Computer Engineering Annual Report, 2004-2005

Computer Engineering focuses on the design, analysis and application of computers and on their applications as components of systems. The UCSC Department of Computer Engineering sustains and strengthens its teaching and research program to provide students with inspiration and quality education in the theory and practice of computer engineering.

Departmental Mission Statement

Achievements

The past year has seen many achievements within the Department of Computer Engineering.

- We established a new minor in Computer Technology targeted for students outside the School of Engineering, especially those interested in K-12 teaching.
- We launched a graduate sequence in Control with the potential for a graduate program spanning several disciplines.
- We gained significant national publicity with our assistive technology research.
- We created a new frosh Hands-On Computer Engineering course, targeted to help students explore majors and increase first and second year retention.
- We offered a new Mechatronics course as part of an undergraduate emphasis in robotics.
- We published a brochure for undergraduate and graduate student outreach.
- We maintained enrollments during a difficult time for engineering.
- We received grant and gift income of $3.4M, 65% larger than the previous year.
- We established a new graduate student organization, eWomen.
- We educated 157 majors and pre-majors and 76 graduate students.
- We graduated 51 BS, 18 MS, and 7 PhD students.

As the Department of Computer Engineering begins its third decade, we look forward to continuing our emphasis on excellence in computer engineering education, research, and teaching, combined with a constant focus on the innovation and incubation of new programs.

1984-1989

- Pat Mantey launches UCSC Engineering
- ABET Accreditation
- Graduate Program

1990-1994

- BS/MS program
- First PhD graduate (1992)
- ISM major launched (Mantey, CS, Econ)

1995-2000

- EE launched
- School of Engineering
- Professional MS program
- CITRIS/ITI Created

2000-2005

- BS Bioinformatics (1st in CA) launched
- Computer Technology Minor
- SURF-IT REU Site

2006-2010

- Autonomous Systems/Control
- Assistive Technologies

Computer Engineering's 20-year history as innovator and incubator of programs

10-Year Plan Retrospective

Computer Engineering has had no net growth since 2001-2. In spite of the lack of growth, we have been able to meet or exceed most 10-year plan measures, when adjusted for the number of faculty.

For 2004-5, the target was 21 LR faculty and 1 open position; we instead have 16 LR faculty and 2 open positions. Thus, we are 24% below plan in LR faculty. As we had no recruitment authorizations in 2004-5, this deficit will be 27% in 2005-6. With current recruitments underway, we expect to have 18 LR faculty in 2006-7, 22% below plan.

Computer Engineering achieved plan or close to plan in 2004-5 in most categories of the 10-year plan, when adjusted for the lower number of LR faculty (16 + 2 slots, rather than 21 + 1 slot). This across-the-board achievement of the 10-year plan goals may be unique within the School. At the undergraduate level, adjustments are made according to LR faculty slots (18) because empty slots enable the hiring of non-senate faculty to cover curriculum. At the graduate level, adjustments are made according to LR faculty positions (16) since only positions we have been authorized to fill can advise graduate students. These numbers include:

- Undergraduate Enrollments: 9% above plan per LR faculty slot
    - 268 FTE enrollments, planned 300, but 18% below LR faculty slots
    - Similarly for overall enrollments
- Undergraduate majors: 25% above plan
    - 57 premajors and 100 majors, plan 125
- Graduate Enrollments: 20% below plan per LR faculty member
    - 57 FTE enrollments
- Graduate students: 10% below plan per LR faculty member
    - Not counting 15 part-time MS students, which place us at plan
- Research funding: 9% above plan per LR faculty member
    - $3M, not including $444k in cash and equipment gifts.
    - Achieving plan with respect to graduate funding will enable us to support a larger graduate program in the coming years, thus closing the shortfall in graduate enrollments and students.
- Research expenditures: 25% below plan per LR faculty member
    - As research funding has now arrived on plan, research expenditures will follow.

Goals

The Department of Computer Engineering has goals of excellence in research, undergraduate and graduate teaching, and service. In research, we target five specific areas of research excellence:

- computer system design
- design technologies
- digital media and sensor technology
- computer networks
- embedded and autonomous systems.

We have also defined a cross-cutting interdisciplinary emphasis in assistive technology as a targeted area of opportunity as we seek to train undergraduate and graduate engineers for the future. In teaching, we strive for innovation and excellence in the classroom and in academic programs. We have led efforts to integrate modern technology in teaching, and are constantly working to improve our undergraduate and graduate curricula. In service, we dedicate ourselves to serving the Baskin School, UCSC, and our professional disciplines. Computer Engineering faculty frequently dedicate themselves to leading many efforts, both on campus and off.

During the coming year, our specific goals will include:

- Successful recruitment of an exceptional Associate or Assistant Professor in VLSI/FPGA system design.
- Successful recruitment of an exceptional Assistant Professor working in the broad field of Assistive Technologies.
- Completing the MSNE program's administrative changes, increasing enrollments, and leveraging with the Technology and Information Management (TIM) program.
- Graduate student outreach and coordination with other SOE programs.
- Collaborating with other departments in the development of bioengineering programs.
- Implementing a workload allocation scheme taking into account research, service, and teaching.
- Working with SOE Development to increase contact with alumni and donors beyond our annual letter.

Opportunities

The Department has identified five exciting opportunities for the near future.

- Assistive technologies and Bioengineering. This area is of extreme importance to the aging population. A group of 3-6 faculty and the creation of a research center could propel us to excellence. The group would have strong collaborations with faculty in digital media and sensor technology, embedded and autonomous systems, Biomolecular Engineering, and Electrical Engineering. This could form a nucleus, with other SOE programs, for launching academic and research programs in bioengineering. Between 1999 and 2002, the number of Bioengineering BS degrees granted increased by 50%, MS by 78%, and PhD by 30%. In the System, bioengineering programs have been or are being created at every campus, and UCSC hosted the 2005 Systemwide Symposium on Bioengineering.

- Program in Autonomous Systems. William Dunbar, Gabriel Elkaim, Jorge Cortes (AMS) have developed a graduate course sequence in control. Computer Engineering has proposed as part of the five-year perspective, the development of a graduate program in control. This cross-cutting area would be expected to include faculty in CE, EE, AMS, ISM, Economics, and potentially other areas. We are poised to launch exceptional robotics research and degree programs with 2 hires in autonomous systems and one hire in embedded systems during the next 5 years. All such positions may be part of the assistive technology emphasis.

- Networks Pinnacle of Excellence. Computer Engineering's most productive research group is in Computer Networks. Indeed, within the School of Engineering, this group has produced more Ph.D. graduates than any other group, and has placed students at many academic institutions. We presently have a strong focus on wireless networks (JJ Garcia-Luna and Katia Obrazcka) and on high-speed network architectures (Anujan Varma). This group is poised to expand to internetworking and applied network security.

Network and internet security has become a key area of applied research within the computer networks field, thanks to the popularity of wireless networks which are more difficult to secure than wireline networks. The demand for graduates with specialization in network security is currently far higher than the supply, and this is likely to persist for some time.

- Invigoration of core areas of computer system design and design technologies. Because of the loss of Professors Karplus, Dai, and Madhyastha, and the exceptional service loads of Professors Ferguson, Larrabee, and Hughey, we have had to turn away many highly qualified applications in these areas. The successful hire of Jose Renau and the 2005-6 recruitment in this area is the start of rebuilding our core strength, though we will need one or two more faculty in this area within the next 5 years to ensure and enable undergraduate and graduate education, training, and research of the highest quality.
- Sustained excellence in Digital Media and Sensor Technology. Our dynamic and collaborative group working in digital media and sensor technology interfaces collaborates extensively in CE, the SOE, and on campus. We have a particular interest in "rich media" technology for education, both in the classroom and on the web. Another hire in this area in the next 5 years will leverage and multiply our research activity in this growing area.

Collaborations

The Department will continue its high level of interdepartmental, interdivisional, and inter-campus collaborations. During the past year, these collaborations have included:

- Professor Ferguson served as Provost of Crown College, SOE Associate Dean, and Chair of the Council of Provosts.
- In the Academic Senate, Professor Ferguson served on Committees, Professor Larrabbee served on Educational Policy, Professor Hughey chaired Educational Policy, and Professor Mantey served on Admissions and Financial Aid.
- Professor Larrabee brings vigor and innovation to undergraduate student recruitment as the SOE Outreach Coordinator.
- Professor Hughey served on the UCSC Extension Task Force, the Academic Advisory Committee, Senate Executive Committee, and the University Committee on Educational Policy.
- Within the SOE, Professor Varma directed the Korea Telcom program, and Professor Mantey chaired the Information Systems and Technology Management advisory committee.
- Professor de Alfaro acted as General Chair (and Program Co-Chair with Professor Abadi) of a successful CONCUR conference
- Professors Dunbar, Elkaim, and Mantey have collaborated extensively with the faculty in Technology and Information Management on joint research and program development.
- Professor Mantey has been involved in STEPS, IGPP, UARC, CITRIS, IUCRP Steering Committee, CRS (Center for Remote Sensing, a part of IGGP), CIMT (Long Marine Lab) and SSRC (CS)
- Professors Dunbar, Hughey, Manduchi, and Mantey are active members of the Center for Biomolecular Science and Engineering.
- Our Senior Design Projects Class, led by Professors Petersen and Bazeghi, has catalyzed many SOE and cross-campus collaborations, especially with Ecology and Evolutionary Biology.

In the coming year, we see many opportunities for further collaboration with the development of the assistive technology emphasis area and bioengineering degree programs, examining the interface between the computer engineering, computer science, and electrical engineering graduate programs,

Advancing diversity

The Department of Computer Engineering will continue to address issues of diversity in manners similar to the prior academic year. Last year,

- Instructor Guy Cox and Professor Hughey lead an NSF Research Experiences for Undergraduates Site SURF-IT, a summer research program with a focus on increasing the number of women and underrepresented minorities in engineering
- Professor Ferguson has leadership roles in the Multicultural Engineering Participation (MEP) program and the NSF Developing Effective Engineering Pathways (DEEP) program with De Anza and Foothill Colleges.
- Professor Hughey is faculty advisor by our Society of Women Engineers chapter, and also helped graduate students organize our newest diversity-oriented group, eWomen.
- Professor Manduchi is advisor to our Society of Hispanic Professional Engineers chapter.
- Professor Hughey worked with Professors Ferguson and Werner to submit an NSF proposal for Broadening Participation in Computing, which if funded would enable creation of a 2-year retention program focused on women in computing.

In the coming year, at the undergraduate level we see CE1 as being a continuing instrument for retention and diversity. At all levels (student and faculty) the growing focus on assistive technology within CE and bioengineering within the SOE is likely to significantly promote diversity within the School.

2004-5 Graduate Degrees Granted by Computer Engineering

Student	Degree	Advisor	Title
Avula, Bhavan	MS	Brandwajn	
Banerjee, Debasree	MS	Garcia-Luna	Supporting Real Time Traffic over Ad-Hoc Wireless Networks
Boyd, Mark	Ph.D	Larrabee	Complexity Analysis of a Massively Parallel Boolean Satisfiability Implication Circuit
Das, Deboja	MS	Varma	Analysis of Fault Recovery Methods on Different Routing Schemes
Devineni, Swapna	MS (CS)	Garcia-Luna	project: Cellular Telephony and Push to Talk Technology
Du, Yu	Ph.D	Dai	Capturing On-Chip Inductance Effects by the Partial Reluctance Approach
Gopinath, Subhash	MS	Varma	Remote Monitoring in OSPF
Guru, Rachna	MS	Garcia-Luna	On the Performance of On-Demand Routing Protocols for Mobile, Multi-Hop Wireless Ad-Hoc Networks
Hilberg, Ruth Soleste	MS	Hughey	
Hong, Bo	Ph.D	Brandt (CS)	Storage and File Systems for MEMS-Based Storage
Huang, Lei	MS (CS)	Garcia-Luna	A Group-Node-Activation Multiple Access Protocol for Ad Hoc Networks
Ji, Hao	Ph.D	Dai	Efficient On-Chip Inductance Modeling
Kuncham, Prashanthi	MS	Garcia-Luna	Implementation of the Wireless Routing Protocol AdHoc OnDemand Distance Vector
Li, Wei	MS	Kang (EE)	Thermal Driven Placement in 3D ICS
Liu, Deyan	MS	Dai	Partial Reluctance Extraction For On Chip Interconnects
Liu, Jiehua	MS	Brandwajn	MSNE Project Course
Masters, Jessica	Ph.D (CS)	Madhyastha	Explanet: A Learning Tool and Hybrid Recommender System for Student-Authored Explanations.
Nguyen, Dat	MS	Schlag	The Development of an Imaging Spectrometer Under Ace Tao Corba Framework
Ren, Beibei	Ph.D	Dai	A Domain-Specific Cell Based ASIC Design Methodology for Digital Signal Processing Applications
Sirigineni, Kiranmaye	MS	Varma	Performance Analysis of IRIS: A Load Balanced Birhoff-Von Neumann Optical Switch
Tu, Spencer	MS	Karplus	EOS: A System for Evaluateable Objects in Scheme
Viswanath, Kumar	Ph.D	Obraczka	Adaptive Routing for Group Communications in Multi-Hop Ad-hoc Networks
Webb, Jonathan	MS	Garcia-Luna	Analysis of Packet Flows in Simulated Ad Hoc Networks Using Standard Network Tools

2004-5 Research and Training Funding Received

Amount	Researcher(s)	Agency	Grant or Gift Title
44,912	Garcia-Luna	UCSD	MURI: Space-Time Processing for Enhanced Mobile Ad-Hoc Wireless Networking
6,620	Manduchi	NSF	Randomized Invariant Features for Recognition
8,347	Obraczka	UC/MICRO	Integrated Multicast for Wireless Multi-hop Ad-hoc Networkd
600,000	Garcia-Luna,Vesecky,Elkaim	NSF	Nets-ProWIN: Spectrum-Agile Wireless Ad-hoc Networking (SWAN)
8,500	Ferguson	UCOP	Scholarship increase for R. Cruz; E. Estacio;
200,000	De Alfaro	NSF	CAREER: Structured Design of Embedded Software
11,454	Mantey	MBARI	Support for Shaomin Ding
130,000	Manduchi, Obraczka	NASA	Managing the Information Flow in a Network of Visual Sensors
15,625	Ferguson	UCOP	MEP Scholorships
12,500	Obraczka	UC/MEXUS	Networked SEREBROs: Ad-hoc Networking for collaborative Search and Rescue Biomimetic Robots
200,000	Garcia-Luna, Obraczka,Sadjadpour	UCOP CLC	SENSE:Scalable and Efficient Networkking of Sensor Elements
54,835	De Alfaro	UCB	Rich Interfaces for component-Based Design
31,958	Dunbar	UARC	Optimization-based Motion Planning for High-speed Waypoint Following of an Autonomous Helicopter
27,547	Manduchi	UARC	Multispectral Image Analysis for UAV Based Wildfire Monitoring
88,936	Garcia-Luna	UCSB	MURI: Protocols to Support Wireless and Mobility
24,069	Elkaim	UARC	Metasensor Technology-high Performance GNC Using Low-cost Sensors
24,329	De Alfaro	UARC	Timed Interfaces for Real-Time Software
100,233	Hughey, Madhyastha	NSF	REU: Summer Undergraduate Research Fellowship in Information Technology
59,816	Manduchi	SRI	Color Recognition in Outdoor Scenes
10,941	Chan, Schlag	UC/MICRO	Parallel Placement and Routing for Field-Programmable Gate Arrays
15,000	Chan, Schlag	Xilinx, Inc	Parallel Placement and Routing for Field-Programmable Gate Arrays
129,512	Garcia-Luna	UCSD	MURI: Space-Time Processing for Enhanced Mobile Ad-Hoc Wireless Networking
100,000	Tao	NSF	CAREER: Elements in Solving the Multiple Object Tracking Problem
100,000	Varma	Lucent	Optical Data Router (ODR) Architecture Design and Evaluation
88,873	De Alfaro	NSF	CAREER: Structured Design of Embedded Software
11,486	Mantey	MBARI	Support for Shaomin Ding
5,000	Tao	NSF	CAREER: Elements in Solving the Multiple Object Tracking Problem (REU Suppl.)
139,267	Hughey	NIH/NIGMS	Predoctoral Bioinformatics Training at UCSC
583,000	Garcia-Luna, Obraczka,Sadjadpour	US Army/AROD	DAWN: Dynamic Ad-hoc Wireless Networking
130,025	Garcia-Luna, Sadjadpour	U. Illinois	RIDE: Robust Internetworking in Disruptive Environments
2,650	Tao	UC DIMI	Real-Time Image-Based Rendering Using Sparsely Placed Video Cameras
12,000	De Alfaro	NSF	CAREER: Structured Design of Embedded Software
260,208	Karplus, Hughey	NIH/NIGMS	Combined Methods for Protein-Structure Prediction
2,850	Chan, Schlag	Xilinx, Inc	Gift: FPGA research and instruction
2,225	Chan, Schlag	Xilinx, Inc	Gift: FPGA research and instruction
10,000	Garcia-Luna	Meru Networks	Gift: Networks research
2,581	Obraczka	Orion Microelec.	Gift: Networks research
10,500	Obraczka	Orion Microelec.	Gift: Networks research
21,000	Garcia-Luna	Anyang Univ.	Gift: Joint research project with Anyang University, Korea
10,560	Garcia-Luna	Nokia	Gift: Networks research
15,000	Chan, Schlag	Xilinx, Inc	Gift: FPGA research and instruction
320,000	Garcia-Luna, Mantey, Smith	Cisco	Gift: Networks instructional laboratory