Welcome CAP Executive Board

June 11th, 2015
CAP Executive Leadership 2014 - 2015

CAP Chairman:
Jeff Carter  CS Alumnus ‘86
Vice President and General Manager of Teradata Platforms

CAP Vice Chairman:
Mark Ambrose
San Diego Site Executive, Raytheon
Welcome New CAP Members!

AUTODESK

OptCTS, Inc.

Mtell

UC San Diego
Jacobs School of Engineering
Welcome Distinguished Students

Triton Engineering Student Council (TESC)

Institute of Electrical and Electronics Engineers (IEEE)
Amy Chung
TESC VP External
Chemical Engineering ‘16
Upcoming Events for Fall

SD Hacks, October 2-4
Engineers on the Green, September 28
Dinner with the Deans, October 23
   Networking for faculty and students

Goals

- Increased corporate interaction
- Expanding student communication with industry beyond DECaF

Potential events

- Networking with Industry
- Company Tours
- Workshops
- Graduate Panels
SD Hacks
October 2-4, 2015

Where community and collaboration meets innovation

● 1000+ attendees from across the nation
  ○ Programmers, entrepreneurs, innovators
● 36 hours of student interaction
● Aiming to become the premiere hackathon in the west coast

Save the Date

● June 15th
  ○ Website Launch: http://sdhacks.io/
  ○ Participation registration opens

Contact Us
Ryan Hill, Director
rjhill@ucsd.edu

Website:
http://sdhacks.io/

Sponsorship Inquiries:
sponsor@sdhacks.io
Sponsor Tiers

Company logo will appear during launch if sponsorship initiated before 6/15

Opportunities

- Recruitment
- Feedback/product adaptation
- Brand recognition and exposure

Sponsorship Inquiries:

sponsor@sdhacks.io
DECaF 2015 Recap
● 93 companies
● 12 corporate sponsors
● Nearly 2000 student attendees (record attendance)
● Reached capacity for Price Center Ballrooms
● Increased company diversity
● T.O.P. Program implemented

Goals for DECaF 2016
● Start promotion August
● Venue expansion
● Expansion to 100 companies
● Continued increase in company diversity

Contact Us!
● Vivek Koppuru, External Career Fairs Lead lkoppuru@ucsd.edu
● Dhruhin Kurli, Internal Career Fairs Lead dkurli@ucsd.edu
● Amy Chung amchung@eng.ucsd.edu
IEEE UCSD Student Branch

Ryan Collins, President - UCSD IEEE
rjcollin@ucsd.edu

Who Are we?

IEEE @ UC San Diego
Jacobs School of Engineering

500+ student members
EE, CE, CS, and various other majors at UCSD
2nd largest IEEE student branch in the country

What is Our Purpose?

Develop students into successful engineers by offering the following
1. Team projects
2. Technical workshops
3. Community-building events
4. Professional development
5. Technical information sessions
We Explore Projects and Compete

- **Micromouse** – 8 teams of 5 students
- **GrandprIEEE** – 8 teams of 5 students
- **Robomagellan** – 8 students
- **Quadcopter** – 8 students

Totals from 2014/2015:
- Available spots – **96**
- Applicants – **300+**
Goals for 2015-2016 Goals

- Improve Micromouse and Grand PrIEEE competition
- Increase workshop quality
- Improve outreach to middle and high school for STEM awareness
- Prepare members for job and internship experiences
<table>
<thead>
<tr>
<th><strong>Focus</strong></th>
<th>Look, Think and Act as a Top 10 Professional Engineering School</th>
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</thead>
<tbody>
<tr>
<td><strong>Values</strong></td>
<td>Engineering for the Global Good</td>
</tr>
<tr>
<td></td>
<td>Exponential Impact through Entrepreneurism</td>
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<tr>
<td></td>
<td>Collaboration to Enrich Relevance</td>
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The Engineering School of The Future

UC San Diego
Jacobs School of Engineering
Jacobs School Strategies

- Maintain Quality and Serve Student/Industry Demand
- Build Strength around Strategic Themes with Cross-Campus and Industry Partners
- Enhance our Innovation Engine
## Balanced Growth

### Ensure Quality and Meet Demand

<table>
<thead>
<tr>
<th></th>
<th>2014</th>
<th>2020</th>
<th>Top 10* Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Faculty</td>
<td>208</td>
<td>280</td>
<td>344</td>
</tr>
<tr>
<td>Undergraduates</td>
<td>6,850</td>
<td>5,800</td>
<td>5,044</td>
</tr>
<tr>
<td>Ugrad/Faculty</td>
<td>33:1</td>
<td>21:1</td>
<td>15:1</td>
</tr>
<tr>
<td>Masters</td>
<td>700</td>
<td>1,450</td>
<td>1,217</td>
</tr>
<tr>
<td>Ph.D.</td>
<td>1,050</td>
<td>1,300</td>
<td>1,510</td>
</tr>
<tr>
<td>Graduate/Faculty</td>
<td>8:1</td>
<td>10:1</td>
<td>8:1</td>
</tr>
</tbody>
</table>

*MIT, Stanford, UC Berkeley, Caltech, CMU, UIllinois, Purdue, Michigan, Texas-Austin
Fall 2015 Freshman Class at a Glance

19,000 Applications – 4,416 Admitted – 900 Acceptances

Among 900 Registered Students:

Average GPA: 4.19 (4.4 scale)
Average SAT: 2042 (2400 possible)

Female: 28%
URM: 14%
Fall 2015 Transfer Class at a Glance

3,306 Applications – 718 Admitted – 325 Acceptances

Among 325 Registered Students:

Average GPA: 3.68 (4.0 scale)

Female: 23%
URM: 15%
Fall 2015 Masters Class at a Glance

5,726 Applications – 1663 Admitted – 724 Acceptances

Among 724 Registered Students:

Average GRE: 320 composite

Quantitative: 166
Verbal: 154
Growing Demand for Empowered Masters-level Talent

Industry demand, regional economic need

M.S. Enrollment to Jacobs School

UC San Diego
Jacobs School of Engineering
Student-Centered Education

- **Student Success Initiative**
  Programs to improve retention and enhance academic success, particularly amongst women and URM.

- **140 Engineering/40 General Education**
  180 unit degree goal to enable students to graduate in four years.

- **Experience Engineering (E4)**
  Design-Make-Break courses, throughout all four years to improve retention and enhance career preparedness.

- **Team Internship Program**
  Engineering projects onsite with corporate partners to enhance career preparedness.
Student Success Initiative

Increase Diversity and Retain Students in the Major

- Introductory Math
- Facilitated Study Groups
- Early Warning System
- Learning Center
E4 Freshman Pilots in Progress

- **Bioengineering**: Winter 2015
  - Electrophysiology for Brain-Machine-Body Interface

- **Mechanical Engineering**: Spring 2015
  - Electric motor propeller plane

- **Computer Science**: Fall 2015
  - Assemble and Program Simple Robot

- **Electrical Engineering**: Fall 2015
  - Manipulating Sound

- **NanoEngineering**: In Progress
  - Nanoparticle Color Displays (www.physik.uni-muenchen.de)

- **Structural Engineering**: In Progress
  - Structural Performance Projects

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Key concepts as an introduction to CSE Major:

- Simple programming
- Simple debugging
- Simple design
- Assembling simple computing devices
- Links between software and the real world

Steve Swanson, Prof. CSE Department
Rajesh Gupta, Chairman & Prof. CSE Department
1. Program a Robot: Learn What’s Possible

**Hypothesis:** Using a simple programming language, I can make the robot move, flash lights, respond to input, etc.

**Exercise:** Program a pre-built robot to perform simple tasks

**Analysis:** Understanding the relationship between code and action, see what’s possible for the robot

**Tools:** Lab space, pre-built robots
2. Design and Build a Robot

**Hypothesis:** I can design and build a robot

**Exercise:** Set goals for the robot. Design it (including decorative elements) using simple web-based tools. Assemble it. Test it

**Analysis:** Identify robot features necessary to achieve the robot’s goal

**Tools:** Soldering facilities, circuit mill, 3D printers, Laser cutters
3. Give it Life

**Hypothesis:** The robot I designed can achieve the goals I set for it

**Exercise:** Program the robot to achieve its goals

**Analysis:** Debugging, refinement of goals, understanding shortcomings and mistakes

**Tools:** Lab space
Key concepts that students will learn as an introduction to their major:

- Circuit theory, assembly, and testing
- Embedded systems programming and debugging
- Transducer mechanisms and interfacing transducers
- Signals and systems theory
- Digital signal processing
- Modular design techniques

Drew Hall, Prof. ECE Department
Truong Nguyen, Chairman & Prof. ECE Department
1. Manipulating Sound

**Hypothesis:** With basics of circuit theory, I can create sound waves and learn common electrical test equipment

**Exercise:** Build an audio amplifier with various filters to attenuate/amplify different frequency bands

**Analysis:** Characterize the transfer function of their circuit and also how they perceive the various filters

**Equipment:** Breadboard, passive components, microphone, speaker, and OpAmps.
Test equipment - power supplies, oscilloscopes, function generators, and signal analyzers
2. Interfacing the Physical World

**Hypothesis:** I will learn to interface electronics through embedded systems programming, debugging, and the theory behind various transduction.

**Exercise:** Build circuit interface sensor modules including: GPS, accelerometer, gyroscope, humidity, pressure, and audio.

**Analysis:** Analyze the measured signals using digital signal processing techniques.

**Equipment:** Arduino microcontrollers and sensor shields will be used for rapid prototyping.
3. Communication Links

**Hypothesis:** I can transmit, receive and interpret information through embedded systems programming, debugging, and communication theory

**Exercise:** Build circuits to transmit and receive data over an optical link

**Analysis:** Analyze the transmitted and received signals including different modulation/demodulation techniques

**Equipment:** Arduino microcontrollers, IR LED, IR photodiode, power supplies, and oscilloscopes

Source: InfoHighTech

Source: Krazatchu
Institutes - Collaboration to Enrich Relevance

- Arts & Humanities
- Global Entrepreneur
- Production & Innovation
- Maker Space Design
- Contextual Robotics
- Materials & Energy
- Data Science & Security
- Engineering & Clinical Medicine
- Oceans & Environment
- Physical Sciences
- Social Sciences
- GPS
- Rady School
- Health Sciences
- Jacobs School
- Scripps
Contextual Robotic Technologies

Partner: Cognitive Science Department (Social Sciences)

7 New Faculty in Engineering and Cognitive Science
$50 Million+ Research Program Already Underway

Goal: Develop Systems that “SEE”, “THINK” and “DO”

Environmental Monitoring/Disaster Response

Education

Assisted Living

Manufacturing, Transportation, Logistics
Contextual Robotic Research

Demonstrate Relevance Robotics Innovation

Northrop Grumman
Launch Robotics Institute through seed research gift in the field.

Four Projects Awarded:
• Swarm Coordination in Disaster Response Operations
  Professor Jorge Cortes and Professor Sonia Martinez

• Real Time Object Detection with Deep Learning Models
  Professor Nuno Vasconcelos

• Information Bottlenecks in Contextual Robotics
  Post-doc Balakrishnan Narayanaswamy

• Image-To-Image Paradigm, A Roadmap to Rapid Contextual Science and Language Understanding
  Professor Zhuowen Tu

UC San Diego
Jacobs School of Engineering
Global Production & Innovation

Partner: School of Global Policy and Strategy

Study the interaction between production/innovation driven by new technologies; and consequences for the world economy.

Provide effective foresight to policy makers and industry partners.
Cali-Baja Partnership Opportunities

Strengthen Design-Manufacturing Ecosystem: Proximity Matters

Skyworks Pilot

• Summer 2015 Internship Program: 15 students
• Faculty Speaker Series (Jan-June: Skyworks and CETYS)
• Discussions underway about master’s-level education partnerships
Questions/Discussion
Inaugural “Agile” Research Centers

Center for Wearable Sensors
Joseph Wang, Patrick Mercier

Center for Extreme Events Research
J.S. Chen

Center for Visual Computing
Ravi Ramamoorthi

Sustainable Power and Energy Center
Shirley Meng

- Cell Factories for Pharmaceutical Production
- Drones and UAVs
Molecular Stretchable Electronics: Towards the Next Generation Robust & Wearable Devices in Energy & Healthcare
Molecularly Stretchable Electronics
for Next-Generation Robust & Wearable Devices in Energy & Healthcare

Darren J. Lipomi

dlipomi@ucsd.edu
group.darrenlipomi.com

Jacobs School of Engineering
CAP Executive Board Meeting
June 11th, 2015
Research History

**Stanford University** (2010 – 2012); Prof. Zhenan Bao
- Intelligence Community (CIA) Fellowship
- Electronic skin
- Stretchable solar cells
- Transparent sensors

**Boston University** (2001 – 2005); Prof. James S. Panek
- Beckman Scholars Fellowship
- Medicinal chemistry

**Harvard University** (2005 – 2010); Prof. George M. Whitesides
- American Chemical Society Fellowship
- Organic solar cells
- Microelectronics
- Chemical sensors
- Nano-optics

Lipomi et al. Nature Nanotechnology 2011, 6, 788
- Transparent, stretchable pressure & motion sensor using carbon nanotubes

Chen, Tee et al. Nature Communications 2014, 6, 788
- Sensor implanted in mouse skull for monitoring intracranial pressure

- Electronic skin
- Stretchable solar cells
- Transparent sensors
More energy in the form of sunlight strikes the earth in an hour than is consumed by human activity in a year.
Land Area

- Is the requirement for land area a deal-breaker for solar?
  
  - Solar panels: **10-20 W/m²**
  
  - Wind: **1-2 W/m²**
  
  - Hydroelectric (Lake Mead): **3 W/m²**
  
  - Biomass (3% efficient algae): **3 W/m²**
  
  - Corn ethanol: **0.1 W/m²**
  
  - Hydrothermal flux: **0.057 W/m²**

Saul Griffith, X-prize lecture: http://www.youtube.com/watch?v=jhT94Bbl70M
Solar Paint?

“the solar energy conversion system can cost [no more than] 10 times more than the cost of paint.”

Lewis and Nocera, *PNAS 2006*

Lewis, N.S. http://nsl.caltech.edu/

- Organic—“plastic”—semiconductors:

\[
\begin{align*}
\text{H}_3\text{C}(\text{H}_2\text{C})_5 & \quad \text{H}_3\text{C}(\text{H}_2\text{C})_5 \\
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\]
Plastic Solar Cells

- Plastic solar cells are >10% efficient (lab scale), have high power to mass ratio (10 W/g), and energy payback of 1 day.

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"...mechanical failure mechanisms were dominant during the field test."

I’ve learned at times it’s best to bend, ‘cause if you don’t, well those are the breaks.

–Jim Croce
“The Hard Way Every Time”

Croce’s Restaurant, Gaslamp Quarter (Now Banker’s Hill)
Goals

1. Improve mechanical stability

2. Enable *molecularly stretchable electronics*
   
   a. integration with moving parts
   
   b. bonding to 3D surfaces

Kim et al. *Nature Mater.* 2010, 9, 511

Shepherd et al. *PNAS* 2011, 50, 1890

Haiti, American Red Cross
Elasticity of Electronic Plastics

- Effect of molecular structure on stiffness of materials

![Diagram of molecular structure and graph showing stiffness vs. number of carbon atoms.](Image)

Stretching & Bonding to 3D Surfaces

The Best of Both Worlds

- Is it possible to maximize efficiency and minimize stiffness?

- Answer: yes!

Prediction of Molecular Stretchability

with Prof. Gaurav Arya

Root, Arya, Lipomi (in preparation)
Automated Mechanical Tests
with Prof. Frederik Krebs, DTU
Epidermal Solar Cells

O'Connor, Zaretski, Savagatrup, Printz, Wilkes, Diaz, Rodriguez, Lipomi et al. (in revision)
Graphene as Transparent Barrier Film?
Low-Cost Manufacturing of Graphene

- Strongest, most conductive material known to science
- Current method destroys 10^5 g catalyst for 1 g graphene

Zaretski, Moetazedi, Kong, Sawyer, Savagatrup, Valle, O’Connor, Printz, Lipomi *Nanotechnology* 2014, 26, 045301
Future Bio-Inspired Electronic Materials

- Characteristics of human tissue
  1. Extreme elasticity
  2. Biodegradability
  3. Capacity for self-repair

Phase I: Synthesis

Site of stimulus response:
- Elastic PEO side chains
  - i) Self-repair
  - ii) (Bio)chemical sensing

Biodegradable elastomeric segment  \( \pi \)-Conjugated semiconducting segment
Impact

- Market forecasts (by 2020)
  - Transparent electrodes: $5B
  - Wearable electronics: $12B
  - Flexible packaging: $250B
  - Solar photovoltaics: $345B

- Social benefits
  - Fracture-proof, ultra-thin modules for solar energy for off-grid, disaster relief, military, intelligence, & developing world applications
  - Stretchable, wearable, implantable, biodegradable devices for preventive medicine & postoperative care

http://electroiq.com/blog/2013/05/transparent-electrode-market-to-grow-to-5-1-billion-by-2020/
Viewers Like You
Thank You
CAP Business

Cody Noghera
Director Corporate Affiliates Program
Jacobs School of Engineering
Thank You to our Corporate Affiliates Program Members and Research Expo Key Sponsors

Welcomed over 600 attendees
A master’s degree for engineering professionals

**AY 2014-15 Summary**

142 Total students enrolled in 4 MAS programs

Graduating this year…

- 35 Architecture-based Enterprise Systems Engineering
- 12 Medical Device Engineering
- 24 Wireless Embedded Systems

MAS Engineering Degrees awarded: 246

**MAS @ Jacobs School 2011 - 2015**

Representation from more than 100 local companies
Master of Advanced Study Updates

A master’s degree for engineering professionals

Fall 2015 – There’s still room!!

We are still accepting applications – deadline is June 30, 2015*

*Special consideration for CAP company employees through July 31st

• Architecture-based Enterprise Systems Engineering
• Medical Device Engineering
• Wireless Embedded Systems
• Data Science and Engineering
Senior Design Projects

MAE 156B: Industry Sponsored Course

What the Course Provides

• Teams of 3-6 students
• 15 week project durations
• Deliver working prototype to sponsors
• IP assigned to sponsor

Projects can be interdisciplinary

• Mechanical
• Electromechanical
• Fluid mechanics
• Heat transfer
• Computer Control

Nathan Delson, Director, MAE Design Center - ndelson@ucsd.edu
https://sites.google.com/a/eng.ucsd.edu/mae3-robots/2015-spring/team-34
Senior Design Projects

Teradata Server Rack Cabinet Movers
- Cradle
- Outriggers
- Battery
- Dual Hydraulics
- Heavy Duty Casters

Delta Design IC Testing and Handling
- Device Under Test
- Holder for Thermal Testing
- Gyro and Accelerometer Testing

SPAWAR
- Surface Towed Geolocation System
- Robotically Controlled ATV
- Water Purification
- Variable Ballast System

ATA Engineering: Modal Analysis Shaker
2015 Team Internship Program

50 Companies  82 Teams  338 Students

TIP Leadership Training Event
June 4th, 4:30-9:00pm

• 100 students attended
• 6 CAP Industry Members
• 4 TIP 2014 Alumni
• Business Basics Presentation
• Dinner & TIP Alumni/Industry Panel
• Team Dynamics + Leadership Presentation
“Students say...”

“Given our limited experience... It’s absolutely necessary to get this training beforehand!”

“My favorite part is the focus on teamwork, and maintaining efficiency & productivity through team dynamics.”

“I am excited to be a part of TIP and transition into the real working world. I enjoyed meeting professionals in my field.”

"UC San Diego
Jacobs School of Engineering"
CAP Year in Review 2014 - 2015

65 Dedicated Partners
5 New Members

84 On-campus Recruiting Events
53 Days @ Jacobs
4 Student Lunches
8 Office Hour Days
10 Interview Days
4 Engineering Competitions
1 TIP Training Day

Key Participation of CAP Executives in
1 Record Research Expo
1 Spirit of Solar Cruise
3 Quarterly Board Meetings
5 Center Research Reviews
CAP Business:

Dates to Remember:

Thursday, October 15, 2015  
CAP Executive Board Meeting

Friday, October 30, 2015  
Contextual Robotics Forum

Thursday, February 4, 2016  
CAP Executive Board Meeting

Thursday, April 14, 2016  
Jacobs School Research Expo