EE Technical Areas

- Micro Devices & Physical Principals
- Integrated Circuits & Systems
- Signals & Information Processing
- Networking & Communications
- Systems Biology & Neuroengineering
EE Overview

- 29 Faculty
  - 2011: Mingoo Seok, John Wright
  - 2012: Christine Fleming, Javad Lavaei
  - 2013: John Paisley, Nima Mesgarani, Debasis Mitra
  - 2014: Zoran Kostic, Javad Ghaderi

- Total research expenditures:
  - 2013-14: $13.6M
  - 2012-13: $12.2M
  - 2011-12: $11.5

- EE students:
  - BS (EE/CE): 2012 55/40; 2013 68/58; 2014 72/48
  - MS (EE/CE): 2012 354/56; 2013 335/54; 2014 380/67
  - PhD: 2012 141; 2013 138; 2014 168
EE Graduate Students

EE Graduate Students

Fall 2006 | Fall 2007 | Fall 2008 | Fall 2009 | Fall 2010 | Fall 2011 | Fall 2012
---|---|---|---|---|---|---
EE/MS | CE/MS | EE/MS-PhD | EE/PhD

• EE Recent hires:
  – John Wright (2011-12, signals & information)
  – Mingoo Seok (2011-12, integrated circuits & sys)
  – Javad Lavaei (2012-13, networking & comm)
  – Christine Fleming (2012-13, systems bio & neuro)
  – Debasis Mitra (2013, networking & comm)
  – John Paisley (2013-14, signals & information)
  – Nima Mesgarani (2013-14, systems bio & neuro)
Micro Devices & Physical Principles

- novel materials and devices created at the interface between electronics and applied physics
- Current significant activity in nanotechnology, photonics, and thin film semiconductors
  - Emphasis on 2D materials, complex oxides, and organic semiconductors.
  - Strong links to Applied Physics, Mechanical Engineering, Biomedical Engineering, Physics, and Chemistry
  - Brookhaven National Labs - strong potential for growth stemming from applications in energy, sensing, optical interconnects, and hybrid microsystems.
  - Topics are crucial to Columbia Nano initiative and many large centers (MURI, IGERT, EFRC, MIRTs, etc.)

- Key areas:
  - Devices for Energy, Communication, and Sensing
  - Novel materials
  - Optical interconnect
  - Hybrid Microsystems
Integrated Circuits & Systems

- Core discipline within EE, leading strength
  - Key areas: connecting the physical world to digital processing; efficient computation and signal processing
  - Ever smaller devices and systems demand novel approaches, particularly for powering and communicating with numerous, small elements such as distributed sensor networks.

- Circuits is hub with extensive links to all other EE areas (devices, networking, signals, and bio-EE),
- Cross-intersections with other engineering and sciences via sensing and/or interaction with the physical world.
- Emerging area for hires: smart power, complex cyber-physical systems ("Internet of things"), and interfaces to biology/medicine;
- Teaching - 30% of our MS students elect circuits as principal area.
Signal & Information Processing

- Manipulating information encoded in signals.
  - Applications in multimedia and communications
  - Interfaces & overlaps to machine learning and statistics, strong link to Data Sciences
  - Current faculty specializing: applications including, communications, video, audio; and tools including, control, machine learning
  - Current gap in information theory, essential mathematics underlying communication, currently driven by advanced wireless applications.
  - Other growth areas: signal processing posed by social networks, distributed sensor networks, green (low-energy) communications, sparse representations, “Big Data,” genomics, media informatics.
Networking & Communications

- Field driven by challenges imposed by data communication for novel anywhere/anytime/any device applications and services

- Key areas
  - Next-gen, high-performance wired/wireless/cloud networks
  - Big-data, Internet-of-things, Ad-hoc devices
  - Data center networks, energy efficiency
  - Overlap with optical devices, energy
  - Peer-to-peer sensor networks, smart grid, cloud computing
  - Cybersecurity, with overlaps from computer science to circuits and physical principals, and crucial to Data Sciences
  - Connections to data sciences, industry collaborations

- Interdisciplinary - Cyber Physical, Optical networking, wireless sensors, cybersecurity
Systems Bio & Neuroengineering

- Newest area within EE
  - Interface between EE and biological sciences; applying systems tools & thinking to biological systems

- Neuroengineering:
  - Capitalizes on Columbia’s strengths in neuroscience (including MBBI and federal BRAIN program) and our computation with neural circuits.
  - Revolutionize understanding of neural information processing by reverse engineering the brain, build cognitive computational capabilities into silicon hardware.

- Systems biology,
  - Apply EE tools (analyzing complex systems) to biological systems, such as genomics and protein networks.

- Highly interdisciplinary
  - Biology, Chemistry, Neuroscience, Biomedical; BRAIN Initiative; Center for Neural Engineering and Computation

- Key EE areas
  - Synthetic biology - engineering novel applications using the existing biological tools and substrate
  - Biological-artificial systems interfaces; NeuroRobotics
Social and Departmental Events
2011-2012

- Halloween Party
- Thanksgiving Party
- Holiday Party
- Valentine Party
- End of the Year BBQ
- Graduation Day Party