Electrical Engineering
&
Computer Engineering

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Department of
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UNIVERSITY OF MICHIGAN

MichiganEngineering

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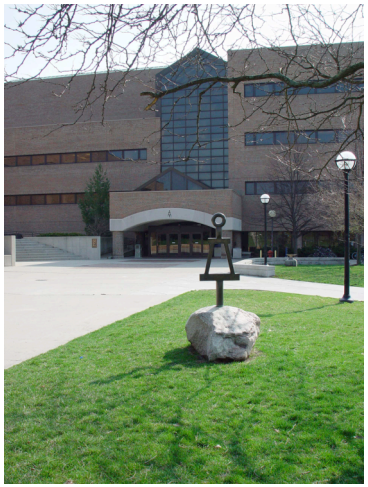
EECS Department

EECS Department History



- EE founded in 1890
- CS founded in 1957
- CE founded in 1965
- EECS formed in 1984

Solid-State Electronics Laboratory Expansion
(Completion 2008)

Computer Science and Engineering Building
(Completed 2006)

EECS Atrium Renovation (2007)

EECS Statistics

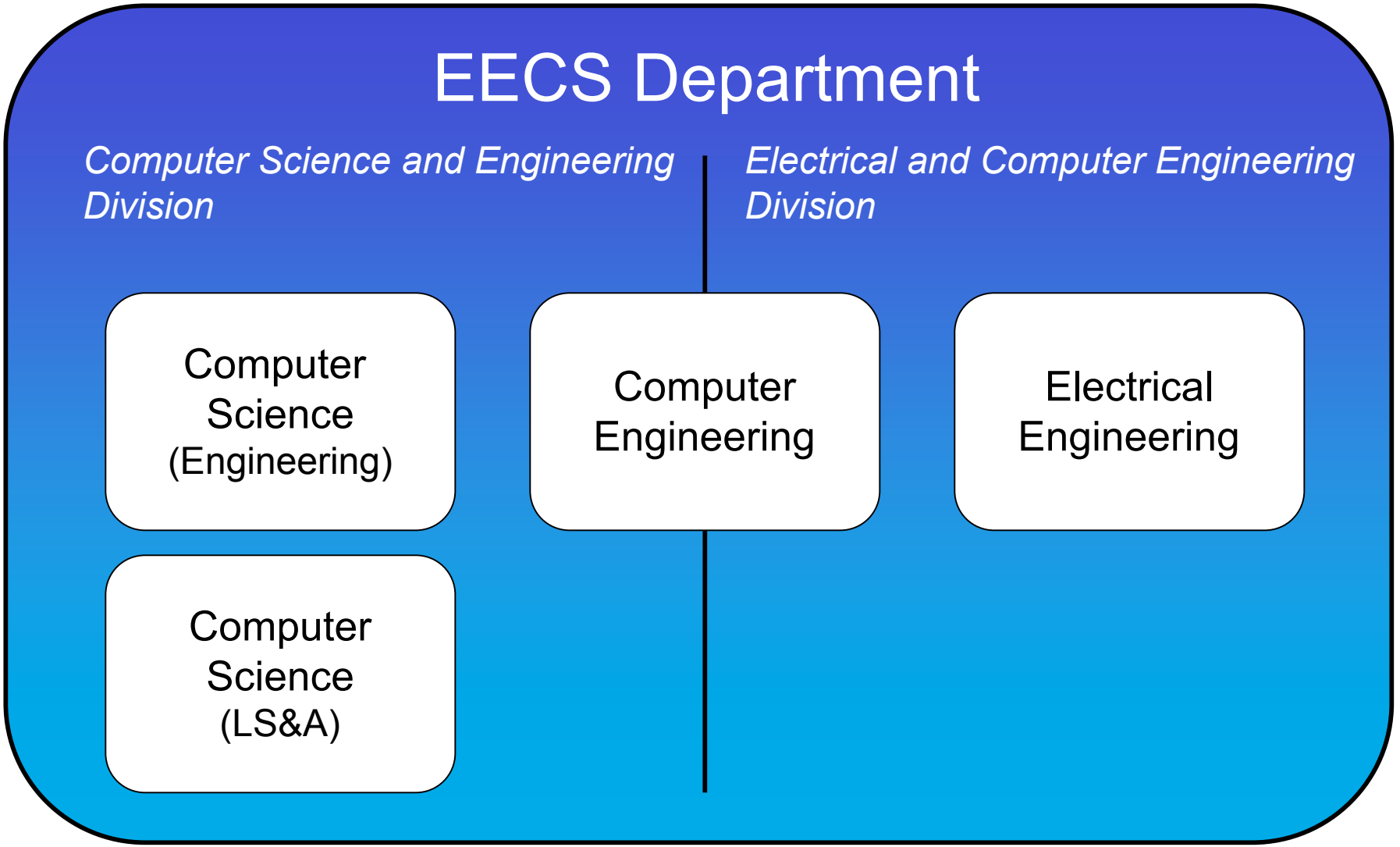
- US News Ranking for Undergraduate Programs (2007)
  - Electrical Engineering: #5
  - Computer Engineering: #6
- Several National Academy of Engineering Members
- About 90 faculty
- Winter 08 (3rd week) declared EECS Majors
  - EE: 354 (about 150 BSEE graduates per year)
  - CE: 161
  - CS: 318
- EECS undergraduate student to faculty ratio < 10
- 600-700 graduate students
- About $38M total annual external research expenditures

EECS Undergraduate Resources

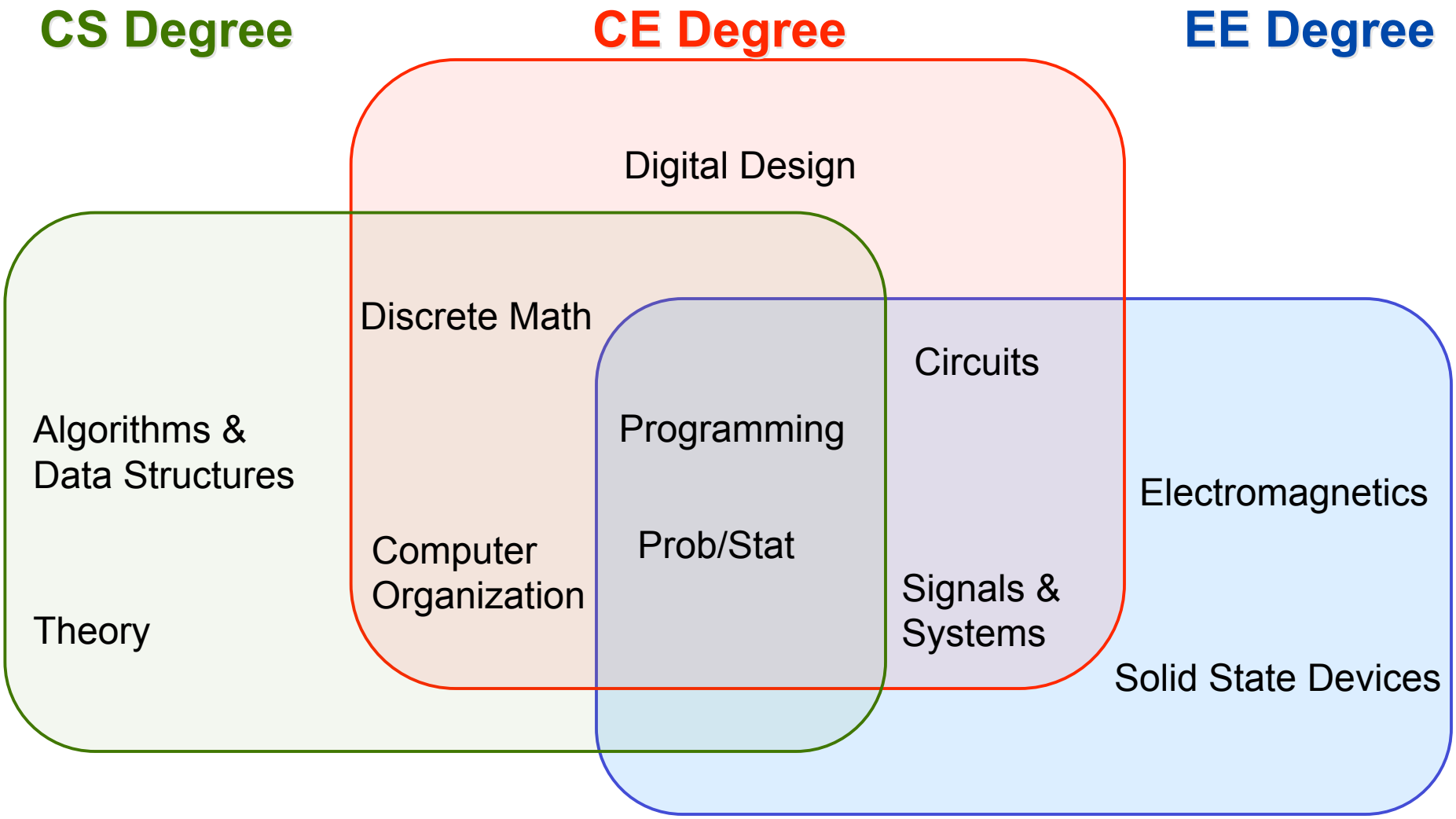
- EECS Undergradate Advising Office
  - Staff: Anna Cihak, Shannon Spencer
  - Faculty advisors
- EECS Learning Center (student volunteers)
- EECS Peer Counseling
- New: Career Mentoring for EECS Undergraduates - Faculty Mentors
- Improved instructional labs
  - New lab support team
  - New Agilent lab equipment throughout in Fall 2007
- Student societies
  - HKN (Eta Kappa Nu)
  - GEECS
  - UMEECS
- Increasing student engagement in practical experiences
  - Team competitions, Radio Club, REU, solar car, …
  - Engin 100 (Microprocessors, Energy sustainability, Music signal processing, …)

EECS Degree Programs

EECS Undergraduate Degrees



Flexible EECS Programs – Core Courses



All 3 programs also require EECS 496 (Professionalism, 2 credits)
teaming, entrepreneurship, ethics, …

Flexible EECS Programs – Continued

EE, CE, CS programs all allow MDE (Major Design Experience) to be taken from *any* degree program! (Why?)

CUGS: concurrent undergraduate / graduate studies

Double majors readily available (e.g., Math, PAT, other CoE, …)

EE requires 7 EECS courses

- (215, 216, 230, 280, 320, 401, 496)
- 33 credits technical electives (lists of electives)
- 11-14 credits general electives

ME requires 12 ME courses (and EECS 314)

- (211 235 240 250 320 335 350 360 382 395 450 495)
- 12 credits technical electives
- 9-12 credits general electives

EE Student Lab Experiences

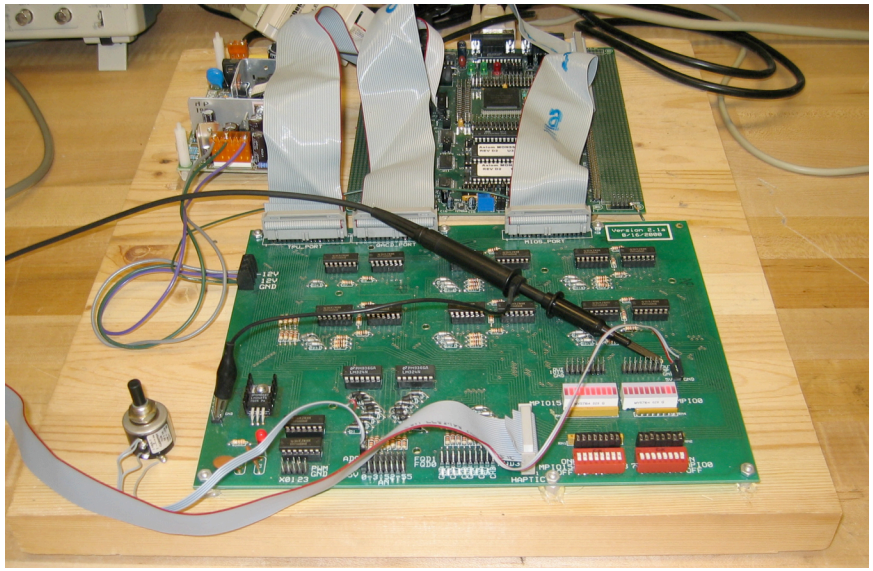
- Most EECS courses include hands-on lab experience
- Circuits
- Electromagnetics
- Optics / lasers
- Solid-state electronics
- Embedded control
- Digital signal processing
- Computer architecture
- …

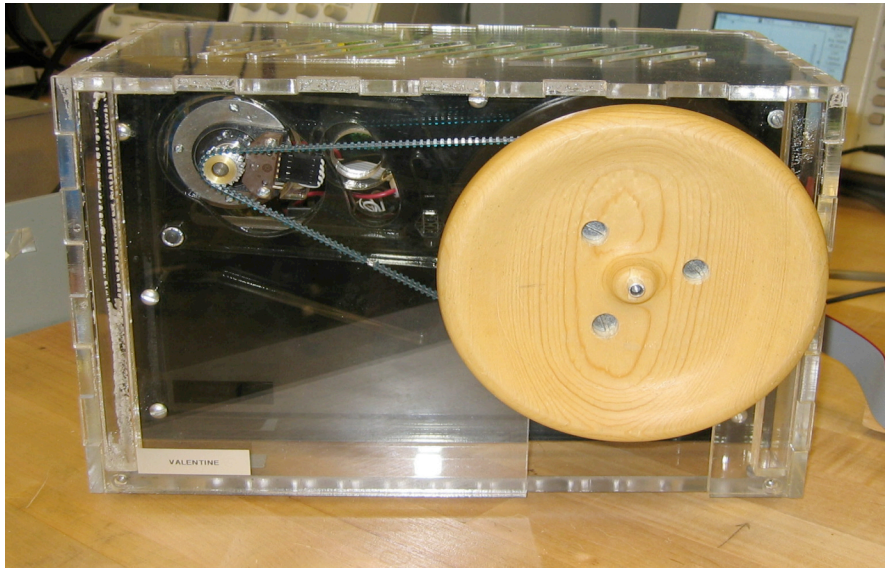
EECS 461: Embedded Control Systems

- Microprocessor control course

  Embedded controllers are ubiquitous in modern systems, e.g., anti-lock brake systems, MP3 players, appliances, routers, …

- Developed in response to requests from local industry
- EE and CE students
- State of the art hardware and software for automotive control
- Topics: hybrid systems, control over networks, human computer interaction, haptic interfaces





Engin 100: Solar Energy

Solar energy systems involve:

- Electronic devices
- Optics
- Circuits
- Control systems
- …

Electrical Engineering: Information and Power/Energy

What is Electrical Engineering?

- http://en.wikipedia.org/wiki/Electrical_engineer

  "Electrical engineering is an engineering field that deals with the study and application of electricity, electronics and electromagnetism. The field first became an identifiable occupation in the late 19th century after commercialization of the electric telegraph and electrical power supply. The field now covers a range of sub-studies including…"

- Then: telegraph and power supply
- Today: **Information** and **Power/Energy**
  - cf iron age, industrial age, silicon / information age, nano age, …
  - Much of nanotechnology is for improving information capture, processing, …

- EE is not just Physics 240!

Electrical Current

- Electrical currents (electrons) can transport *information* or *energy*

- So can electromagnetic waves (photons): examples?

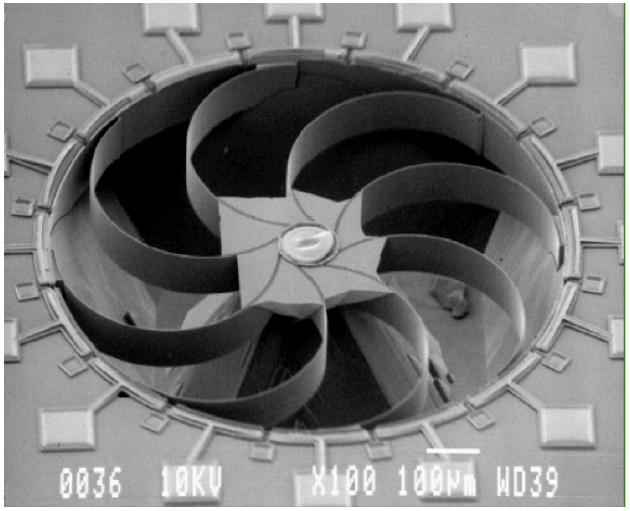
Information and EE

- Information acquisition (sensing)
- Information processing
- Information storage
- Information transmission
- Information utilization

Information Acquisition

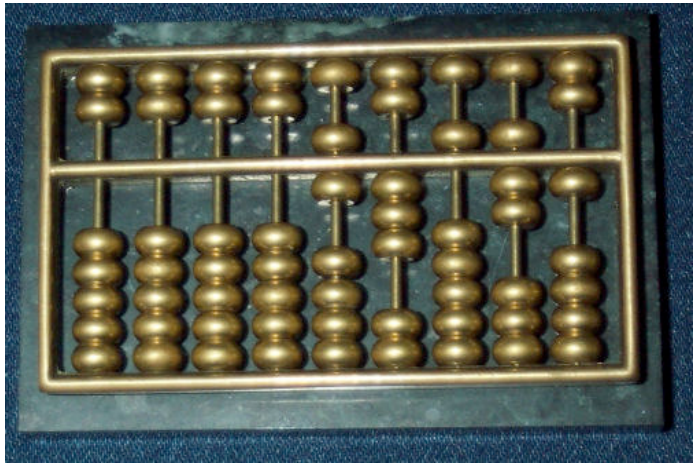
Mechanical

Electrical / Optical



MEMS (micro electro mechanical systems) ring gyroscope
EECS Prof. Khalil Najafi

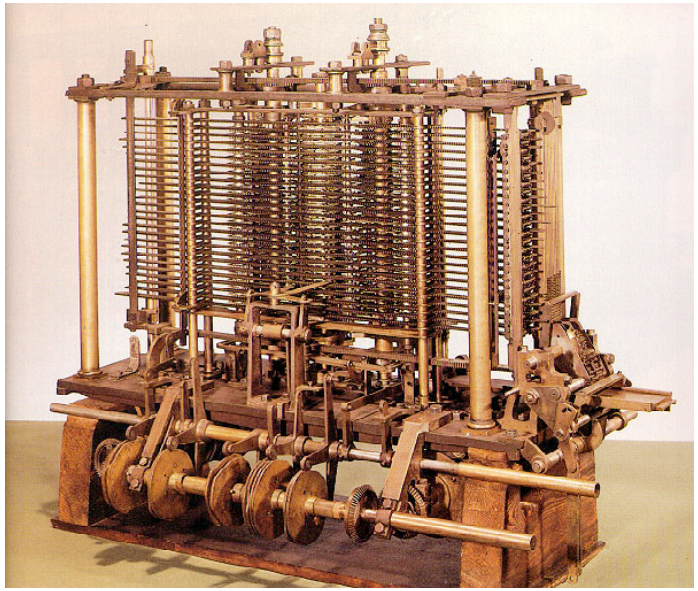
Information Processing

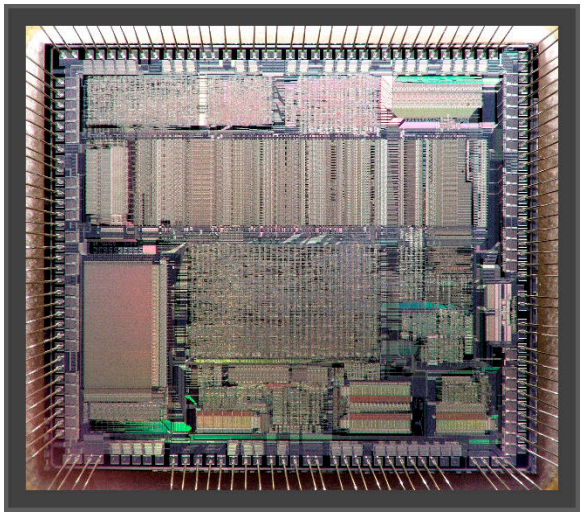


Mechanical

(photos not to scale…)

Electronic

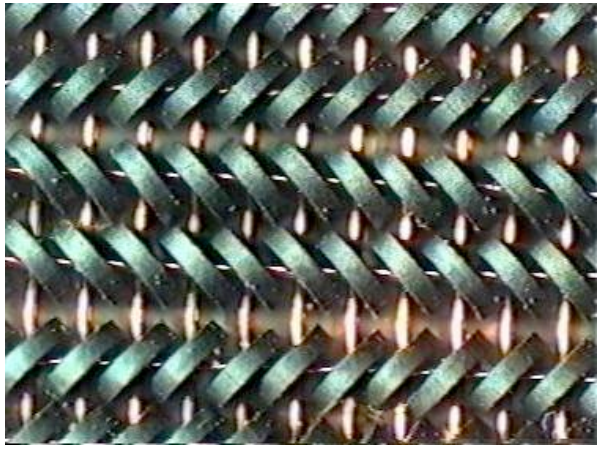




http://diephotos.blogspot.com/

Information Storage

Mechanical

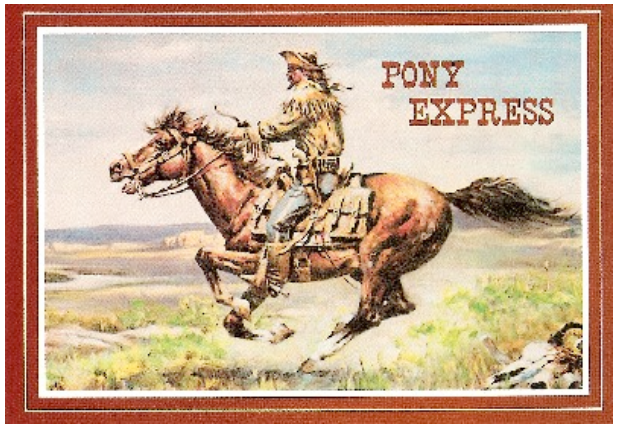


Magnetic

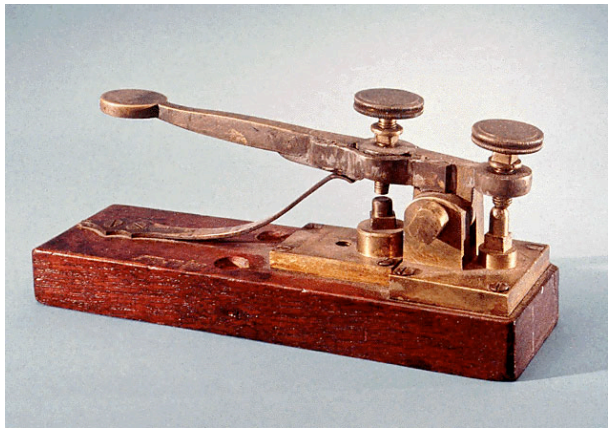
Optical

Electronic: fast, small, inexpensive, reliable, …

Information Transmission

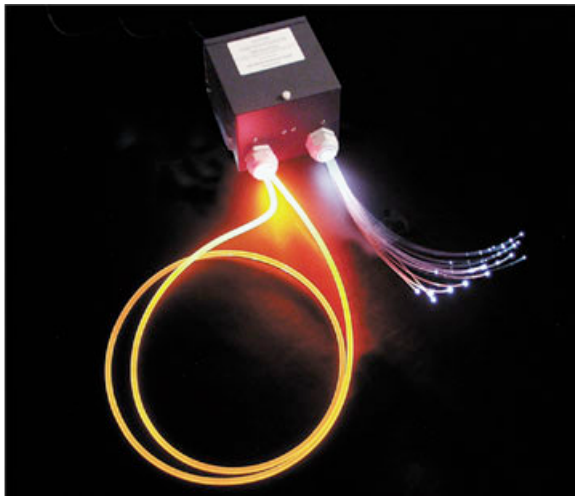


Mechanical



Electromechanical

Optical



Wireless Electronics (EM waves)

http://static.howstuffworks.com/gif/cell-phone-exploded.jpg

Information Utilization: Entertainment

“Portable” Music - Mechanical

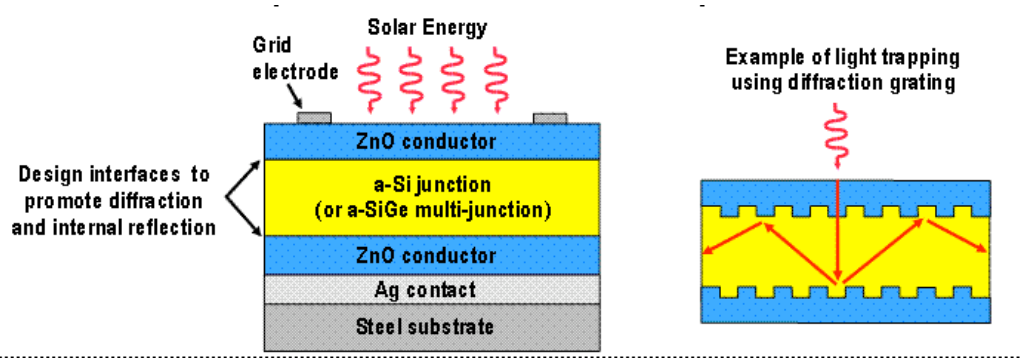
Portable Music - Electronic

http://a.abcnews.com/images/Technology/pd_phonograph_061017_ssv.jpg

End-to-end Example: Digital Photography

- Digital camera (A/D converter)
  - Optoelectronic sensor converts light to electricity
  - Electrical signals digitized and stored
  - Sophisticated embedded controller
- Computer
  - Digital image processing (Photoshop, iPhoto, GIMP, …)
- LCD Flat-panel Display (D/A converter)
  - Converts processed digital signal into light
- Contrast with film photography: chemical processing
- Summary: electrons and photons are excellent for information capture, processing, storage, transmission, and utilization
  - Hence high demand for EE skills

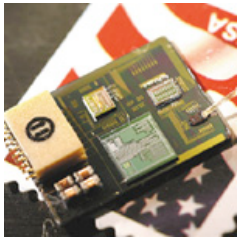
EE and Energy



Solar cell technology:

Improving efficiency through new materials and new electronic device structures

Prof. Jamie Phillips (UM BSEE / PhD degrees)



Low-power electronics: numerous projects

Power systems and electronics, wind energy:

- Faculty being recruited now!
- Even in energy industry, improved information is essential for improving efficiency

EE and the Environment

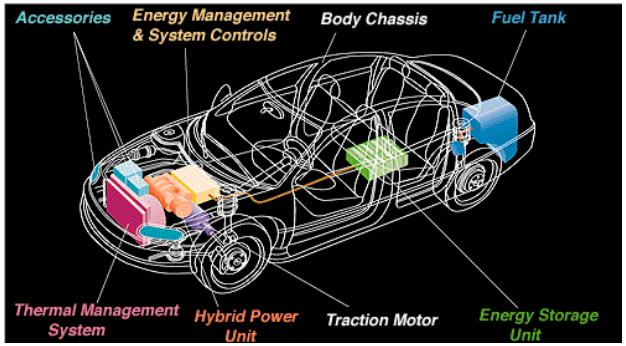
Electromagnetics:

Remote sensing of the earth's terrain and vegetation using radiometric imaging and polarimetric radar has applications for weather prediction and modeling, and global warming.

http://www.eecs.umich.edu/RADLAB

EEs develop many other sensing technologies

Wireless integrated microsystems (WIMS) center is developing sensors for bio-molecules, ionizing radiation, pressure, temperature, humidity, …

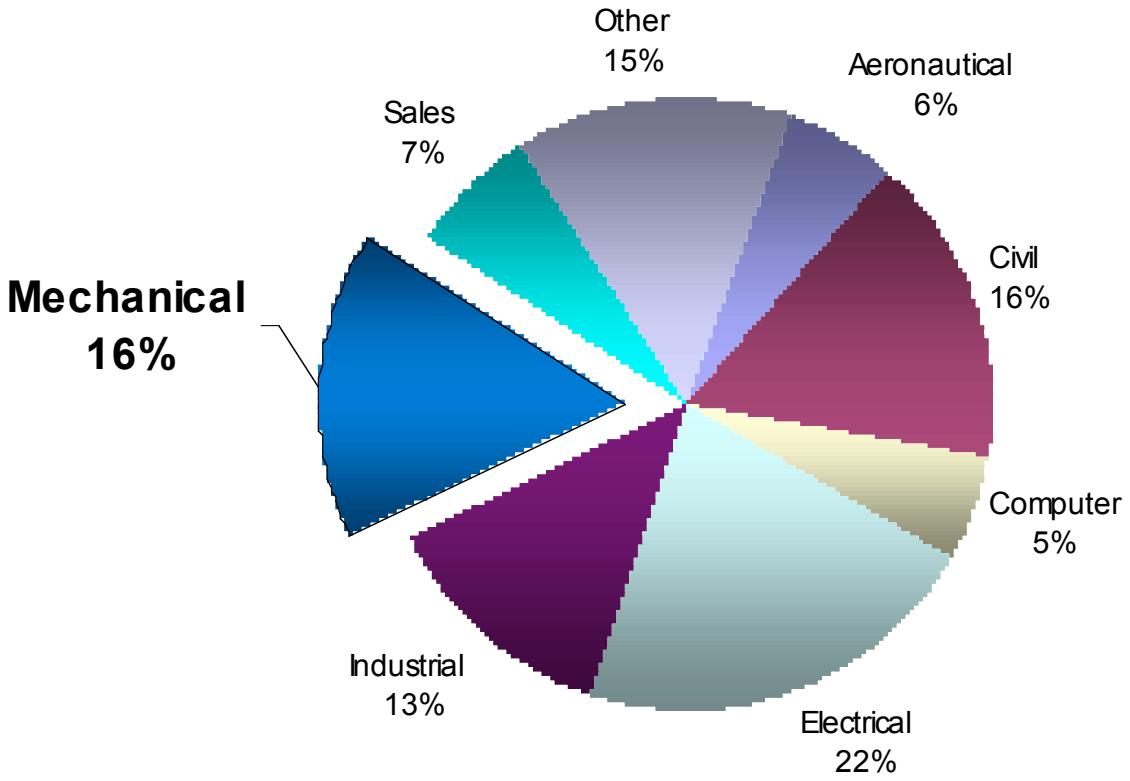


Hybrid vehicles - sophisticated electronics and control systems impact fuel efficiency

Information…

EECS Careers

Engineering Positions in Industry



ME Prof. Assanis, Engin 110, Feb. 8, 2008:
"ME in highest demand of all BS (2006)"

National Association of Colleges & Employers
http://www.jobweb.com/joboutlook/2006/default.htm

What do you think?

National Association of Colleges and Employers
Starting Salary Survey

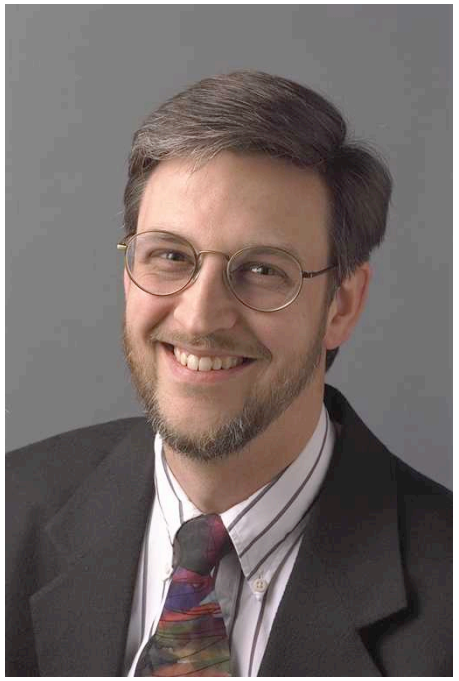
Discipline	Average starting salary
• Aerospace engineering	$49,873
• Biomedical engineering	$46,520
• Chemical engineering	$56,335
• Civil engineering	$46,023
• Computer engineering	$53,651
• Computer science	$51,305
• Electrical engineering	$53,552
• Geological engineering	$51,643
• Materials science	$55,468
• Mathematics/statistics	$41,124 (!)
• Mechanical engineering	$51,732

http://www.ccse.umn.edu/salarystats.html

EE Majors in Unexpected Places

- Doug Noll, BME Chair
- Dawn Tilbury, ME
- Mark Van Oyen, IOE
- Jing Sun, NAME

- They all have PhD degrees in EE!



Industry Leaders Say

- Mark Hurd, chairman and CEO of Hewlett-Packard:

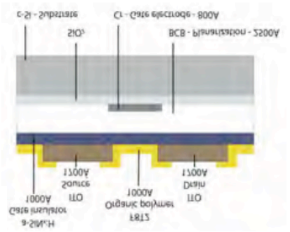
  “[The US] is graduating more sports management professionals than engineers, which isn't good in a global economy where innovation can make or break a company.” (2008-1-12 speech in Texas)

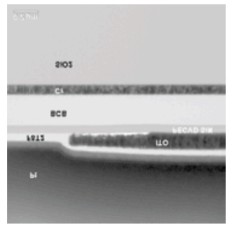
- Bill Gates of Microsoft:

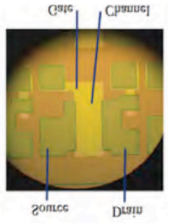
  New York Times quoted him saying the “shortage of scientists and engineers” is “acute.” (2008-3-12 visit to Capitol Hill)

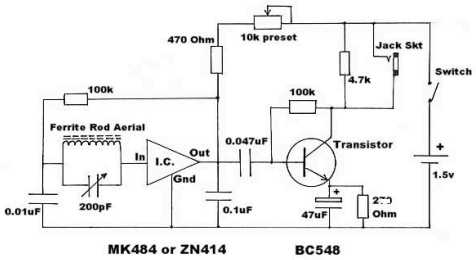
EE Design Across Multiple Scales

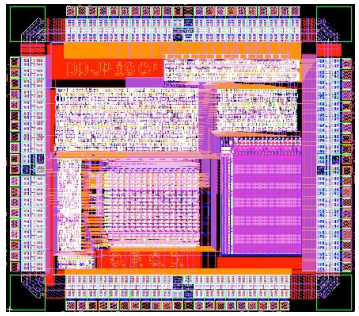
- EE majors design, analyze, build and test at many scales
- Devices
- Circuit / VLSI
- Subsystem
- System (GPS, power network, internet, …) in collaboration with many fields

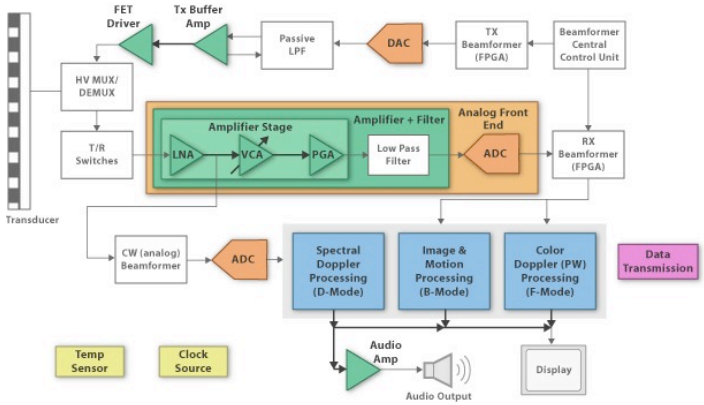












After Graduation

Work in industry

- Numerous types of companies employs EECS majors
- Automobile, aerospace, computer, consumer electronics, defense, entertainment, financial(!), government, telecommunications, …

Entrepreneurship: Start a company

- Many of our alumni have started their own highly successful companies (Google, Sun Microsystems, Arbor Networks, Xoran, …)
- High-tech startups usually based on EE,CE,CS technologies

Attend graduate school

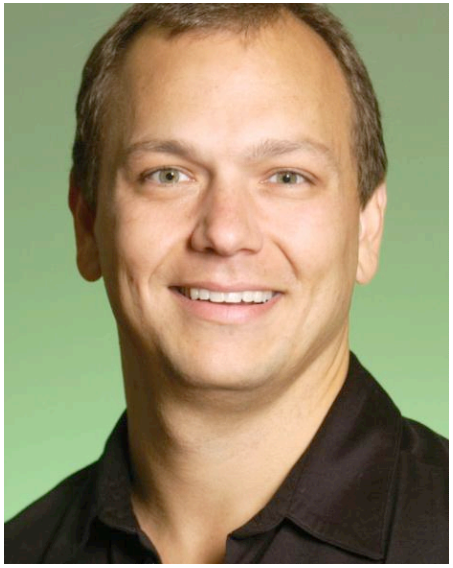
- In addition to engineering, many of our students continue their education in law, medicine, business, or a variety of other fields

Become a teacher and educate the next generation

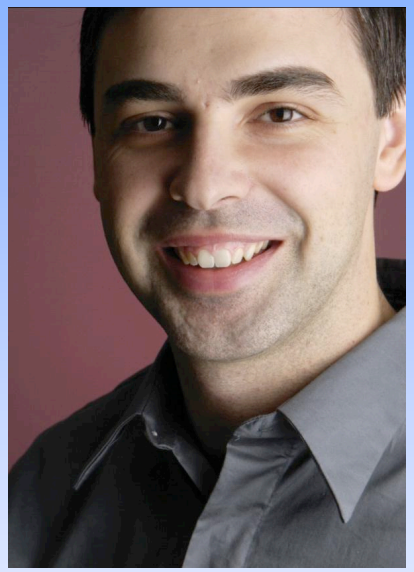
EECS Alumni

Alumni Profiles

- **Tony Fadell (BSE CE ‘91)**
- Senior VP, Apple Computer
- Created the iPod
- Founded 3 companies while a student at Michigan



Alumni Profiles



Larry Page (BSE CE ’95)

Co-founder and president, Products of Google, Inc.

Recently opened an office in Ann Arbor

Lori Mirek (BSE EE ’85)

MBA, Harvard

Founded Currenex in 1999, a firm specializing in international finance.

She is currently a director of the United Nations Association of the USA and the Business Council for the United Nations

Mehdi Hatamian

(MSE ‘78, PhD EE ‘82)

VP of Engineering for DSP Microelectronics Technology, Broadcom

53 Patents

Produced first gigabit transceiver with his team

Alumnus Extraordinaire: Claude Shannon

- UM BSE EE ’36
- UM BSE Math ’36

- 1916-2001
- Born Petoskey, MI
- Raised in Gaylord, MI

Claude Shannon

- Father of information theory
- MSEE thesis (MIT) showed how Boolean algebra and binary arithmetic would apply to circuits, laying the foundation for all modern digital circuits.
- Two 1948 papers at Bell Labs described how to best encode information for transmission, laying the foundation for all modern digital communications, digital multimedia devices, etc. More next lecture.
- Introduced sampling theory
- Major contributions to cryptography

EECS Students

Student Teams

- Solar car
- Mars rover
- MRacing
- Mclimber
- Space Systems
- Entrepreneurial groups

- All these teams need EECS majors

Get involved with real-world engineering problems as you compete with the best in the world

Get Involved – Make Friends - Join a Student Society!

Some of the student societies you can join:

EECS:

- HKN – Eta Kappa Nu, international honor society for electrical and computer engineers
- IEEE – Institute of Electrical and Electronics Engineers
- GEECS – Girls in EECS
- ACM – Association for Computing Machinery
- UMEECS – Underrepresented Minorities in EECS
- Amateur Radio Club
- Special Interest Group on Computer Graphics (SIGGRAPH)

CoE:

- Solar Car Team
- SWE – Society of Women Engineers
- Tau Beta Pi – College of Engineering Honors Society
- Epeians – The Engineering Leadership Honor Society

2005 Solar Car - Momentum

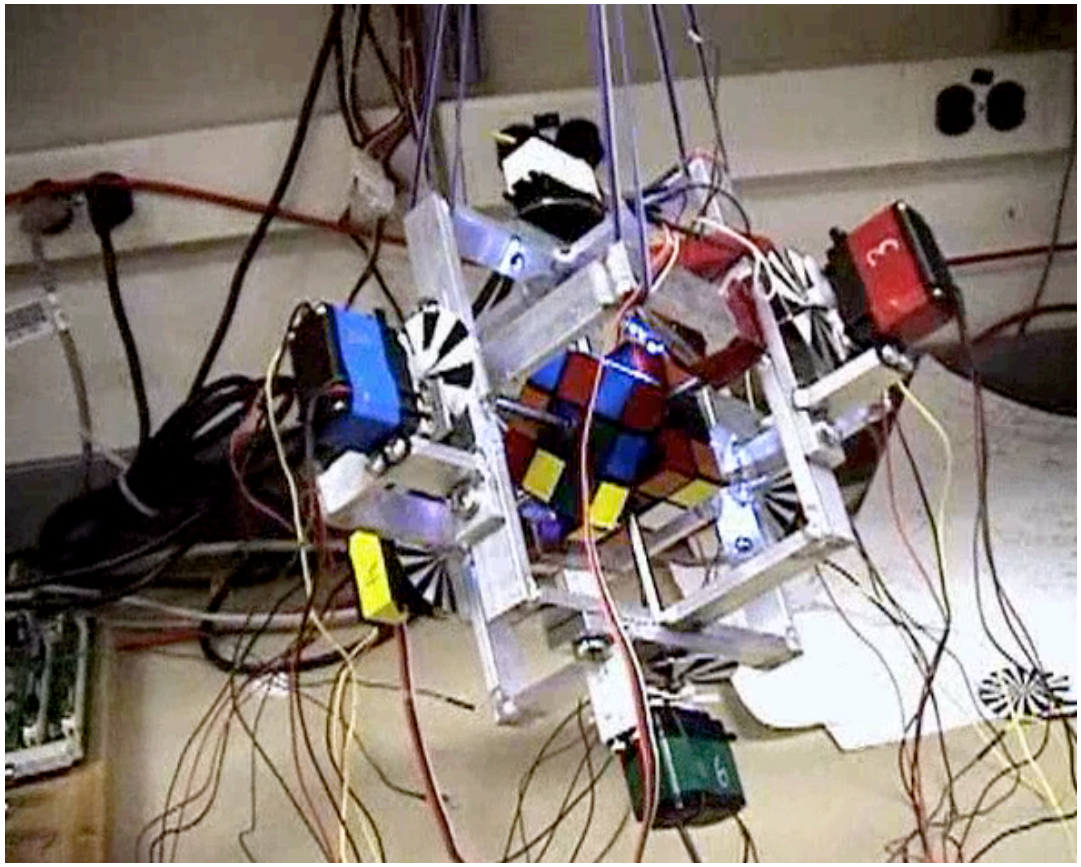
Undergraduate Awards

- Classes with design competitions with industry sponsors
- Department and College Awards
  - Senior Outstanding Achievement Award
  - Undergraduate Outstanding Research Award
  - Undergraduate Outstanding Service Award
  - William L. Everitt Student Award of Excellence
  - Entrepreneurship Award
  - Richard K. Brown Scholarship
  - Distinguished Achievement Award
  - Mildred & Steele Bailey Prize
  - Marian Sarah Parker Prize
  - Henry Ford II Distinguished Class Prize
  - Distinguished Leadership Award
  - William Harvey Seeley Prize
  - EECS Senior Scholars
  - ...
- Student project teams
- …

Mustafa Rangwala, EE major, and team from Space Systems Fabrication Laboratory, took 1st place in Can Satellite Competition

Impressive Student Projects

- EECS 373: Design of Microprocessor-Based Systems
- Doug Li
- Jeff Lovell
- Mike Zajac
- Winter 2005



Rubiks Cubebot

- Video
- http://www.youtube.com/watch?v=q3sklQ3R6kQ

EECS Advising Office

We love questions!

Anna Cihak

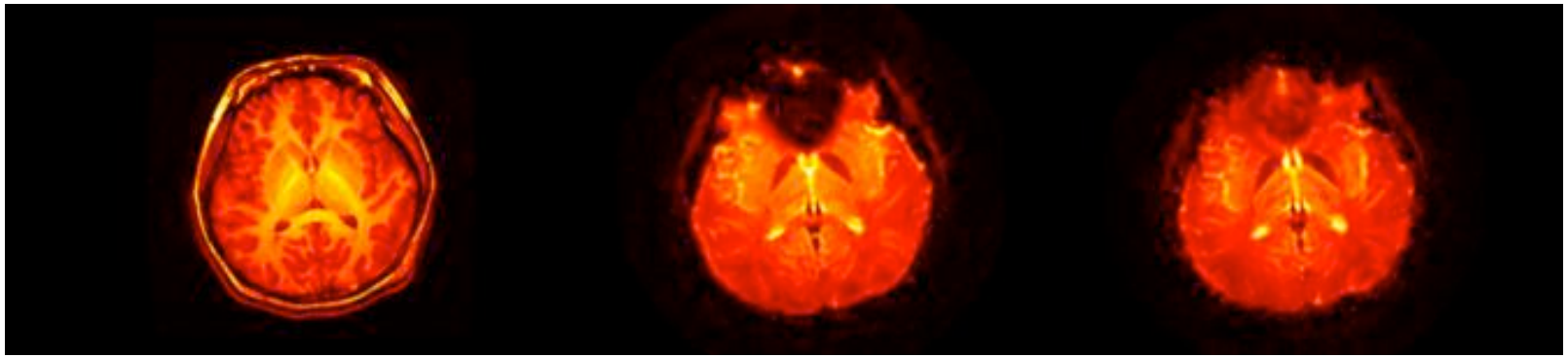
Shannon Spencer

Julie Claus

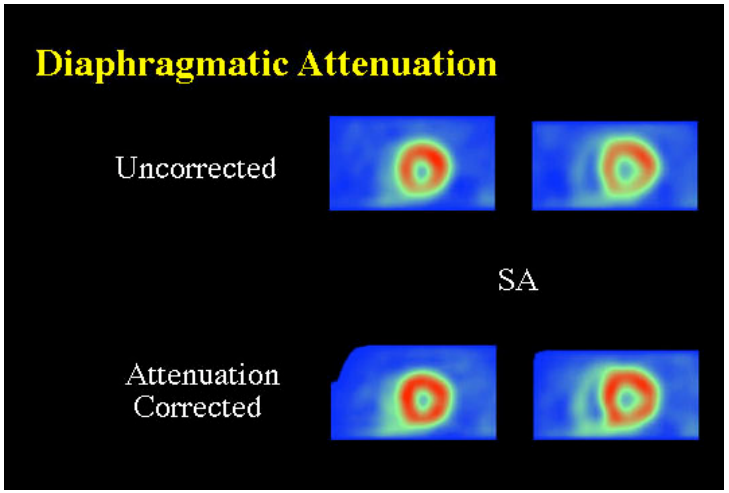
3415 EECS Building
763-2305
ugadmin@eecs.umich.edu

EECS Fields

Biomedical Imaging with Signal Processing



- **Improve MRI brain images**



SPECT cardiac scans

Corrected version shows a healthy heart