American Way of University Education and Research: an Informal Discussion

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http://ece.rice.edu/lasersci/

RICE

OUTLINE

WUT

Wroclaw

Poland

Oct. 27 2011

- Rice University
- Who am I
- What is the University
- Engineering Education
- Electrical Engineering
- Technology for Education
- Rice Engineering Experience
- Summary

29°43'02.67" N, 95°24'11.37" W

© 2008 Tele Atlas

Pointer 29°43'01.52" N   95°24'12.43" W   elev   50 ft Streaming |||||||| 100%   Eye alt   5395 ft

Rice University, Houston

Rice University, Houston

Rice University, Houston

Rice University, Houston

Duncan Hall, Rice University

Brochstein Pavillion, Rice University,

Rice University, Houston

Space Science Bldg. , Rice University

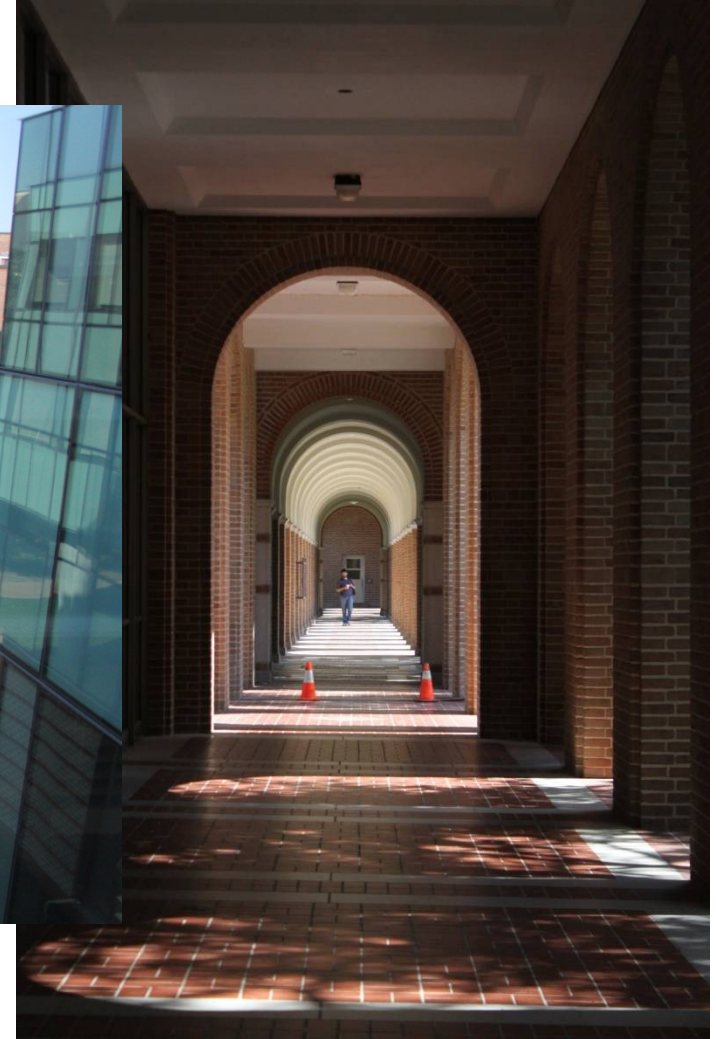# Laser Science Group Laboratory, Rice University

Rice University, Houston

Rice University, Houston

Rice University, Houston

Who Am I?

- PhD in EE from Stanford University 1958
- Faculty member at Rice University, 44 years
- Research and teaching in Laser Physics and Technology
  - Electromagnetic Field Theory
  - Laser Spectroscopy
- Written over 300 articles and contributed to 5 books
- Visiting faculty at
- Chairman of ECE department at Rice (
- Dean of engineering at Rice
- One of the founders of Connexions
- First visited Poland in 1944

RICE

Where did the University Come From?

Locations:
- Athens, Greece
- Bologna, Italy
- Paris, France
- Oxford, England
- Berlin, Germany
- China and India

Supported by:

- Public
- Religion
- Government
- Business

What is the University?

The University is an institution where "universal knowledge" is discovered, created, taught, and learned. Types of university are:

- Liberal Arts College (Wellesley, Trinity, Reed)

- Research University (Stanford, Princeton, Rice)

- Technical Institute (MIT, Caltech, GeorgiaTech)

- Multiversity (UC Berkeley, UT Austin, Illinois)

- Public, Private and Corporate

How did the American University come into Being?

- New England Colleges (Harvard, 1636)

- Land Grant College Act of 1862

- Johns Hopkins (Research) University, 1876

- World War II and the Cold War, 1942-1990

- The GI Bill, 1944

- The Information Age, *now*!

Where is the University Going?

- A new relationship with the public
- A new use of Technology in education
- A new relationship with government and business
- A new model of education and career:
    - must respond to increase in amount of knowledge
    - must respond to rapid obsolescence of knowledge
    - change of faculty role from authority to mentor
    - change from teacher control to shared control
- Must prepare students to learn how to learn

The Research University

Quotation

"We choose to combine basic research, a fair mixture of applied research, training for research, and undergraduate education at the same place, done by the same people, frequently at the same time"

The Top 20 US Universities

Rank	School	Overall Score*
1	Harvard University, MA	100
1	Princeton University, NJ	100
2	Yale University, CT	98.7
3	Columbia University, NY	97.5
4	California Institute of Technology	96.8
5	Massachusetts Institue of Technology	98.1
6	Stanford University, CA	97.5
7	University of Chicago, IL	94.7
8	University of Pennsylvania	94.6
9	Duke University, NC	94.5
10	Dartmouth College, NH	94.4
11	Northwestern University, IL	93.7
12	Johns Hopkins University, MD	93.5
13	Washington University	93.1
14	Rice University, TX	92
15	Brown University	89.5
16	Vanderbilt University, TN	89.4
17	Cornell University, NY	88.5
18	University of Notre Dame, IN	88.4
19	Emory University, GA	88.1
20	University of California, Berkeley	87

* Academic Reputation, student selectivity, faculty resources, financial resources

Electrical Engineering

Electricity transmits energy and information

EE is abstract, therefore, requires

- More mathematics than other subjects
- More physics than many other subjects
- Use of visualization
- Use of simulation

Electrical Engineering

- Applied mathematics
- Applied physics (and Chemistry)
- Design, research

- Computation
- Biology

- Business
- Entrepreneurship

- 22 tenured/tenure track
- One open position
  - Neuroengineering
- 3 professors in the practice
- 1 research faculty
- 30 joint/adjunct faculty

- Graduate
  - Several external fellowships
  - Graduates placed in academia/industrial R&D
    - ➢ UIUC, Michigan, MIT, Georgia Tech, Colorado, …
    - ➢ TI, Intel, Nokia, IBM, Google, Microsoft, …
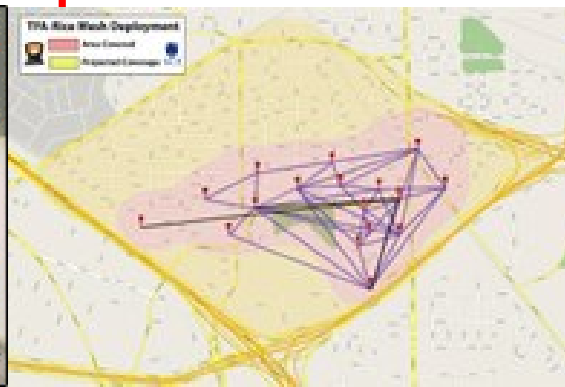 - Societies
    - ➢ SPIE, GSA, GSC, IEEE

- Focus

  - Computer/Neuro engineering and nano-electronics

  - Photonics and nano-engineering

  - Systems

- Annual research expenditure

  - $12M and going up

Photo by C. Radloff

Analog/RF Circuits and Systems
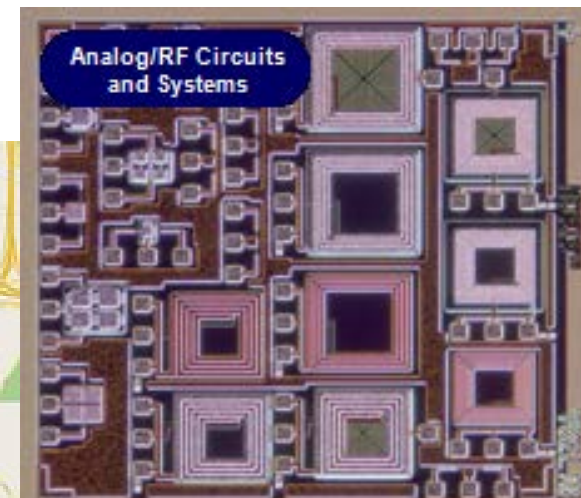
- Space
  - Duncan hall
  - Abercrombie lab
  - Space sciences
  - Smalley institute
  - The Brockman hall of physics
    - Spring 2011
    - 18,000 sqft (labs and offices) for ECE

Undergraduate Degrees

- Bachelor of Science
  - Astrophysics
  - Biochemistry
  - Cell Biology
  - Chemistry
  - Chemical Physics
  - Earth Science
  - Ecology
  - Evolutionary Biology
  - Physics

- Bachelor of Science Degree in Engineering
  - Chemical Engineering
  - Civil Engineering
  - Computer Science
  - Electrical Engineering
  - Material Science
  - Mechanical Engineering
  - Bio Engineering

Technology for Education

- Matlab, Mathematica, Maple, LabView
- OpenCourseware (OCW), Connexions, Wikipedia, Google
- Sakai (a community of educators collaborating to open software that advances teaching and research)
- Moodle (course and learning management system)
- Desktop, laptop, hand-held, mobile smart phone plus Internet; social software systems; tablet devices

Curriculum in Signal Processing

- Mathematics
- Signals and Systems
- Signal processing theory and systems
- Communications theory and systems
- Control theory and systems
- Applications and research

Education in the New System

Shift emphasis from

- Training to education
- Teaching to learning (teacher to student)
- Passive to active (and interactive)
- Process to concept (concept inventory)
- Understand to discover

Need research in learning technical material

Technology for Education

- Matlab, Mathematica, Maple, LabView

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Open Educational Resources

The Open Educational Resource (OER) movement was inspired by the Open Source movement in software.

- Open Course Ware "OCW" (MIT)
- Connexions "Cnx" (Rice)
- Wikipedia (Wikibooks, etc.)
- Creative Commons "CC" (Stanford, Duke)
- Curriki, PLoS, EOL, Shuttleworth's Siyavula Project, CK-12 Project, OSI, etc.

Books and On-Line Use with XML

Books from Connexions:

- Personalized, on-demand printing, up-to-date, inexpensive, collaboratively authored, allows pre and post publication review, never "out of print", "Long tail" publications. One button buy

On-Line use of Connexions:

- Allows modern pedagogy: concept-based, problem solving-based, discovery-based learning. Dynamic, interactive, linked, adapts to learning style, student and author driven, allows "assessment and evaluation", problem sets

Connexions Now

Usage

Repository: 7250 modules, 20,000 revisions, 405 courses or books, 7200 author accounts, 147 countries, print-on-demand books

In Oct. 2008: 17M hits, 1.0M pages views, 520K unique users from 157 countries

Globalization

Europe: Germany, Norway, England, etc.

Asia: China, India, Pakistan, Japan, Vietnam, Korea
Africa: South Africa

LACCEI: (conversation with Mexico, Argentina, Brazil, Chile, and Uruguay started)

Engineering Education

- Curriculum will assume several careers for a person
- Will assume life-long learning and availability of distance learning
- Will prepare a person for management and leadership
- Will make use of internships and summer jobs
- Greater importance will be placed on writing and communication skills
- Education will use collaboration with other universities, industry, and business
- Greater use will be made of technology in education
- The need for both depth and breadth implies a new

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What is Connexions?

1. A **repository** of modules of information available through the web on the Internet
   - Modules (and collections) encoded in XML, one concept, a few pages, a quantum of information

2. A set of **tools** for authoring, maintaining and using the content of the repository
   - Module editor, importer, course or book composer, repository organizer, Creative Commons license, tools for printing books

3. A **community** of people who share educational interests and information
   - Interest groups (authors, instructors, students),

Fundamentals of Signal Processing

By: Minh Do

Course Content

» Introduction to Fundamentals of Signal Processing

FOUNDATIONS

» Signals Represent Information

» Introduction to Systems

» Discrete-Time Signals and Systems

» Linear Time-Invariant Systems

Start Course

Course Author: Minh Do

Course Description: Presents fundamental concepts and tools in signal processing including: linear and shift-invariant systems, vector spaces and signal expansions, Fourier transforms, sampling, spectral and time-frequency analyses, digital filtering, z-transform, random signals and processes, Wiener and adaptive filters.

Contributing Authors: Anders Gjendemsjø, Benjamin Fite, Clayton Scott, Don Johnson, Douglas L. Jones, Hyeokho Choi, Ivan Selesnick, Justin Romberg, Melissa Selik, Michael Haag, Minh Do, Ricardo Radaelli-Sanchez, Richard Baraniuk, Rob Nowak

Fundamentals of Signal Processing
Minh Do

C O N N E X I O N S

Rice University

Connexions Now

Usage

Repository: 16,370 modules, 30,000 revisions, 1001 courses or books, 10,200 author accounts, 147 countries, print-on-demand books

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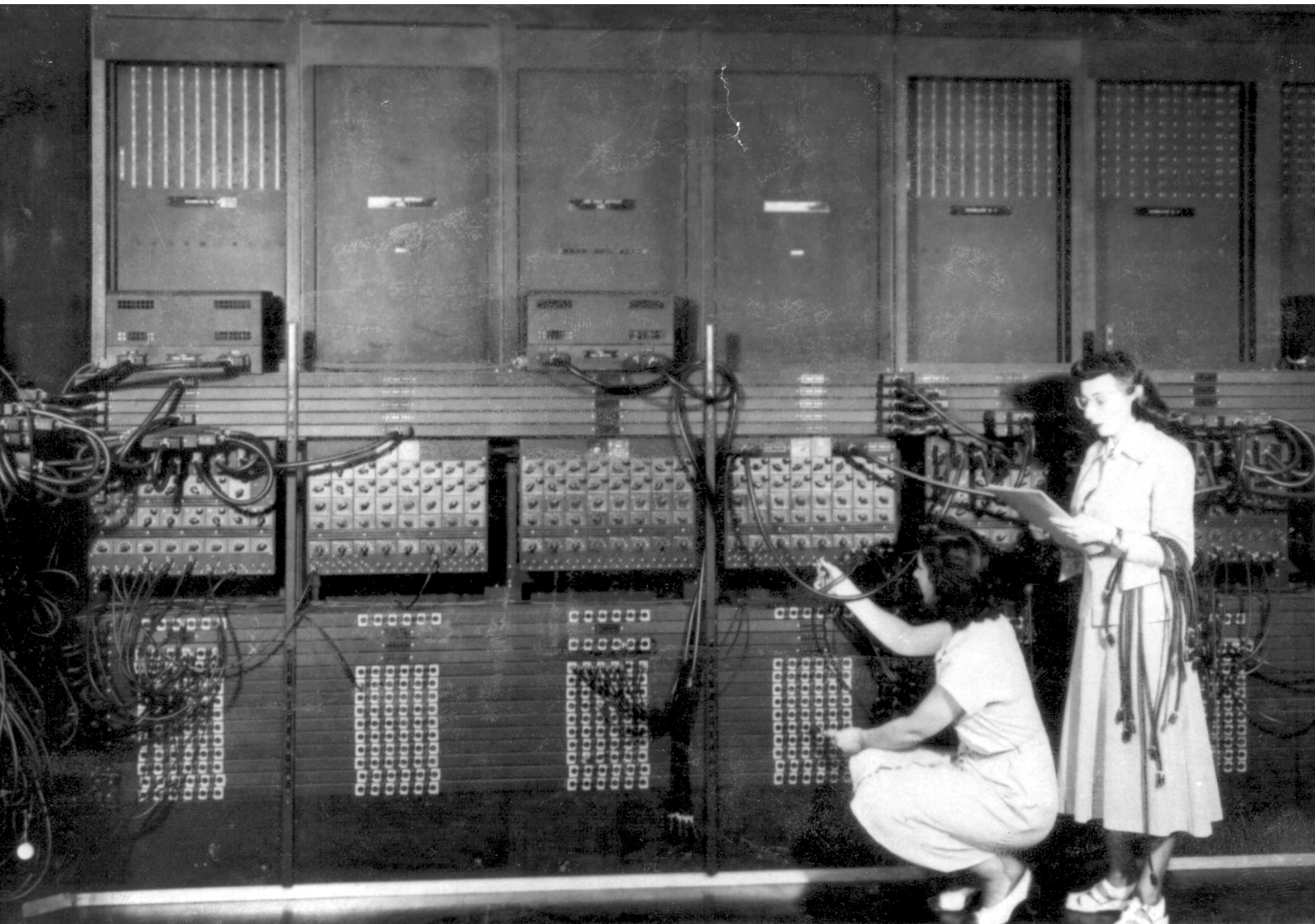
Globalization

Europe: Germany, Norway, England, etc.

Asia: China, India, Pakistan, Japan, Vietnam, Korea
  Africa: South Africa

LACCEI: (conversation with Mexico, Argentina, Brazil, Chile, and Uruguay started)

Next-gen "computer"

Need new "programming" paradigm

- Existing paradigms
  - *C++/Java* written by *Professionals*

- Possible new paradigms
  - Intention, interest described by *Homer*

Need a new "smartphone"

Need a new "smartphone"

- Existing smartphones
  - personal computer

- Possible new smartphone
  - sensor, actuator
  - interface between physical and digital worlds

To summarize

- Two principles
    - Hardware is cheap and getting cheaper
    - Human is precious

- We must rethink "computers" every 6 years

Fabulous RECG students:

Ahmad Rahmati, Mian Dong, Jiayang Liu, Hasan Dumanli, Xiaozhu Lin, Hang Yu, Ardalan Amiri Sani, Siqi Zhao, Zhen Wang, Clay Shepard, Robert LiKamWa, and Jeff Bridge

Fabulous Rice collaborators:

Behnaam Aazhang, Joe Cavallaro, Rudy Guerra, Edward Knightly, Phil Kortum, Doug Natelson, Ashu Sabharwal, Vivek Sarkar, James Tour, Wotao Yin

Why Rice Engineering?

DESIGN

RESEARCH

INTERNATIONAL EXPERIENCE

CIVIC ENGAGEMENT

COMMUNICATION

LEADERSHIP

DEPARTMENTS

FUNDAMENTALS

BIOENGINEERING

COMPUTATIONAL AND APPLIED MATHEMATICS

CHEMICAL AND BIOMOLECULAR ENGINEERING

CIVIL AND ENVIRONMENTAL ENGINEERING
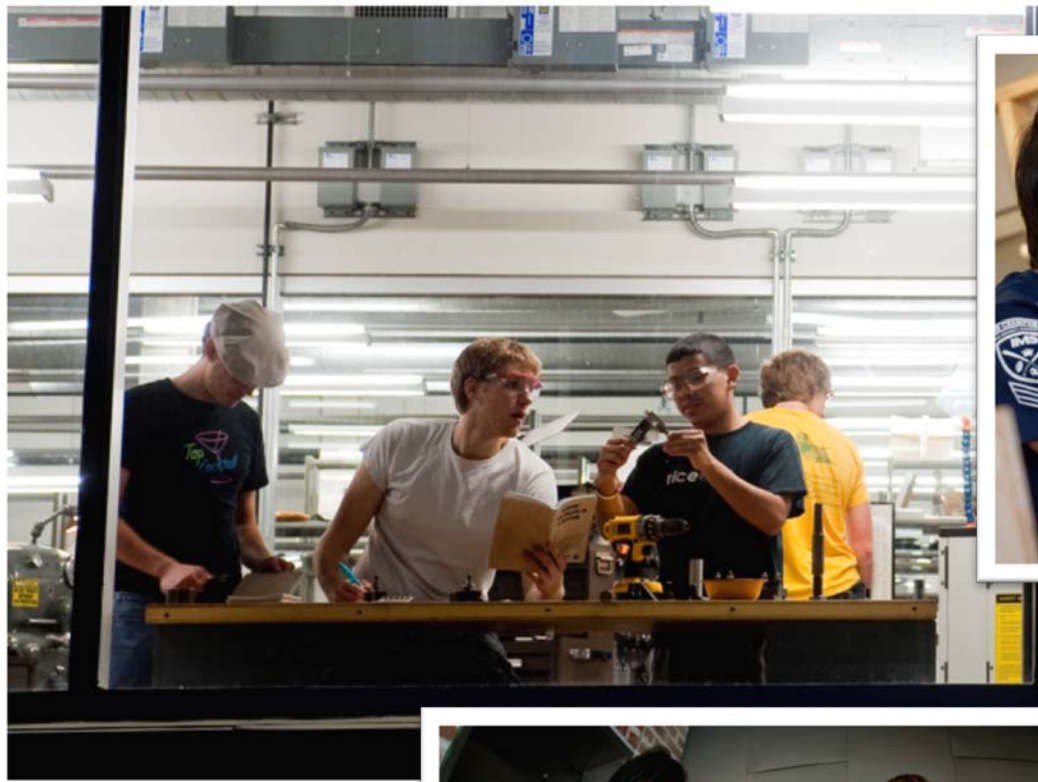
COMPUTER SCIENCE

ELECTRICAL AND COMPUTER ENGINEERING
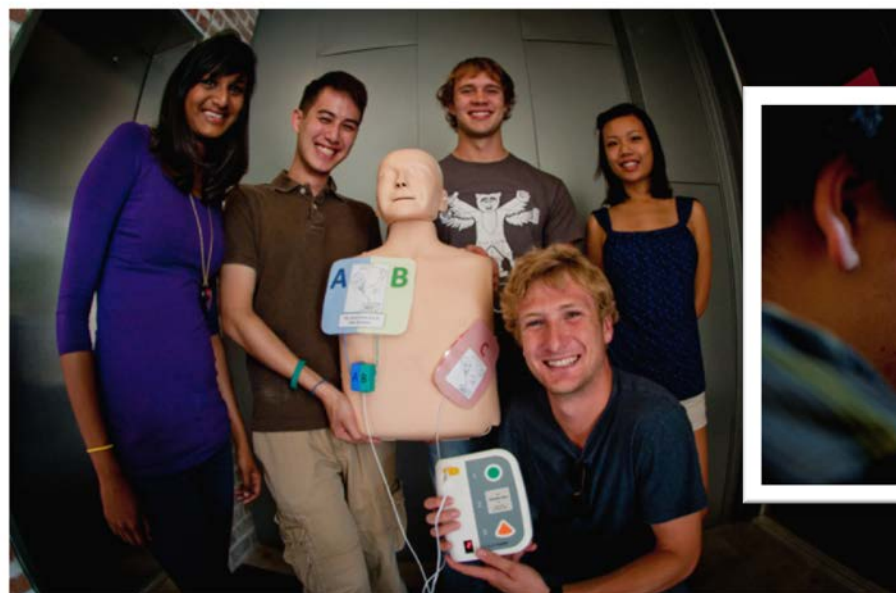
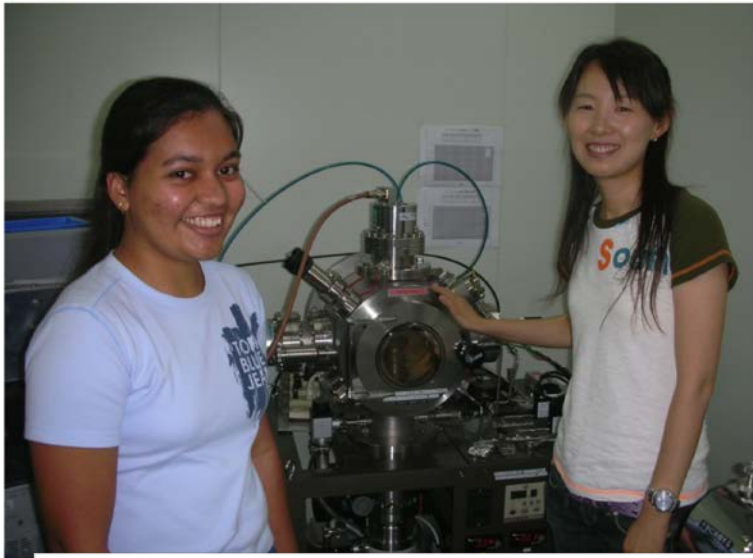**MECHANICAL ENGINEEERING AND MATERIALS SCIENCE**

STATISTICS

DESIGN

INTERNATIONAL

Engineers Without Borders in Nicaragua

CIVIC ENGAGEMENT

Wireless access in Pecan Park
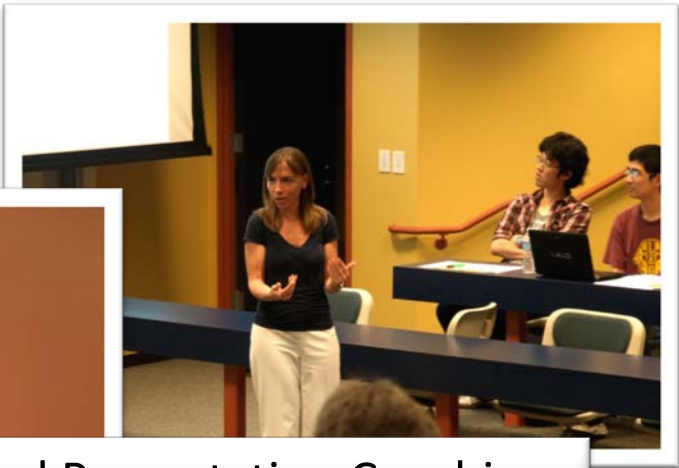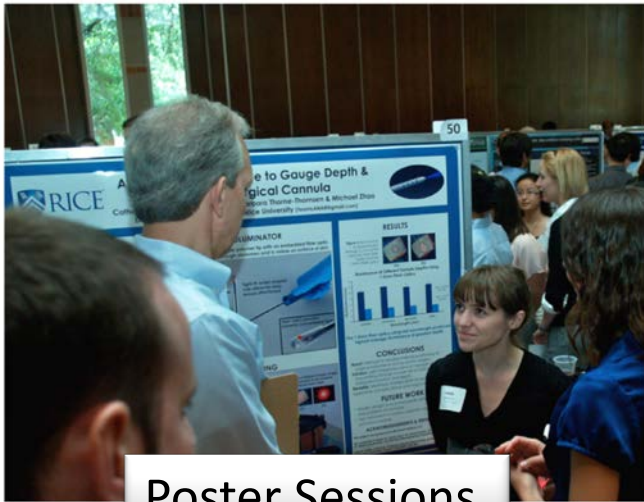
DREAM Project

Washington D.C. Interns 2011

COMMUNICATION

Classroom Presentations

Oral Presentation Coaching

Poster Sessions

EWB National Conference

Rice Center for Engineering Leadership
Mission: Graduate engineers who will be leaders in engineering, research, business and public policy.
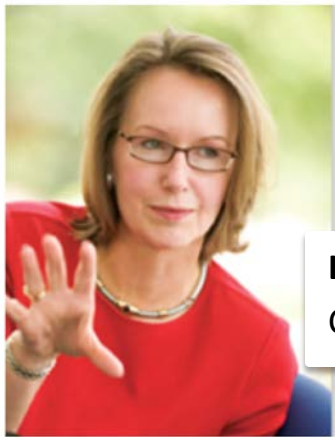
rcel.rice.edu

ALUMNI

Sandra Johnson Baylor

Manager, IBM Linux Technology Center

Christine Ehlig-Economides

A.B.Stevens Endowed Professorship, Texas A&M; Member NAE

Lynn Elsenhans

CEO, Sunoco

Rakesh Agarwal

CEO, Snapstream

Mark Hall

Consultant

Former technical director, Sony Pictures

John Doerr

Venture Capitalist

Lotus, Sun, Compaq, Amazon, Netscape,Google

Rice Engineering Experience

- Prepares you for your future
  - Learn how to learn
  - Develop leadership abilities
  - Develop communications skills
  - Design systems and devices to solve real-world problems
  - Understand engineering in global/social context
  - Create new knowledge through research