrical and Computer Engineering
caleb.kemere@rice.edu
Research areas: Neuroengineering
Dr. Kemere is researching memory manipulation for the greater good (treating PTSD) and Deep Brain Stimulation for treatment of diseases like Parkinson's. He is interested in building interfaces with memory and cognitive processes; model-based signal processing; and low-power embedded systems.

Kevin Kelly, Associate Professor, Electrical and Computer Engineering
kkelly@rice.edu
Research areas: Photonics, Electronics & Nanodevices
Dr. Kelly is interested in imaging and spectroscopy at the nanoscale, and understanding the role of mathematics in image acquisition and interpretation. Other interests include Scanning Probe Microscopy, Electronic Materials, Compressive Infrared and Hyperspectral Imaging.

Yingyan Lin, Assistant Professor, Electrical & Computer Engineering
yingyan.lin@rice.edu
Research areas: Computer Engineering; Data Science
Dr. Lin's research interests include analog and mixed-signal circuits, error resiliency techniques, and VLSI circuits and architectures for machine learning systems on resource-constrained platforms. REU opportunities available.

ECE is Engineering the Brain
The Kemere lab designs systems to interact with complex neural circuits to explore how information is processed, stored and retrieved in both healthy brains and those with disorders, focusing on memory and Deep Brain Stimulation.
Michael T. Orchard, Professor, Electrical & Computer Engineering  
orchard@rice.edu  
**Research areas:** Data Science; Systems  
Dr. Orchard researches image and video modeling and compression.

Gururaj Naik, Assistant Professor, Electrical & Computer Engineering  
guru@rice.edu  
**Research areas:** Photonics, Electronics & Nanodevices  
Dr. Naik is interested in light and heat management for clean energy: thermovoltaics and photovoltaics; materials for plasmonics and metamaterials; and large-area nanofabrication and integration. **REU opportunities available.**

Ankit Patel, Assistant Professor, Electrical & Computer Engineering  
abp4@rice.edu  
**Research areas:** Data Science; Neuroengineering; Systems  
Dr. Patel is interested in probabilistic theories of deep learning from first principles; neurally-inspired learning and computation; medical imaging diagnosis; reverse-engineering neocortex; and deep learning for particle physics.

ECE is Research in Education  
The Baraniuk lab researches how the brain perceives depth and 3D vision. They are interested in machine learning and image and neural information processing.

ECE is ‘Upconverted’ Light  
Guru Naik’s method to ‘upconvert’ light could make solar cells more efficient and disease-targeting nanoparticles more effective.
Xaq Pitkow, Assistant Professor, Electrical and Computer Engineering
Assistant Professor, Computational Neuroscience, Baylor College of Medicine
xaq.pitkow@rice.edu
Research areas: Data Science; Neuroengineering
Dr. Pitkow’s research includes theories of neural computation in animal brains. Topics include: probabilistic inference, control theory, nonlinear dynamics, and population codes. Current projects include analyzing behaviors of animals playing video games; designing animal virtual reality environments; stimulating and analyzing computation in neural networks.

Jacob T. Robinson, Assistant Professor, Electrical and Computer Engineering & Bioengineering
jacob.t.robinson@rice.edu
Research areas: Data Science; Neuroengineering; Photonics, Electronics & Nanodevices
Dr. Robinson uses nanotechnology to interact with the brain and to treat neurological disorders. He uses nanotechnology to measure and manipulate neural activity. REU opportunities available.

Akane Sano, Assistant Professor, Electrical and Computer Engineering
akane.sano@rice.edu
Research areas: Data Science; Systems
Dr. Sano is interested in affective computing, particularly mobile and personalized health. Currently, she is lead investigator on the SNAPSHOT study measuring sleep, stress, and ambulation in everyday living.

Ashutosh Sabharwal*, Professor, Electrical and Computer Engineering
ashu@rice.edu
Research areas: Data Science; Systems
Dr. Sabharwal is interested in mobile health - using smart devices to diagnose and treat patients in more scenarios, to measure medicine adherence, and to impact health behaviors. He’s also interested in wireless networks, information theory, multiple antenna systems, coding and computation.

Santiago Segarra, Assistant Professor, Electrical and Computer Engineering
santiago.segarra@rice.edu
Research areas: Data Science
Dr. Segarra is interested in network theory, data analysis, machine learning, and graph signal processing. His focus is to develop tools to better process and understand network data, and apply these tools to real-world problems.

ECE is Mobile Health
In partnership with IBM, ECE researchers have developed a prototype Multi-Purpose Eldercare Robot Assistant (MERA). The Watson-enabled robot is designed to help assist the elderly and their caregivers in an “aging in place” environment.

*Denotes VIP leading Faculty
ECE is Wide-field Microscopes
A paper in Science Advances by Rice engineers Ashok Veeraraghavan, Jacob Robinson, Richard Baraniuk and their labs describes a wide-field microscope thinner than a credit card, small enough to sit on a fingertip.

Harel Shouval, Adjunct Associate Professor, Electrical and Computer Engineering
Professor, Neuroscience, UT Health
harel.shouval@uth.tmc.edu
Research areas: Neuroengineering
Dr. Shouval is interested in forming an integrated picture of learning, memory and development, processes that share many common mechanisms.

Ray Simar*, Professor in the Practice, Electrical and Computer Engineering (Digital Signal Processing Architecture)
ray.simar@rice.edu
Research areas: Systems
Dr. Simar’s team has built a putter that gives active feedback to golfers. They’re now working on a self-driving motorcycle. His research includes digital signal processors, design methodology and programming tools.

Peter J. Varman, Professor, Electrical and Computer Engineering & Computer Science
pjv@rice.edu
Research areas: Computer Engineering; Data Science
Dr. Varman researches computer systems, storage and memory systems, virtualization and resource management, and cloud computing. REU opportunities available.

Ashok Veeraraghavan, Associate Professor, Electrical and Computer Engineering
vashok@rice.edu
Research areas: Data Science; Neuroengineering; Systems
In addition to his recent development of a lensless camera, Dr. Veeraraghavan has a strong interest in mobile health and using smart devices to diagnose and treat patients. He is interested in computational imaging, compressive sensing for imaging, signal processing and computer vision.
**Gary Woods**, Professor in the Practice, Electrical and Computer Engineering (Computer Technology)
gary.woods@rice.edu
**Research areas**: Photonics, Electronics & Nanodevices
Dr. Woods is interested in mobile health, semiconductor failure analysis, and optical probing and debugging of advanced integrated circuits. He has advised groups who've gone on to: develop a vest to help the deaf hear; develop a dynamic radar and digital imaging system; and create an automated monitoring and control system for water waste reduction in oil fields.

**Kaiyuan Yang**, Assistant Professor, Electrical and Computer Engineering
kyang@rice.edu
**Research areas**: Computer Engineering
Dr. Yang's research focuses on designing low-power digital and mixed-signal circuits for future secure and low-power applications, especially the Internet of Things (IoT). He is also interested in hardware security and circuit/system design with emerging devices.

**Lin Zhong**, Professor, Electrical and Computer Engineering *(Sabattical Spring 2019)*
lzhong@rice.edu
**Research areas**: Computer Engineering; Data Science
Dr. Zhong's team recently developed RIO, which allows an application on one mobile system to utilize I/O from another. He's interested in mobile and embedded systems, human-computer interaction, and nanoelectronics. **REU opportunities available.**

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