BOSTON UNIVERSITY

Department of Electrical and Computer Engineering

2002 - 2003 Annual Report

July 1, 2002 - June 30, 2003

www.bu.edu/ece

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one: Highlights

This report provides a detailed description of the instructional and research activities of the faculty, staff, and students of the Department of Electrical and Computer Engineering (ECE) at Boston University during the 2002-2003 academic year. Instructional activities are reported for Fall 2002, Spring 2003, and Summer 2003 semesters. Publications and scholarly activities, as well as budget information, are reported for the 2003 fiscal year (July 1, 2002 to June 30, 2003). Key data for this year are also compared to previous years to show progress and identify trends. More information on ECE's recent activities is reported at the department website, *http://www.bu.edu/ece*.

1.1 Faculty

Two new full-time faculty joined the ECE Department this year: Murat Alanyali and Maja Bystrom. **Murat Alanyali** was appointed Assistant Professor (tenure-track) beginning July 1, 2002. He received his Ph.D. from the University of Illinois, Urbana-Champaign, in 1996. His research interests include high-speed networks. *(See sidebar below.)* **Maja Bystrom** was appointed Associate Professor (tenure-track) beginning September 1, 2002. She received a Ph.D. from Rensselaer Polytechnic Institute in 1997. Her recent research work is in the area of signal processing and telecommunications, focusing on channel modeling and network design. *(See sidebar on page 1-2.)*

Despite University budget cuts, the Department continued its vigorous efforts to recruit new faculty in selected strategic areas. As a result, **Roberto Paiella** will be joining the ECE faculty at the rank of Assistant Professor (tenure-track) in September. He received his Ph.D. in 1998 from the California Institute of Technology. Since then, he has been on the technical staff of Lucent Technologies, then later Agere Systems. His research interests lie in photonic devices including quantum-well structures in group-III nitrides and ultrafast pulsed lasers and all-optical switches.

Professor **Fred Schubert** left the ECE Department to join the faculty of Rensselaer Polytechnic Institute.

Professor **Selim Ünlü** began an appointment as Associate Chair for the Graduate Programs, replacing Professor **Bill Oliver** who stepped down.

Professor **Malvin Teich** took a sabbatical semester in Fall 2002 and Professor **Robert Kotiuga** was on leave of absence during Spring 2003 in order to complete a research monograph.

This has been a banner year for the ECE junior faculty. Professor **Venkatesh Saligrama** received the prestigious PECASE award; Professor **David Starobinski** received the NSF CAREER award, which Professor **Murat Alanyali** also expects to receive shortly; and Professor **Enrico Bellotti** received an ONR Young Investigator award. *(See page 1-2 for more information.)* With these awards, all of the ECE assistant professors have received either an NSF CAREER award or an ONR Young Investigator award. *(See page 2-6.)*

1.2 Staff

A number of new staff joined the ECE Department in 2002-2003. **Jeffrey Albro** joined the staff in August as Systems Administrator I in charge of the VLSI and Signals Laboratories. He has a BS from Tufts University with 8 years of experience in UNIX and LINUX. **Kristen Anderson**, formerly on the staff of the Physics Department, accepted the position of Academic Programs Administrator. She has been with BU for nine years and holds a BA from Regis College as well as an MS from BU. **Scott Enos** became the new Grants Administrator. He joins ECE with experience as an employee of the Office of Grant and Contract Accounting. In January, **Hemayat Nabiel** accepted the position of Financial Manager. A graduate of New York University in 2001, he is working towards an MA at BU. He has also worked at University Computers.

Murat Alanyali received his Ph.D. in 1996 from the Department of Electrical and Computer Engineering at the University of Illinois, Urbana-Champaign, and subsequently spent a year as a post-doctoral fellow at Lucent Techonologies. Dr. Alanyali then went on to join the faculty of Bilkent University in Turkey as an Assistant Professor. He joined the faculty of Boston University at the same rank effective July 1, 2002.

Dr. Alanyali's general specialty is computer systems engineering, specifically in high-speed networks. He expects to receive funding shortly for these projects from the National Science Foundation in the form of a CAREER Award.

Maja Bystrom joined the ECE Department as an Associate Professor (tenure-track) on September 1, 2002. She holds a PhD from the Department of Electrical, Computer and Systems Engineering at Rensselaer Polytechnic Institute. Upon her graduation from RPI in 1997, she joined the faculty of the ECE Department at Drexel University, where she was named "Best Professor" for her teaching.

Professor Bystrom is an expert in signal processing and telecommunications. Her current research is in source and channel coding, multimedia communications, and digital signal processing. Her research is funded through an NSF CAREER award.

1.3 Awards and Honors

Special Grants

Professor **Venkatesh Saligrama** received the Presidential Early Career Award for Scientists and Engineers. This award is the highest honor bestowed by the US government on outstanding scientists and engineers beginning their independent careers and is conferred annually at the White House.

Professor **Enrico Bellotti** received the Office of Naval Research Young Investigators Award for research entitled "Single-Photon 3D Image Sensors."

Professor **David Starobinski** received a National Science Foundation CAREER Award for research entitled "Quality of Service Engineering with Multiple Time-Scale Traffic."

Teaching Awards

Professor **Ari Trachtenberg** received the 2002/2003 ECE Faculty Teaching Excellence Award from the Department. *(See page 3-2).*

Other Faculty Awards and Honors

Professor **Jeffrey Carruthers** was promoted to IEEE Senior Member.

Professor **Theodore Moustakas** received an honorary doctoral degree from the Aristotle University of Thessaloniki in Greece.

Professor **Leopold Felsen** received the degree of *Laurea honoris causa* from the University of Sannio in Italy.

Professor **Roscoe Giles** served as General Chair of the highly successful 15th Annual High-Performance Computing and Networking Conference. The record-breaking conference attracted an estimated 7,200 participants and featured over 200 exhibitors.

Professor **Michael Ruane** served on the panel of judges for the 2002 Design News Best Products of the Year.

Graduate Student Awards

Graduate student **Peter McNerney** received the 2002/2003 ECE Graduate Teaching Fellow of the Year Award.

The Dean's Award for the College of Engineering at Boston University Science and Technology Day 2003 was given to **Tyler Gore**, **Fangyi Chen**, **Marianne Nourzad**, **Christian Karl**, **Zibing Yang**, and **Shan Lu** for their poster "Cochlea on a Chip" with Professor **Allyn Hubbard**.

The Berman Future of Light Award at Science Day was received by **Magued Nasr** for a poster entitled "Quantum Optical Coherence Tomography with Dispersion Cancellation." Nasr is supervised by Professors **Bahaa Saleh**, **Alexander Sergienko**, and **Malvin Teich**.

1.4 Undergraduate Program

Enrollment in the BS program has been steady in recent years. A total of 373 students enrolled in the Electrical Engineering (EE) and Computer Systems Engineering (CSE) programs, with CSE enrollment now making up roughly 57% of the total undergraduate enrollment. The number of EE and CSE BS degrees awarded this year were 53 and 53, respectively. *(See details in Section 3.1 and enrollment history in Section 6.1.)*

High-quality instruction continues to be of paramount importance to the ECE Department. The curriculum has been continuously updated to meet the needs of tomorrow's engineers. A process of continual program improvement has been established with the goal of meeting our program educational objectives. Specific expected outcomes have been defined, and mechanisms for assessing their achievement include review of the core courses by a faculty committee, graduation surveys, review by the ECE Industrial Advisory Council, and meetings with student representatives to obtain their feedback. The program objectives are also assessed through alumni surveys. *(See Section 3 for a detailed description of our program for improvement.)*

Efforts to enhance the undergraduate laboratories are successfully ongoing, with new equipment, maintenance, and upgrades this year at a total cost of $248k. In both classrooms and laboratories, emphasis is placed on design, laboratory practice, and applications. Successful ideas that were intitiated in previous years, such as the Teaching Workshop, the ECE Project Conference Day, ECE Advising Day, and the ECE Teaching Excellence Award, continued this year. *(See Section 3 for more information.)*

The high-quality of the ECE undergraduate student body has also been demonstrated this year by the activities of our student groups. The Kappa Sigma chapter of the Eta Kappa Nu honor society was established in March 2003. This group has already launched a successful tutoring program to assist undergraduates in achieving their academic goals. BU's IEEE Student Section

hosted the Region 1 Student Paper Contest, as well as the 2003 Regional Student Conference. BU undergraduate Jill Anderson took first place in the paper contest. For the second year running, the IEEE Student Section also won first place in a world-wide IEEE website contest. *(See section 3.6 for more information on student activities.)*

1.5 Graduate Program

New student recruiting efforts were successful in 2002-2003. Overall, applications rose by 20% to both the PhD program and MS program. A new scholarship, the Dean's Research Fellowship, was created to improve recruitment. The DRF allows students 8 credit hours of courses, while giving them the opportunity to engage in research early on in their career. This new program engaged faculty actively in recruiting, as half of the program's funding is generated through research funds. The acceptance rate for DRFs was 80%.

Enrollment in the MS program increased by 9 students (from 54 to 63). The number of PHD students increased substantially by 26 students (from 68 to 94) after a slight decrease last year. This is likely due to an increasing tendency for students to apply directly to the PhD program. All in all, 40 new MS students and 34 new PhD students entered the program in AY2002-2003.

There were also substantial updates to the graduate curriculum this year. Most notably, the MS in Photonics program started formally in September 2002 with 3 full-time students. It was also offered as a program option for new applicants this year, so we expect that there will be rapid growth in this area. Seven new courses were also added to the graduate curriculum in 2002-2003. We are also continuing the practice of developing new special topics courses. When these courses are successful, they are frequently assigned a course number and integrated into the curriculum as a regular offering.

1.6 Research

New research funding this year totalled approximately $6.0M. The average annual research funding in the 1996-03 period is $5.2M, as compared to an average of $2.4M in the 1990-95 period. These figures include only grants for which the Principal Investigators (PI) were ECE faculty. Including the shares of grants for which ECE faculty were Co-PIs, the total of new research funds this year is $6.9M. *(See Section 5.5 for details on research funding.)*

Large research grants received this year include a new grant from NIH/NIBIB in support of the research of **Bennett Goldberg**, **Selim Ünlü**, **Anna Swan**, and **Clem Karl** in nanoscale imaging ($1.7M for 5 years); an NSF grant in support of **Selim Ünlü**, **Bennett Goldberg**, **Anna Swan**, Kamil Ekinci, and P. Mohanty for research in optics of nanostructures ($1.2M); the renewal of a DARPA grant in support of the research of **Alexander Sergienko**, **Bahaa Saleh**, and **Malvin Teich** in the area of quantum cryptography ($520k this year); several new and renewed grants from DOD and NSF in support of the research of **Theodore Moustakas** in GaN devices (totaling approximately $1M). Funding for the NSF Center for Subsurface Imaging and Sensing Systems (CenSSIS) has been renewed this year after a successful Year-3 site visit review. Boston University's share of this four-university coalition totals approximately $3.5M (5 year period). This effort is led by **Bahaa Saleh**, **David Castañón**, and **Michael Ruane** in the ECE Department and involves several other ECE and College faculty.

In the educational arena, large grants include an NSF IGERT traineeship grant in the area of integration of high-performance computing in science education. This grant involves a number of faculty from several departments, including **Roscoe Giles** from the ECE Department. Another NSF grant received this year supports a GK-12 Science Technology and Mathematics Partnership led by **Bennett Goldberg** and **Michael Ruane**.

(See Section 4.13.) This year, the ECE faculty, academic staff, and graduate students have published 80 research papers in archival journals, authored or co-authored 9 book chapters, and made 166 conference contributions (papers, abstracts, and presentations). They have also filed 13 patents or patent disclosures. *(See Section 5.4 for a complete listing of faculty publications.)* The Department sponsored a new weekly Research Spotlight Seminar series this year. Twelve ECE faculty presented highlights of their research.

1.7 Special Events

ECE Day 2003

Initiated in 1997, the ECE Day is a forum for presentation of the students' senior design projects. Held at the end of the Spring semester, ECE Day 2003 included 24 presentations on different projects conducted by groups of 2 to 4 students. The presentations were attended by students, faculty, alumni, company representatives, and members of the ECE Industrial Advisory Council. *(For more information on ECE Day 2003 see Section 3.4.)*

ECE Retreat

The ECE Department held its annual Faculty Retreat on May 5, 2003. This year, the emphasis was on discussion of the Department's current state of research and research funding, as well as potential directions of future growth.

Industrial Advisory Council

The IAC held its annual meeting on May 2, 2003. Research ties to industry and entrepreneurial opportunities were the focus of discussion as well as the Department's MS programs and Senior Design Project program. A full list of IAC members and the companies with which they are affiliated follows on the next page.

Industrial Advisory Council Members

Hassan Ahmed
President
Sonus Networks, Inc.

Tom Arseneault
Vice President of Engineering
Information and Electronic
Warfare Systems
BAE Systems

William Bowhers
Engineering Manager
Teradyne

Jihad Boura
Technical Staff
Altera

Julie M. Cubino
Manager, ASIC Design Kit
IBM Microelectronics

D. George Gata
Mixed Signal Custom Products
Department
Texas Instruments

Katie Hall
Founder, CTO, Director
PhotonEx

Micah Knapp
Staff Engineer
SGI

Christina Knopp
Marketing Manager
DUSA Pharmaceuticals Inc.

Kevin Knopp
Director of Engineering
Ahura Corporation

David Kukulinsky
President
SIR, Inc.

Ben H. Mbugua
Front Line Application Manager,
DSP Division
Analog Devices, Inc.,

Rich Molnar
Technical Staff
MIT Lincoln Laboratory

Anthony Palmieri
Marketing Applications
Applied Micro Circuits Corp.

John Reinke
Sr. Dir. eBusiness Solutions Grp.
Siebel Systems Inc.

Gary Smith
Principal Engineer
Corning Lasertron, Inc.

Above: *Members of the ECE Industrial Advisory Council*

two: *Faculty & Staff*

2.1 Faculty

Murat Alanyali, *Assistant Professor*
- Ph.D., University of Illinois, Urbana-Champaign, 1996
- Communication networks, stochastic networks, optical and wireless networking

Enrico Bellotti, *Assistant Professor*
- Ph.D., Georgia Institute of Technology, 1999
- Computational electronics; semiconductor materials and device simulations; power electronics; parallel and cluster computing
- 2003 ONR Young Investigator Award

Irving Bigio, *Professor*
- Ph.D., University of Michigan, 1974
- Medical application of optics, lasers, and spectroscopy; biophotonics; applied spectroscopy; nonlinear optics, quantum electronics, and laser physics
- Fellow - Optical Society of America and American Society for Lasers in Medicine and Surgery

Richard Brower, *Professor*
- Ph.D., Physics, University of California, 1969
- Quantum field theory of Strings and Particles; lattice methods for QCD and statistical mechanics; molecular dynamics simulation for biomolecules

Maja Bystrom, *Associate Professor*
- Ph.D., Rensselaer Polytechnic Institute, 1997
- Source and channel coding; multimedia communications; digital signal processing
- NSF CAREER Award

David Campbell, *Professor & Dean*
- Ph.D., Cambridge University, 1970
- General nonlinear phenomena and complex systems; novel electronic materials, including conducting polymers and organic and high tc superconductors; electron transport in semiconductor superlattices
- Fellow - American Physical Society and American Association for the Advancement of Science; Editor-in-Chief, *Chaos;* Editor, *Physics Reports*

Jeffrey Carruthers, *Assistant Professor*
- Ph.D., University of California, Berkeley, 1997
- Wireless infrared communications; broadband communications; mobile and wireless networks
- NSF CAREER Award
- 2000/01 ECE Faculty Award for Excellence in Teaching

David Castañón, *Professor*
- Ph.D., Massachusetts Institute of Technology, 1976
- Stochastic control; estimation optimization; image understanding and parallel computation
- Associate Editor, *Computational Optimization and Applications*; Associate Director, Center for Subsurface Sensing and Imaging Systems

Azza Fahim, *Assistant Professor*
- Ph.D., Cairo University, 1984
- Electric machines; computations in electromagnetics

Roscoe Giles, *Professor*
- Ph.D., Stanford University, 1975
- Advanced computer architectures; distributed and parallel computing; computational science
- NSF Partnerships for Advanced Computational Infrastructure (PACI): Co-Chair, National Educational Outreach and Training Coordinating Committee; Co-Chair, Alliance Collaborative and Data Storage Team
- 1996 College of Engineering Award for Excellence in Teaching

Martin Herbordt, *Associate Professor*
- Ph.D., University of Massachusetts, 1994
- Computer architecture; design automation; switch design; computer vision architecture; bioinformatics
- NSF CAREER Award

Mark Horenstein, *Professor & Associate Dean for Graduate Programs*
- Ph.D., Massachusetts Institute of Technology, 1978
- Applied electromagnetics; electrostatics, micro-electromechanical systems (MEMS)
- President, Electrostatics Society of America
- Registered Professional Engineer

Allyn Hubbard, *Professor*
- Ph.D., University of Wisconsin-Madison, 1977
- VLSI circuit design; digital, analog, subthreshold analog, biCMOS, CMOS; information processing in neurons, neural net chips, synthetic aperture radar (SAR) processing chips, sonar processing chips; auditory models and experiments
- 2002 College of Engineering teaching award

Floyd Humphrey, *Research Professor*
- Ph.D., California Institute of Technology, 1956
- Computer simulations of magnetic materials and storage devices; magnetic sensors
- Life Fellow, IEEE; IEEE - 100th Anniversary Gold Medal for Service; Magnetics Society 1988 Achievement Award; Millenium Medal

W. Clement Karl, *Associate Professor*
- Ph.D., Massachusetts Institute of Technology, 1991
- Multidimensional and multiscale signal and image processing and estimation, particularly applied to geometrically and medically oriented problems
- 1999/00 ECE Faculty Award for Excellence in Teaching

Mark Karpovsky, *Professor*
- Ph.D., Leningrad Electrotechnical Institute, 1967
- Testing and diagnosis of computer hardware; fault-tolerant computing; error correcting codes
- Fellow, IEEE

Thomas Kincaid, *Professor*
- Ph.D., Massachusetts Institute of Technology, 1965
- Signal and image processing; neurodynamics; non-destructive testing

Ronald Knepper, *Professor*
- Ph.D., Carnegie Mellon University, 1969
- VLSI integrated circuit technology; silicon CMOS & bipolar devices; numerical device simulation; SiGe BICMOS device and circuit modeling
- Fellow, IEEE

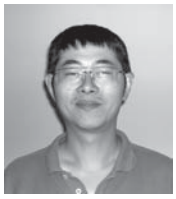
Janusz Konrad, *Associate Professor*
- Ph.D., McGill University, 1989
- Multimedia communications; image and video processing; stereoscopic and 3-D imaging; digital signal processing
- Associate Editor, *IEEE Trans. on Image Processing,* 1996-2000; Associate Technical Editor, *IEEE Communications Magazine*
- IEEE Signal Processing Magazine Award

Robert Kotiuga, *Associate Professor*
- Ph.D., McGill University, 1985
- Electromagnetics; numerical methods for three-dimensional vector field problems; Whitney forms and the Finite Element Method; geometric inverse problems
- Member, Electromagnetics Academy

Min-Chang Lee, *Professor*
- Ph.D., University of California, San Diego, 1977
- Radio communications; experimental plasma physics; ionospheric plasma physics

Lev Levitin, *Distinguished Professor*
- Ph.D., USSR Academy of Sciences, Gorky University, 1969
- Information theory; physics of communication and computing; quantum theory of measurements; complex and organized systems; reliable computing
- Fellow, IEEE; Member, New York Academy of Sciences; Member of the International Academy of Informatics

Thomas Little, *Associate Professor*
- Ph.D., Syracuse University, 1991
- Multimedia Computing, Mobile Ad Hoc Networks, Sensor Networks
- Editorial Board Member, ACM/ Springer Multimedia Systems, Journal of Multimedia Tools and Applications
- Entrepreneur



Fei Luo, *Research Associate Professor*
- Ph.D., Chongqing University, 1991
- Distributed fiber optic sensors and systems; optical fiber grating sensors; interferometric sensors and fiber optic smart structures

Theodore Morse, *Professor*
- Ph.D., Northwestern Univeristy, 1961
- Photonic material processing; optical fiber fabrication, lasers, and sensors
- Fulbright Fellow, Germany

Theodore Moustakas, *Professor*
- Ph.D., Columbia University, 1974
- III-nitride semiconductors (materials growth and device fabrication); growth by MBE, MOCVD, HVPE and gas-cluster ion beam deposition (GCIB); growth, fabrication and characterization of optical devices, electronic devices and electromechanical devices
- Fellow - American Physical Society and Electrochemical Society; Member - Advisory Board, North American MBE; Governing Body, Dielectric Science and Technology Division of the Electrochemical Society
- 1997/98 ECE Faculty Award for Excellence in Teaching

S. Hamid Nawab, *Associate Professor & Associate Chair for Undergraduate Studies*
- Ph.D., Massachusetts Institute of Technology, 1982
- Digital signal processing, real-time, low-power, and distributed signal processing; image processing; communication and biomedical applications; integrated DSP environments and architectures, knowledge-based signal processing, and applications in auditory scene interpretation, music and EMG signal analysis.
- 1988 Best Paper Award, *IEEE Signal Processing Society;* 1993 Metcalf Award for Excellence in Teaching; 1998 College of Engineering Award for Excellence in Teaching

William Oliver, *Associate Professor*
- Ph.D., University of Illinois, 1973
- Radar studies of the upper atmosphere and ionosphere; geophysical modeling and simulation; global change in the upper atmosphere

Tatyana Roziner, *Associate Professor*
- Ph.D., Moscow Scientific Research Institute, 1975
- Digital design; testing and diagnostics of computer hardware; fault-tolerant computing

Michael Ruane, *Associate Professor*
- Ph.D., Massachusetts Institute of Technology, 1980
- Magneto-optical materials; micro-magnetic modeling; optical data storage; optical systems
- 1998/99 ECE Faculty Award for Excellence in Teaching

Bahaa E.A. Saleh, *Professor & Chair*
- Ph.D., Johns Hopkins University, 1971
- Quantum optics; statistical optics; optical processing; image Processing; liquid crystal displays
- Fellow – IEEE, Optical Society of America, and John Simon Guggenheim Foundation; Editor-in-Chief, *Journal of the Optical Society of America A* (1991-1997); Deputy Director, Center for Subsurface Sensing and Imaging Systems
- Optical Society of America Beller Award (1999)

Venkatesh Saligrama, *Assistant Professor*
- Ph.D., Massachusetts Institute of Technology, 1997
- Statistical signal processing and its applications to communications and information control theory

Alexander Sergienko, *Associate Professor*
- Ph.D., Moscow State University, 1987
- Quantum optics, including quantum radiometry and metrology; laser physics; nonlinear optics; quantum communications; remote laser sensing; correlation spectroscopy, field optical microscopy and spectroscopy of semiconductor materials and devices
- NSF CAREER Award
- 2001 College of Engineering Award for Excellence in Teaching

Thomas Skinner, *Associate Professor*
- Ph.D., Boston University, 1982
- Microprocessors; computer networks; operating systems; distributed systems
- 1997 College of Engineering Award for Excellence in Teaching

David Starobinski, *Assistant Professor*
- Ph.D., Technion, Israel Institute of Technology, 1999
- Networks performance evaluation; wireless networking; mobile computing
- NSF CAREER Award

Anna Swan, *Research Assistant Professor*

- Ph.D., Boston University, 1993
- Material characterization and spectroscopy of low dimensional systems, semiconductors and devices; Development of nanoscale optical self-interference microscopy

Alexander Taubin, *Associate Professor*

- Ph.D., Electrotechnical University of St. Petersburg, 1981
- Asynchronous circuit, logic design; computer architecture; CAD; methods of format verification

Malvin C. Teich, *Professor*

- Ph.D., Cornell University, 1966
- Quantum optics and imaging; photonics; fractal stochastic processes; information transmission in biological sensory systems
- Fellow – IEEE, Optical Society of America, American Physical Society, Acoustical Society of America, American Association for the Advancement of Science, and John Simon Guggenheim Foundation; IEEE Browder J. Thompson Memorial Prize; IEEE Morris E. Leeds Award; Palacky University Memorial Gold Medal

Tommaso Toffoli, *Associate Professor*

- Ph.D., University of Michigan, 1977
- Fundamental connections between physics and computation; fine-grained modeling of physics-like systems technology (cellular automata machines) and methodology (programmable matter); personal knowledge structuring
- Editorial Board Member, *Complex Systems; The Interjournal*

Ari Trachtenberg, *Assistant Professor*

- Ph.D., University of Illinois, Urbana-Champaign, 2000
- Error correcting codes; data synchronization (especially for PDAs and mobile networks); sensor-based location detection; algorithms
- NSF CAREER Award
- 2002/2003 ECE Faculty Award for Excellence in Teaching

Selim Ünlü, *Associate Professor & Associate Chair for Graduate Studies*

- Ph.D., University of Illinois, Urbana-Champaign, 1992
- Design, processing, characterization and simulation of semiconductor optoelectronic devices; near-field optical microscopy and spectroscopy of semiconductor materials and devices
- NSF CAREER Award; ONR Young Investigator Award
- 2001/2002 ECE Faculty Award for Excellence in Teaching

Affiliated Faculty

John Baillieul, *Professor (primary appointment with the Department of Aerospace and Mechanical Engineering)*

- Ph.D., Harvard University, 1975
- Robotics; control of mechanical systems; mathematical system theory
- Chairman, Department of Aerospace and Mechanical Engineering; past Editor-in-Chief, IEEE Transactions on Automatic Control; Director, Boston Univeristy, Center for Control and Dynamics of Smart Structures and Center for Communicating Networked Control Systems; IEEE Fellow, IEEE Control Systems Society Distinguished Member, and Vice-President Technical Activities

Christos Cassandras, *Professor (primary appointment with the Department of Manufacturing Engineering)*

- Ph.D., Harvard University, 1982
- Analysis and control of discrete event dynamic systems; stochastic control and optimization; dynamic control of computer and communication networks
- Editor-in-Chief, *IEEE Transactions on Autonomic Control*; Member, IEEE Control Systems Society Board of Governors; Fellow, IEEE; 1991 Lilly Fellow

Supriya Chakrabarti, *Professor (primary appointment with the Department of Astronomy and the Center for Space Physics)*

- Ph.D., University of California, Berkeley, 1982
- Planetary atmospheres; ultraviolet spectroscopy, rocket and ground based experiments
- Director, Center for Space Physics

Solomon Eisenberg, *Associate Professor & Associate Dean for Undergraduate Programs (primary appointment with the Department of Biomedical Engineering)*

- Sc.D., Massachusetts Institute of Technology, 1983
- Electrically mediated phenomena in tissues and biopolymers
- NSF Presidential Young Investigator (1987-1993)
- 1990 Metcalf Award for Excellence in Teaching

Leopold Felsen, *Professor (primary appointment with the Department of Aerospace and Mechanical Engineering)*

- D.E.E., Polytechnic Institute of Brooklyn, 1952
- Wave propagation and diffraction in various disciplines; high-frequency and time domain asymptotics; wave-oriented data-processing and imaging
- Member, National Academy of Engineering; Fellow – IEEE, Optical Society of America, Acoustical Society of America, John Simon Guggenheim Foundation; IEEE Medals: Heinrich Hertz Gold Medal, 1991, Centennial, 1984, 3rd Millenium, 2000; Humboldt Foundation, Senior Scientist Award, 1980; Honorary Doctorate, Technical University of Denmark, 1979; URSI Balthasar Van der Pol Gold Medal, 1975

Theodore Fritz, *Professor (primary appointment with the Department of Astronomy and the Center for Space Physics)*

- Ph.D., University of Iowa, 1967
- Space plasma and magnetospheric physics; magneto sphere-ionosphere coupling; substorms; charged particles and compositions; rocket and satellite experiments

Bennett Goldberg, *Professor (primary appointment with the Department of Physics)*

- Ph.D., Brown University, 1987
- Room-and low-temperature, near-field microscopy of semiconductors and biological systems; magneto-optics and magneto-transport of two- and one-dimensional electron fields
- Alfred P. Sloan Fellow, NSF Presidential Young Investigator

Michael Mendillo, *Professor (primary appointment with the Department of Astronomy and the Center for Space Physics)*

- Ph.D., Boston University, 1971
- Signal processing in Space Physics; Low-light-level CCD instrumentation; atmospheric emission tomography; GPS satellite communications; space plasmas in the solar system
- Fellow, American Geophysical Union

Eric Schwartz, *Professor (primary appointment with Department of Cognitive and Neural Systems)*

- Ph.D., Columbia University, 1973
- Computational neural science; machine vision, neuroanatomy; neural modeling

William Skocpol, *Professor (primary appointment with Department of Physics)*

- Ph.D., Harvard University, 1974
- Nanofabrication; device processing; transport experiments in materials
- Fellow, American Physical Society

Emeritus Faculty

John Brackett, *Professor Emeritus*

- Ph.D., Purdue University, 1963
- Software engineering; software requirements definition; object-oriented testing; rapid prototyping of embedded systems

David Perreault, *Professor Emeritus*

- Ph.D., Purdue University, 1968
- Nonlinear networks; computer-aided design; micro-processors; distributed digital networks

Richard Vidale, *Professor Emeritus*

- Ph.D., University of Wisconsin-Madison, 1964
- Modeling and simulation, software engineering

Moe Wasserman, *Professor Emeritus*

- Ph.D., University of Michigan, 1955
- Semiconductor processing, electronic circuits

IEEE Fellows

Christos Cassandras
Leopold Felsen
Floyd Humphrey
Mark Karpovsky
Ronald Knepper
Lev Levitin
Bahaa E.A. Saleh
Malvin C. Teich

NSF PYI/CAREER Awards

Maja Bystrom*
Jeffrey Carruthers*
Martin Herbordt*
Thomas Little
Alexander Sergienko*
David Starobinski*
Ari Trachtenberg*
Selim Ünlü

** denotes current awardee*

2.2 Adjunct Faculty

The ECE Department looks outside the department and university for individuals to teach a few specific courses, as the need arises. These individuals bring a vast amount of engineering expertise, in both academic and industrial capacities, to the classroom. To the right is a list of people who have helped the Department meet its teaching needs over the past year.

Alan Pisano, *SC463 (Fall 2002) & SC402 (Spring 2003)*
- PhD, Northeastern University, 1974

Ramamurthy Mani, *SC516 (Fall 2002)*
- PhD, Boston University, 1998

Vladimir Kleptsyn, *EK130 (Fall 2002)*
- PhD, Moscow Lomonosov's Institute of Fine Chemical Technology, 1983

2.3 Research Staff

Name	Title	Sponsor
Abouraddy, Ayman	Research Associate	Bahaa Saleh
Bertazzi, Francesco*	Research Assistant	Enrico Bellotti
Boura, Jihad*	Senior Research Associate	Allyn Hubbard
Carlson, Erica	Research Associate	David Campbell
Carmachia, Vittorio*	Research Assistant	Enrico Bellotti
Choi, Sang Soo*	Visiting Scholar	Theodore Morse
Cohen, Howard	Research Assistant	Allyn Hubbard
Di Giuseppe, Giovanni	Research Associate	Alexander Sergienko
Emsley, Matthew	Research Associate	Selim Ünlü
Galdi, Vincenzo*	Research Associate	David Castañón
Gessmann, Thomas*	Research Associate	Fred Schubert
Guillet de Chatellus, Hugues	Research Associate	Alexander Sergienko
Jaeger, Gregg*	Senior Research Associate	Alexander Sergienko
Karl, Matthias	Visiting Scholar	Maja Bystrom
Kwon, Oh-Hyun	Research Assistant	Bahaa Saleh
Poëll, Björn*	Visiting Scholar	Selim Ünlü
Redjdal, Makhlouf	Research Associate	Floyd Humphrey
Shubochkin, Roman	Research Assistant	Theodore Morse
Thomidis, Christos	Research Assistant	Theodore Moustakas
Wylangowski, George*	Senior Research Associate	Theodore Morse

** Completed Appointment during 2002/2003*

2.4 Administrative and Technical Staff

Albro, Jeffrey	*Systems Analyst/Administrator I*
Anderson, Kristen	*Academic Programs Administrator*
Barbieri, Joe*	*Financial Manager*
Caine, Aaron	*Systems Analyst/Administrator III*
Enos, Scott	*Grants Administrator*
Fedyunin, Yuri	*MBE Laboratory Manager*
Goodman, Jeremy	*Administrative Assistant*
Kim, Jae*	*Grants Administrator*
Kleptsyn, Vladimir	*Laboratory Engineer*
Levin, Yefim	*Microprocessor Laboratory Manager*
Nabiel, Hemayat	*Financial Manager*
Reigadas, Rosemarie	*Senior Administrative Secretary*
Rennie, Wayne	*Department Director*
Rodriguez, Raul	*Electronics Laboratory Manager*

** Resigned during 2002/2003*

Raul Rodriguez retired on July 11, 2003 after 25 years of service to the ECE Department. Raul held the post of Senior Electronics Technician managing the Electronics and Circuits Instructional Lab. Raul will be relocating to Florida. His work keeping the lab running smoothly will be sorely missed.

2.5 Department Administration & Committees

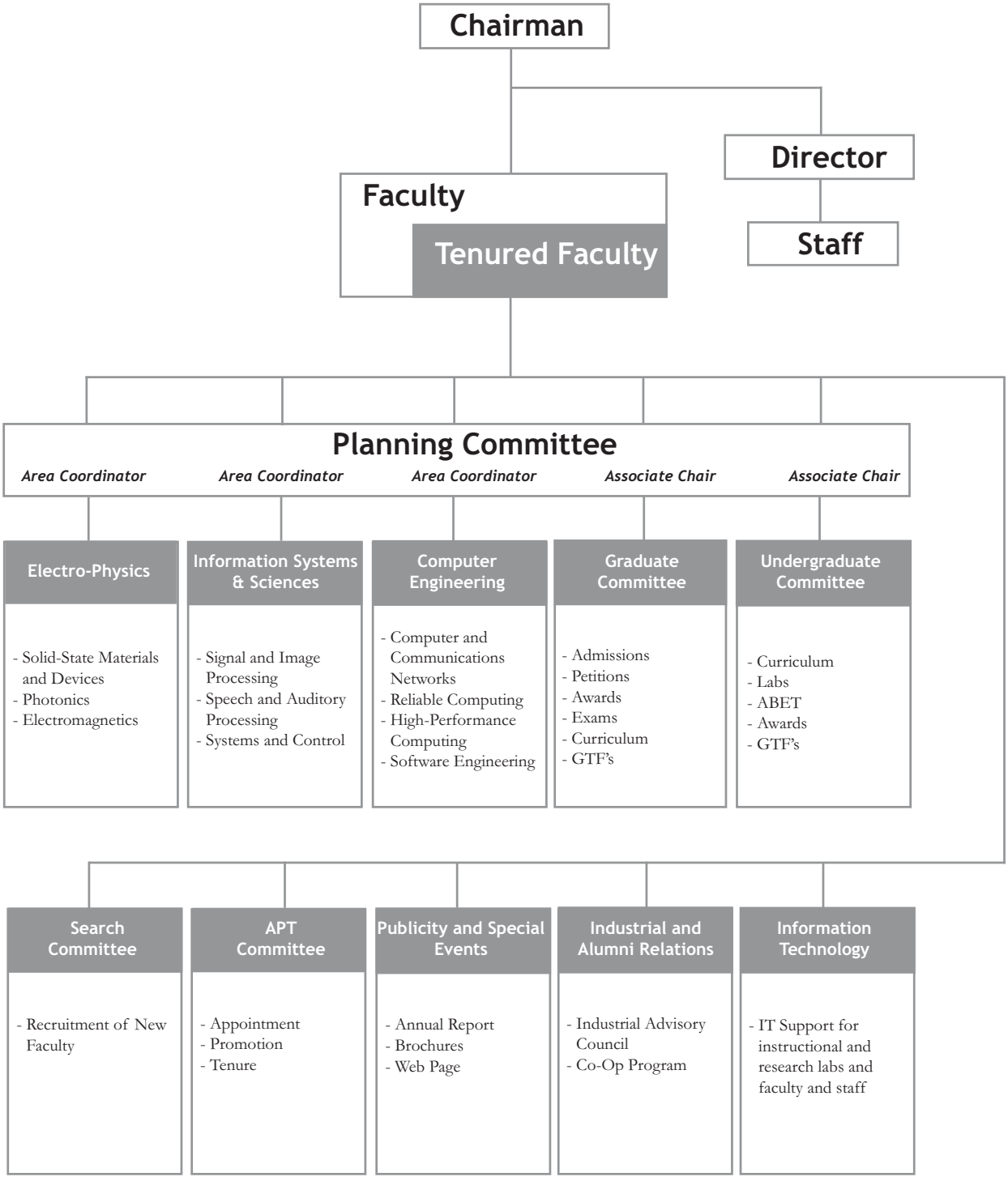
Saleh, Bahaa	*Department Chair*
Nawab, Hamid	*Associate Chair for Undergraduate Studies*
Ünlü, Selim	*Associate Chair for Graduate Studies*
Rennie, Wayne	*Department Director*

Faculty committees direct the academic operations and planning for the ECE Department. The Undergraduate and Graduate Committees are responsible for curricular and stuent affairs. The Planning Committee is comprised of the coordinators of the three areas of research and instruction (electro-physics, information systems and sciences, and computer engineering), the Chairman, Director, and the two Associate Chairs, and is responsible for strategic initiatives.

Planning Committee	Graduate Committee	Undergraduate Committee	Search Committee	APT Committee
Saleh (Chair)	**Ünlü (Chair)**	**Nawab (Chair)**	**Saleh (Chair)**	**Saleh (Chair)**
Ünlü (Assoc. Chair)	Alanyali	Bystrom	Carruthers	Bigio
Nawab (Assoc. Chair)	Bellotti	Horenstein	Castañón	Brower
Herbordt (Comp. Eng.)	Lee	Kincaid	Giles	Castañón
Karl (I.S.S.)	Levitin	Knepper	Herbordt	Hubbard
Ruane (Electro-Phys.)	Saligrama	Ruane	Lee	Karpovsky
Rennie (ex-officio)	Taubin	Sergienko	Moustakas	Moustakas
	Toffoli	Starobinski	Rennie (ex-officio)	Teich
	Trachtenberg			Rennie (ex-officio)

Publicity and Special Events	Industrial and Alumni Relations	Information Technology Advisory Committee	EK100 Advisors	Senior Design Advisors
Saleh (Chair)	**Saleh (Chair)**	**Konrad (Chair)**	Brackett	Bystrom
Goodman (ex-officio)	Brackett	Caine (ex-officio)	Brower	Carruthers
Konrad	Hubbard	Carruthers	Castañón	Castañón
Kotiuga	Kincaid	Giles	Lee	Giles
Rennie	Knepper	Herbordt	Nawab	Horenstein
Ruane	Morse	Hubbard	Ruane	Hubbard
Toffoli	Pisano	Karl	Starobinski	Karl
	Rennie	Ruane	Taubin	Konrad
	Ruane	Rennie		Kotiuga
	Skinner			Lee
				Morse
				Nawab
				Saleh
				Toffoli
				Trachtenberg
				Ünlü

2.6 Department Organizational Chart



2.7 ECE Representation in the College of Engineering and the University

College of Engineering Committee	Faculty
APT Committee	Bigio, Hubbard, Levitin
Graduate Committee	Ünlü
Scholarship Exam Committee	Ünlü
Undergraduate Committee	Nawab
Student Conduct Committee	Kincaid
Professional Practice Advisory Group	Knepper

University Committee	Faculty
Committee on Research Activities and Libraries	Ünlü
Faculty Council	Giles, Ünlü
Patent Policy Committee	Moustakas
Undergraduate Research Opportunity Program	Ünlü
Student Conduct Committee	Ünlü

Advisory Group	Faculty
IEEE	Nawab
Minority Engineers' Society (MES)	Giles
Student Association of Graduate Engineers (SAGE)	Ruane
Society of Hispanic Professional Engineers (SHPE)	Castañón
Tau Beta Pi	Nawab
Engineering House	Nawab
Eta Kappa Nu	Lee

three: Undergraduate Programs

3.1 Academic Programs

This has been an exciting academic year for our undergraduate programs in Electrical Engineering and Computer Systems Engineering. Academic year 2002-2003 saw curricular changes, substantial enhancements to our instructional laboratories, and formation of a new student honor society as well as the full implementation of a new, on-going evaluation system for the undergraduate curriculum. The Department is also continuing to prepare for its upcoming ABET review in Fall 2003.

Based on the results of our ongoing evaluations and recommendations from ECE's Industrial Advisory Council, substantial revision of the Senior Design Project curriculum has been implemented, including restructuring from a one semester course to a two semester sequence, which has resulted in improved quality in the projects presented. Other curricular isues currently being discussed include improvements in math and statistics education and changes to the natural science requirement, as well as identifying target areas for new course additions. More information on our improvement processes is available in Section 3.7.

Substantial upgrades have been made to many of the instructional laboratories in preparation for the Fall. As core facilities for our undergraduate programs, these laboratories are the focus of ongoing evaluation and upgrades. In the Circuits and Electronics Laboratory, all desktop workstations were upgraded with the addition of new GPIB interface hardware and thirteen National Instruments ELVIS development stations. A complete overhaul was also done of the Signals and Networks Laboratories, replacing 37 workstations, 6 of which are now high-performance and high-memory Pentium IV Xenon workstations, as well as installation of an additional video projector allowing for overlapping lab demonstrations. Our Software Engineering and Microprocessor laboratories were both partially upgraded with new workstations. The Microprocessor lab also received a video projector. The ECE wireless network was also expanded to cover approximately 90% of the Department, allowing for easier access to online educational materials. *(See Section 3.2 for descriptions of laboratories.)*

Enrollment and Degrees Awarded

Fall 2002 Enrollment

	Electrical	Computer Systems	Total
Freshmen*	29	44	73
Sophomores*	31	59	90
Juniors	42	55	97
Seniors	60	53	113
Total	**162**	**211**	**373**

* Note: ENG students are not required to declare their major until their Junior year.

Degrees Awarded

Electrical Engineering	53
Computer Systems Engineering	53
Total	**106**

Honors Students

Summa Cum Laude	15
Magna Cum Laude	9
Cum Laude	13
Total	**37**

ECE Advising Day

Continuing a tradition initiated in 1998, each semester an ECE Advising Day was held just prior to the commencement of the telephone registration period for the next term. On these days many ECE faculty volunteered up to four hours of pre-registration advising time for their students.

Teaching Workshops

The ECE tradition of holding teaching workshops every semester continued this year. Now a requirement (as course SC850) for all new graduate teaching fellows in the College of Engineering, six 1-hour workshops were held each semester. These workshops included panel and solo discussions as well as role-playing scenarios on teaching methodology, presentation techniques, pedagogy, ethics, etc.

2003 ECE Teaching Award

During the 1997-98 academic year, the ECE Department instituted an award to recognize innovation and excellence in teaching in the department. The award, based on nominations from College students, faculty, and staff, carries with it a $1000 prize to be used towards instructional activities. A committee of ECE professors and students evaluated the nominees. They looked at teaching statements and classroom material, sat in on classes, and collected comments from students.

This year's winner was Professor Ari Trachtenberg. *(See sidebar.)*

ECE Teaching Award

Assistant Professor Ari Trachtenberg is the winner of the 2003 ECE Award for Excellence and Innovation in Teaching. The 2003 ECE Teaching Award Committee, chaired by Professor Nawab and including Professors Ünlü and Carruthers as well as student representatives, recommended this award. The committee recognizes Professor Trachtenberg's accomplishments in regard to the following:

1. Development of a web-based immediate-feedback system that evaluates programming homework, provides feedback on mistakes or inconsistencies, and provides a competitive comparison with other submitted homework.
2. Encouragement of active learning in the classroom. For example, when describing a shortest-path algorithm useful for computer networks, the students physically "enact" the algorithm. Each student represents a node, and students pass messages to each other according to the algorithm code.
3. Encouraging the type of teamwork found in the work force by dividing the class into teams and throughout the semester providing to each team challenging problems that require joint creativity and parallel tasking in order to earn extra course credit. These teams also have the benefit of seeing and understanding the various solutions that the other teams develop.
4. Earning excellent teaching evaluations in SC330 and SC504 and a strong commitment to advising and mentoring.

3.2 Instructional Laboratories

Circuits and Electronics Laboratory

The Circuits and Electronics lab includes a full line of Hewlett-Packard bench top instruments and National Instruments ELVIS development stations linked by LabVIEW software. This continually updated facility, which supports ECE courses in circuits and electronics, enables us to offer traditional lab experiments in circuits and electronics in a modern laboratory setting that emulates those found in industry. The lab also can support more advanced experiments in signals and systems, communications, electromagnetics, and photonics. *Nawab*

Control Systems Laboratory

This laboratory houses 4 ECP model 220 Industrial Plant Emulators for studying the control of practical systems. These systems consist of an electromechanical apparatus including an adjustable mechanical mechanism ("plant") with actuators and sensors. Various types of controllers (e.g. PID, State-Feedback, LQR) can be designed and implemented in either continuous or discrete time formulations using a DSP-based real-time controller with a Windows XP graphical interface. Non-ideal conditions that are often present in real-world applications can be studied. Integrated with the systems are MATLAB and SIMULINK design tools, which can be used to design control systems that can then be implemented in the hardware. Analytical models of both the "plant" and the "controller" can be validated with actual hardware responses. *Pisano*

Electronic Design Automation/VLSI Laboratory

In this lab, students design circuits and systems using state-of-the-art Electronic Design Automation facilities. Hardware includes 32 Sun Workstations, plus chip testing equipment and associated display and software systems. Software tools include Synopsis, Mentor Graphics, and Cadence. *Hubbard, Knepper, Roziner, Kincaid, Herbordt, Taubin*

High Performance Computing Laboratory

The High Performance Computing Laboratory at Boston University was created with support from the National Science Foundation (NSF) in order to support the development of undergraduate courses in parallel and high performance computing. The courses offered at Boston University serve as a national model for computational science education. The lab features a network of multimedia graphics workstations linked at high speed to the supercomputers at the Center for Computational Science and the Scientific Computing and Visualization Lab. *Giles*

High Tech Tools and Toys Laboratory

HTTTL is the instructional laboratory associated with Boston University's NSF-funded Engineering Research Center for

Subsurface Sensing and Imaging Systems (CenSSIS). The laboratory houses a variety of PC-based imaging camera systems, machine vision systems and acoustic imaging systems. Software for imaging includes MATLAB, Image Processing Toolbox, Image Builder, Vision Foundry, ENVI and LabVIEW. The HTTTL supports freshman EK130 modules in imaging and subsurface imaging, senior design capstone projects in imaging, and experiments in senior level electives related to imaging. *Ruane*

Image and Signal Processing Laboratory

This laboratory serves graduate instructional and research needs by providing advanced computational resources and associated software packages. Fast workstations are connected to dual servers through a gigabit network which include access to high capacity monochrome and color printers and storage devices. State of the art processing and optimization software is available. This laboratory was developed with funds from the National Science Foundation. *Karl*

Microprocessor and PC Laboratory

This lab features instruction in the programming and interfacing of microcomputers and digital controllers. Higher-level courses emphasize the design of systems using microprocessors. Various simulators, and analysis packages are available. *Skinner, Toffoli*

Network Computing Laboratory

The Network Computing Laboratory studies interconnection network topologies; routing, network flow control, and deadlocks in multicomputer networks; multicast and broadcast, fault-tolerance in interconnection networks; modules for realization (nodes and routers); performance metrics and scalability; message passing interference, protocols and programming, scalable coherent interfact (SCI), and distributed shared memory; network of workstations (NOW), case studies of high performance scalable networks, and cluster computing. *Karpovsky*

Networks Laboratory

This laboratory provides facilities for experiments involving data communication links, local-area networks, and wide-area networks. Powerful computer-based simulation and analysis tools are available to compare and evaluate network designs. Facilities are also provided for experimentation with local-area network switching and routing hardware. *Carruthers*

Photonics Laboratory

The Photonics Laboratory supports the introductory and intermediate level courses in the MS in Photonics program. Four stations each have a vibration isolated optical table, lasers, fiber components and systems, electronic test equipment, and GBIP connected PCs for data logging and instrument control. Shared equipment exists for experiments and demonstrations in interferometry, spectrometry, diffraction, holography, acoustic and electro-optic modulation, and optical spectrum analysis. A secure annex room houses two additional isolated tables, electronics and optical equipment to support thesis and senior design projects that require long-term setup of apparatus. *Ruane, Ünlü, Teich*

Radio Communication Laboratory

The Radio Communication Laboratory supports lab experiments for courses in electrodynamics, waves and antennae, and wireless communication. Equipment includes a transmission line training station, benchtop receiving/transmitting antenna, radio receivers covering the radio spectrum from 1.6 MHz to 440 MHz, and two radio transmitters. Several antennae, including a four element rotating beam, a long-wave trap dipole, and a two-meter vertically polarized directional antenna, are located on the roof of the photonics building. The Radio Communication Laboratory also serves as the home of the ECE-sponsored Boston University Amateur Radio Club. *Horenstein*

Senior Project Laboratory

This lab is operated as a virtual company, serving real-world customers such as NASA, Analog Devices, Boston and Brookline Public Schools, social service agencies, and faculty and staff across the University. Each team has twenty-four hour access to a permanent bench setup with a networked Pentium PC, benchtop GPIB-based HP test equipment, and software for schematic design, simulation, and PCB layout. Electronics and shop support is provided. Shared tools include high speed scopes, logic analyzers, spectrum analyzers, E-prom, PLA and FPGA burners, and various compilers and cross-compilers for DSP and micro-controller development. *Ruane, Knepper, Horenstein*

Signals Laboratory

This laboratory houses numerous workstations for digital signal processing, image processing, and various real-time applications covering the complete audio frequency spectrum. Equipment includes PC's, microphones, DSP boards, speakers, amplifiers, digital cameras, and software packages such as MATLAB and Hyperception. The courses served by this laboratory include SC401 (Signals and Systems), SC416 (Intro to Digital Signal Processing), SC 512 (Digital Signal Processing), and some ECE modules in EK130 (Introduction to Engineering). *Nawab*

Software Engineering Laboratory

An instructional and research lab, the Software Engineering Laboratory (SEL) supports courses and research on the economical design of reliable software for large-scale, computer-based systems. The laboratory provides a network of workstations running Windows XP and provides students with state-of-the art development and modeling tools for the design, implementation and testing of distributed software systems. *Brackett*

Expenditures for Instructional Laboratories 2002-2003

Facility	Equipment	Approximate Cost
Microprocessing Lab	Workstations, lab kits, etc.	$58,490.63
Software Engineering Lab	Software licenses, maintenance, etc.	$1,880.50
VLSI Lab	Software licenses, maintenance, etc.	$12,667.18
Electronics Lab	Workstations, lab kits, electronic kits, etc.	$83,956.75
Signals/Networks Lab	Workstations, memory, webcams, etc.	$69,026.49
Senior Design Lab	Software licenses, electronics (capacitors, transformers, etc.)	$4,643.54
Other Lab Expenses	Wireless infrastructure upgrade, FPGA boards, etc.	$17,899.85
Total		**$248,564.94**

3.3 Undergraduate Courses

Course Number and Title		Fall 02	Spring 03	Summer 03
EK100	Freshman Seminar	Faculty		
EK130	Intro to Engineering	Horenstein Kincaid Kleptsyn Ruane	Konrad Morse Ruane	
EK307	Electric Circuit Theory	Fahim Lee	Fahim Roziner	Lee
EK317*	Circuit Theory I	Fahim		
EK318*	Circuit Theory II		Giles	
SC311	Intro to Logic Design	Kincaid Taubin	Kincaid	
SC312	Computer Organization	Herbordt	Herbordt	
SC330	Applied Algorithms	Brower	Castañón	
SC401	Signals and Systems	Bystrom	Bystrom	Carruthers
SC402	Control Systems		Pisano	
SC410	Intro to Electronics	Bellotti Kotiuga Lee Sergienko	Lee	Fedyunin
SC412	Analog Electronics		Knepper	
SC415	Communication Systems	Carruthers	Roziner	
SC416	Intro to Digital Signal Processing	Nawab	Konrad	
SC440	Intro to Operating Systems	Skinner	Skinner	Skinner
SC447	Software Design	Skinner	Skinner	Skinner
SC450	Microprocessors	Toffoli	Toffoli	
SC455	Electromagnetic Systems I	Kotiuga	Lee	
SC456	Electromagnetic Systems II		Horenstein	
SC463	Senior Design Project I	Ruane	Ruane	
SC464	Senior Design Project II	Knepper	Knepper	
SC471	Physics of Semiconductor Devices	Moustakas	Moustakas	

3.4 ECE Day Senior Projects

All ECE seniors complete a team-based, two semester capstone senior design project. Teams must design and prototype a product, electronic device, or software system for a real-life "customer." Customers are drawn from industry, small businesses, community groups, and faculty and staff. Initially students learn design methods, project management, team dynamics, communication skills, and legal and ethical standards for design. They form teams, research their project concept, and prepare project proposals. A substantial "first-deliverable" milestone and oral presentation complete the first semester. The second semester is spent in the Senior Project Laboratory, PHO111/113. Students must make presentations to their customer, write inter- and intra-office memos, design their project to meet customer specifications, manage the project budget, and deliver their working prototype, including a detailed instruction manual. Project records are maintained in personal design logbooks. Teams have 24/7 access to their dedicated, fully-equipped laboratory bench, and can use professional CAD and prototyping tools for circuits, embedded systems, and software development. ECE Day comprises student project presentations, awards for best team presentations, and delivery of the projects.

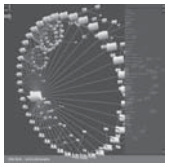
2003 P.T. Hsu Award

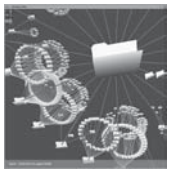
Honoring Professor P.T. Hsu, the Outstanding Senior Design Project Award acknowledges the best overall ECE senior design project. A faculty selection committee considers degree of success, difficulty, scope, creativity, cost, project communications, and team effectiveness. Team InnoLab, working for Professor Maja Bystrom (ECE) was the 2003 winner of the P.T. Hsu award. Team members included Karen Fung, Adam Miezianko, Zavnura Pingkan, and Kristopher Rambish. The 3D Workspace, designed with OpenGL under Linux, allows the user to view interrelations of their file systems in a three-dimensional environment. The environment, which can be, rotated, zoomed, panned, and spun, permits understanding not possible in two dimensions. By using symbolic links, many relations between objects are clear even if their actual location on the system is not. From an engineering standpoint, the software can reveal relations to the user that graphs can't convey for one simple reason: One needs to know what they want to compare to create a graph. InnoLAB's 3D Workspace software aids in finding exactly those comparisons. Their Linux software was released at *http://sourceforge.net/projects/innolab* and was also entered in a National Science Foundation contest on scientific visualization.

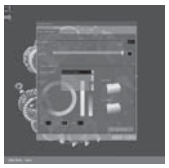
Notable Seniors Projects 2002-2003

Team and Members	**Project and Customer**
Team 02 - WFIS Andrew Craven Philip Li Daniel MacDonald Satyan Shah	Ultra-sensitive Cigarette Smoke Detector Dr. R. Sokolove, BU City Hospital "Integrated sensor, detection electronics and alarm system to detect unauthorized cigarette smoking by patients in hospital rooms"
Team 05 – Aurora B Tech Stephen Hines Sean Laing Eric Ponsart James Tuohy	Visual Amp M. Kopaczynski, The Carter School, Boston "A dynamic three color LED display with switches and voice activation for handicapped students"
Team 10 – Plug-n-Play Hiroshi Hikichi Keni Patel Cheng Run Neil Shah	Digital Implementation of Myoelectric Sensor DelSys, Incorporated "Digital conversion, collection and control of signals from two skin sensors, USB interface and laptop software for biomedical studies"
Team 11 - MicroSpy Suneil Berajawala Saurabh Calla Jason Nagel Farhat Saleem	Wireless Blocking and Anti-Blocking Professor Carruthers, ECE Networks Laboratory "Hardware and software for identifying, intercepting and blocking unauthorized intruders into a wireless network"
Team 19 – Blind Sentries Matthew Evans Travis Larsen Maciek Lewandowski Eren Tigrel	Acoustic Scarecrow Professor Oliver, ECE "IR and video detection of crows entering a restricted garden area, control of a two-axis turret, and ultrasonic harassment of the intruders"

Team InnoLAB: Karen Fund, Zavnura Pingkan, Adam Miezianko, and Krish Rambish, in front of their development systems.



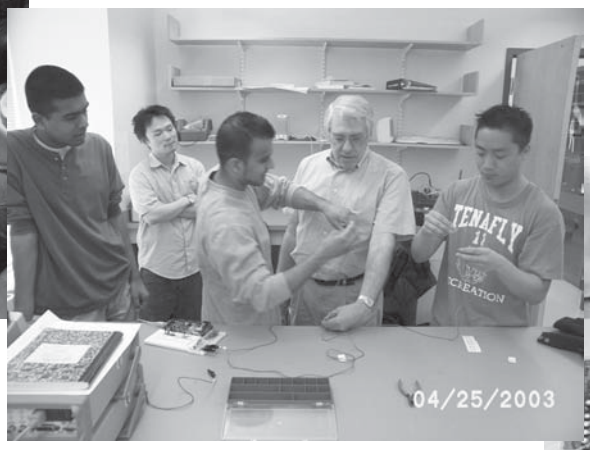


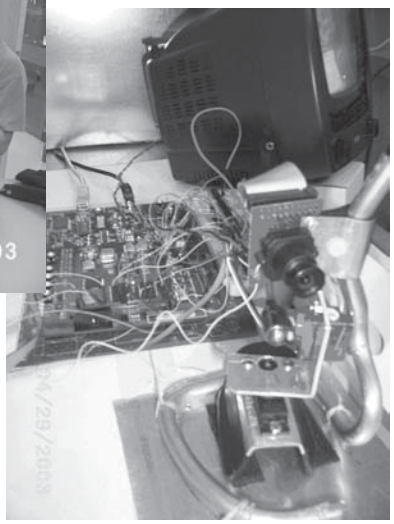


At left: 3D Workspace of high-level directory, showing first sub-level (large circle), and sub-levels beyond the first (smaller satellite rings). The blue window on the right is for detailed text information about specific file contents. The upper left arrows lead to utility widgets for control of color, lighting, text, etc.

Detail of the 3D Workspace by team InnoLAB. The display can be fully rotated in 3D, and users can control speeds of animation, color and lighting. Over 16,000 lines of code, including a custom widget library, were developed and documented.

Custom widgets provided customer functionality and accelerated development. This widget, built entirely by Team InnoLab, controls the appearances of folders, sliders and lighting angles. The circular color wheel and shading bars immediately display color selection and RGB values.





Left: Ilya Tatar and Tzoul-Ki Chan assemble power wires into their autonomous submersible vehicle prior to testing the unit in the BU swimming pool. The controls and data interface box is visible on the top of the system, which was build by a collaborating AME team. Gene Gorsky and Jeremiah Bridgwood helped design the controller and sonar sensing unit.

Center: Professor Knepper serves as the exercise subject for the digital myoelectric sensor system on Demo Day for Senior Design. Neil Shah, Hiroshi Kikichi, and Cheng Run watch as Keni Patel applies the electrodes. The digital system is on the white protoboard.

Right: Team 19 developed this video controlled laser tracker as part of their acoustic scarecrow system. The minature CCD camera talks through an Analog Devices Blackfin DSP board to locate new elements in an average picture, and runs a two-axis controller to aim a small diode laser at the new "target."

3.5 Freshman Research Opportunity Program (FROP) — Summer 2003

Student Name	Professor
Roy Arjoon	Hubbard
Sahil Jain	Trachtenberg
Adam Lavely	Ruane
Andrew Leach	Hubbard
Raphael Mattamal	Ünlü/Goldberg
Megan Shanholtz	Campbell
Erica Spengler	Morse
Peter Voyvodic	Campbell
Joanna Yoho	Oliver

3.6 Student Activities

The ECE Department supports two active undergraduate students groups, an IEEE Student Section and the Eta Kappa Nu honor society, which was founded in 2003. These groups both held a number of successful events this past year, ranging from lectures and panel presentations to social events for members to educational service activities. Events for 2002-2003 are detailed below.

IEEE Student Section

Lectures/Presentations/Panels

Magnetic Levitation and Control Presentation

Dr. Marc Thompson of Thompson Consulting gave a talk about his research and work in magnetic levitation and control for high-speed ground transportation (such as Maglev trains), including some demonstrations on how the technology works.

Engineering Matters, Inc. Presentation

Dr. David Cope, President of the Newton, MA based company Engineering Matters, Inc., gave a presentation on some of the innovative projects that his company is working on, including their EM Force-Feedback Joystick as well as their analysis of the underlying causes of Ground-Induced Current (GIC) and solutions to mitigate the damaging effects of GIC in the national power grid including demonstrations.

MIMO Communication Presentation

Dr. Daniel Bliss from MIT's Lincoln Laboratory gave a presentation on MIMO (multiple-input multiple-output) communication systems. This technology enables increased spectral efficiency providing higher data rates within the confines of a limited spectrum allocation in wireless communication.

Distributed Computing Presentation

Dr. Jim Waldo, Distinguished Engineer from Sun Microsystems gave a presentation on distributed computing, including the current state of networks and computers and where the future will take us and Sun Microsystem's Jini networking technology.

Bose Automotive Audio Presentation

Dr. Richard Miller from Bose, based in Framingham, MA, came to talk about the design process of automotive audio products. His presentation included demonstrations of the Bose designed audio systems in new Cadillac and Infiniti cars.

Tour of Mitsubishi Electric Research Laboratory (MERL)

Students attended a tour of the Mitsubishi Electric Research Laboratory in Cambridge and met with several engineers to learn about some of their many projects. Some of demonstrations included facial recognition technology, shader lamps: the use of video projectors to animate objects, and their DiamondTouch touch-sensitive computer input hardware.

Educational Activities

Fundamentals of Engineering Review Sessions

To encourage students to take the Fundamentals of Engineering Examination, the IEEE worked with the Boston University ASME Student Chapter to continue the program where the various engineering departments at Boston University provide a 100% exam fee reimbursement to seniors who take the exam and report their scores. A stipulation that students be reimbursed the fees associated with taking the FE exam is that they attend review sessions. Study materials were provided to students who registered for the exam and a weekend was organized when professors would be on hand to do problems and answer questions from the various sections of the exam. These review sessions were held for both sittings of the FE exam, in both the Fall and Spring semesters.

Region 1 Student Paper Contest

Boston University had one entry in the 2003 IEEE Paper Contest. Boston University student, Jill Anderson, took 1st Place with her paper entitled "Solar Powered Desalination Using Parabolic Mirrors."

2003 Regional Student Conference

The Boston University IEEE Student Branch won a bid to host the 2003 Regional Student Conference. Students from IEEE's Region 1, including all of New England down through northern New Jersey attended Boston University for the Micromouse robotics competition and the Regional Student Paper Conference, both organized by our Student Branch.

Micromouse Team

With the support of the Electrical and Computer Engineering Department and the College of Engineering, the IEEE had its first Micromouse team not affiliated with Senior Design. The team was mainly comprised of juniors and underclassmen and although technical issues prevented the team from competing in the 2003 Micromouse Contest, the issues have been identified and the mouse will be ready for next year's competition.

Other Activities

Recruiting Booths

Our branch had booths set up at a variety of engineering events on campus to let students know who we are, what we do, and that we're active:

Student Activities Fair: This fair is so entering freshman can learn about the various student organization represented in the College of Engineering.

Fall/Spring Engineering Career Fair: We attended both engineering career fairs to talk with both student and companies about our IEEE branch.

National Engineers Week: A booth was set up so students could learn about the IEEE and to promote our E-Week events.

Volunteering at Habitat for Humanity

A group of fifteen IEEE students volunteered a Sunday to help build a Habitat for Humanity home.

Movie Night

Only IEEE Student Members were invited to a screening of the movie "Lord of the Rings: Fellowship of the Ring" shown on a large screen.

Quake Arena Tournament

As part of National Engineers Week (E-Week), the IEEE organized our Second Annual Network Gaming Competition. This year students competed for prizes in a Quake III Arena tournament.

"Inside the Space Station" Movie

As part of National Engineers Week (E-Week), the IEEE organized a presentation of the Discovery Channel movie, Inside the Space Station on the large screen in Photonics 206.

Web Site Contest

After taking 1st Place in the 2002 IEEE Web Site Contest, our branch completely revamped the site and entered it in the 2003 competition. Again, our Student Branch placed 1st Place out of all the IEEE Student Branches in the world.

Eta Kappa Nu Honor Society

The Kappa Sigma Chapter of Eta Kappa Nu (HKN), the National Society of Electrical and Computer Engineering, was established here at Boston University on March 21, 2003. The induction ceremony was attended by the 20 or so charter members together with Professor Min-Chang Lee, the faculty advisor to the chapter, Professor Ron Knepper, a former member of HKN, Professor Bahaa Saleh, the Department Chairman, and Deans Sol Eisenberg and David Campbell. The establishment of the chapter was done by Dr. Ron Spanke, the Excecutive Secretary of HKN and Mr. Eric Herz, the president-elect of HKN. The ceremony lasted for about an hour and a half and the program consisted of two parts, first, the establishment of the chapter and then the induction of the founding members. Today, as a newly established chapter, HKN is trying to keep its mission in helping students achieve their academic goals by launching an ECE tutoring program in which the members of HKN volunteer their time to help needy undergraduates in their coursework from EK307 through SC571.

A second induction was held on the afternoon of April 18,2003, in which 5 new students were inducted into HKN. This was the first all student run induction for BU HKN, under the supervision of Professor Lee. The Kappa Sigma Chapter would like to thank the Department, Marc Davino, the charter members, and its charter executive board, namely, Richard Schloss, Neil Shah, Sarhaub Calla, Keni Patel, Ian Frazier, Scott Hendrickson and Earl Valencia for making HKN Kappa Sigma Chapter a reality at Boston University.

3.7 Process for Continual Program Improvement

In AY 2002-2003 the Department's formal process for continual improvement of its undergraduate programs in Electrical Engineering and Computer Systems Engineering completed its fifth year of implementation and refinement. By the end of Spring 2003, all the major components of the process were fully defined and installed. In particular, we have set up processes for achieving, assessing and improving program educational objectives as well as achieving, assessing, and improving program outcomes in order to provide a systematic framework for continual program improvement (CPI). Figure 1 depicts the CPI process. The upper feedback loop in the diagram represents the processes that are carried out every three years in order to (1) **assess** the realization of objectives, (2) **update** the objectives and (3) **adjust** the EE program in order to improve the degree to which the objectives are being achieved. The lower feedback loop (drawn with dashed lines) in the diagram represents the *annual* processes carried out to assess the EE program outcomes (relating to student learning between matriculation and graduation) and the subsequent "closing of the loop" through a program adjustment process.

The undergraduate programs in EE/CSE have as their educational objectives that several years after graduation students are expected to:

- Build a career path with informed choices about its EE/CSE aspects.
- Be competitive in the EE/CSE job market.
- Contribute to the well-being of profession/community.

In addition, our graduates are expected to pursue one or more of the following:

- Graduate education in engineering or allied fields.
- Breadth of responsibilities in a small company environment.
- Specialized expertise within a large company environment.
- Sales/Marketing positions in technology companies.
- Basic and applied research.
- Applications in other professions, such as medicine, and law.

As stated above, the objectives relate to what EE/CSE graduates are expected to achieve several years after graduation. For implementation purposes, we currently take "several years after graduation" to mean 2-5 years after graduation.

The realization of objectives is assessed by the ECE Undergraduate Committee at three-year intervals on the basis of data/reports from ongoing on-line alumni surveys, employer surveys, ECE Industrial Advisory Council meetings, and ECE faculty meetings. This assessment is then used in two basic

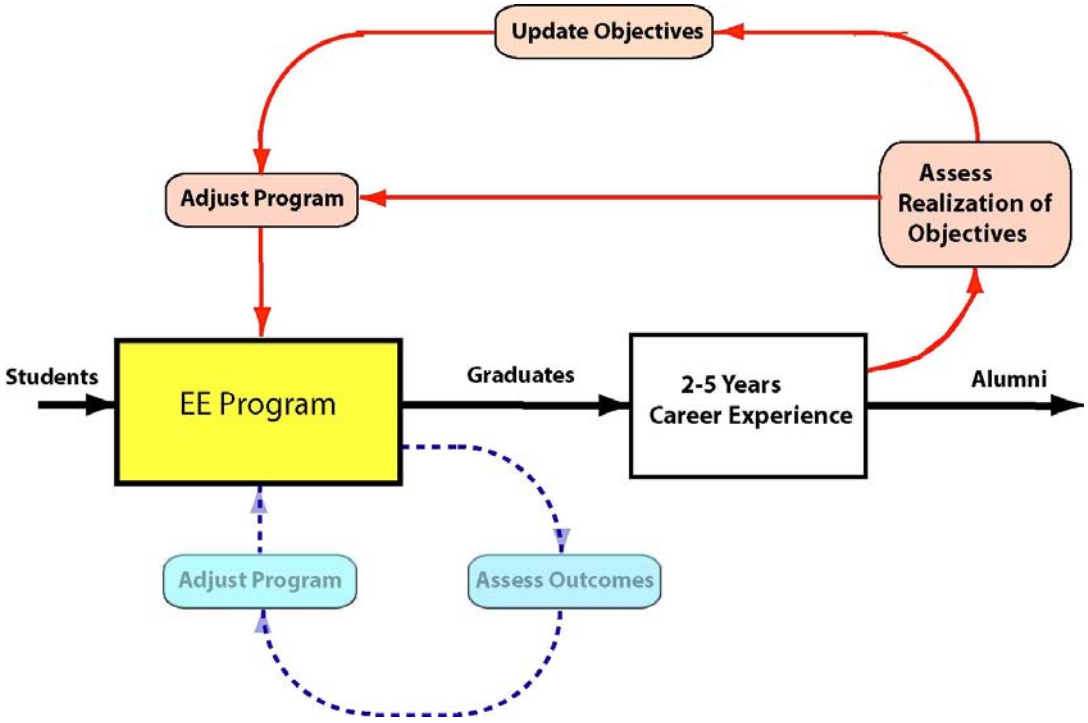


Figure 1: Diagram Representing Continual Program Improvement (CPI) Process for EE

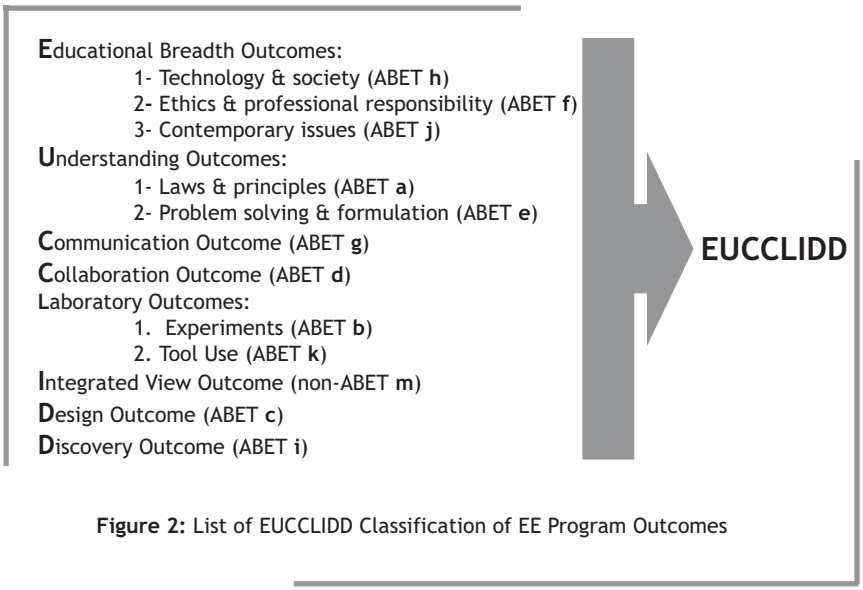


Figure 2: List of EUCCLIDD Classification of EE Program Outcomes

ways: (1) by direct adjustment of the outcome achievement processes to improve upon the degree to which objectives are currently being realized, and (2) by updating the objectives to reflect changed circumstances and subsequently to adjust the program in accordance with the changed objectives. Recommendations for program improvement are then presented by the Chair of the ECE Undergraduate Committee to the entire ECE faculty for discussion, amendments, and voting (if necessary).

We have also established an outcome classification framework we call *EUCCLIDD*, an acronym derived from a listing of the desired attributes of our EE program graduates: **E**ducational Breadth, **U**nderstanding of theory, **C**ommunication skills, **C**ollaboration skills for teamwork, **L**aboratory skills and knowledge, **I**ntegrated View of EE/CSE, **D**esign skills and knowledge, and **D**iscovery skills and knowledge. The EUCCLIDD classification of outcomes and the corresponding ABET a-k classifications are listed in Figure 2.

Note that the EUCCLIDD framework includes each of the ABET a-k outcomes and one additional non-ABET outcome labeled m. [Note we skipped the letter 'EL' because its lower case often gets confused with the integer 1].

The assessment of program outcomes is carried out on an annual basis. The ECE Undergraduate Committee conducts the assessment of outcomes using data/reports from ECE course offerings (syllabi, course materials, samples of student work), internal student surveys, external student surveys, ECE student forums, Industrial Advisory Council meetings, and ECE faculty meetings. Recommendations for program adjustment through the outcomes achievement process are then presented by the Chairman of the ECE Undergraduate Committee to the faculty for discussion, amendments, and voting (if necessary).

3.8 Assessment/Evaluation of Objectives

The realization of Program Educational Objectives will be primarily assessed on the basis of responses to various entries on the ECE Alumni Survey that was placed on the ECE Website in June 2002. For assessing the program objectives, in Spring 2003 we formulated the following set of corresponding goal metrics and achievement standards:

Objective 1: Build a career path with informed choices about its EE aspects.
Corresponding Entry on Survey Form: Entry 3. In my opinion, my current (or intended) career path and the knowledge/skills gained during my BS education are _____.
Corresponding Answer Options on Survey Form: (1) Strongly Related, (2) Somewhat Related, and (3) Not Related.
Metrics Tracked: For assessment purposes, we intend to track the percentage of respondents who choose answer (1) as well as the percentage of respondents who choose answer (3). Our aim is to increase the percentage for answer (1) and to decrease the percentage for answer (3) as an indication of program improvement.
Realization/Achievement Standard for this objective is that when averaged over a 3-year period, more than 50% of the respondents should answer "Strongly Related" while less than 10% should answer "Not Related."

Objective 2: Be competitive in the EE job market.
Corresponding Entry on Survey Form: Entry 4. In my opinion, my position in the job market for my chosen career is _____.
Corresponding Answer Options on Survey Form: (1) Competitive, (2) Somewhat Competitive, and (3) Not Compeitive.

Metrics Tracked: For assessment purposes, we intend to track the percentage of respondents who choose answer (1) as well as the percentage of respondents who choose answer (3). Our aim is to increase the percentage for answer (1) and to decrease the percentage for answer (3) as an indication of program improvement.
Realization/Achievement Standard for this objective is that when averaged over a 3-year period, more than 50% of the respondents should answer "Competitive" while less than 10% should answer "Not Competitive."

Objective 3(a): Contribute to the well being of profession.
Corresponding Entry on Survey Form: Entry 12. My membership status in the IEEE is_____. I am a member of another professional organization: _____.
Corresponding Answer Options on Survey Form: (1) I am currently a member, (2) I am currently not a member but I have been a member in the past, (3) I have never been a member, (4) I plan to become a member in the future.
Metrics Tracked: For assessment purposes, we intend to track the percentage of respondents who choose answer (1) or indicate membership in another professional organization. We also intend to track the percentage of respondents who choose at least one of: (1), (2),(4), and membership in another professional organization. Our aim is to increase both these percentages as an indication of program improvement.
Realization/Achievement Standard for this objective is that when averaged over a 3-year period, more than 50% of the respondents should indicate current membership in a professional organization while less than 10% should indicate the absence of past, present or intended (in the future) membership in the IEEE as well as the absence of membership in any other professional organization.

Objective 3(b): Contribute to the well being of community.
Corresponding Entry on Survey Form: Entry 13. My involvement with community includes: _____. (More than 1 choice may be indicated)
Corresponding Answer Options on Survey Form: (1) Volunteering, (2) Cultural/Social Activities, (3) Civic Activities, (4) Mentorship, (5) Sports, (6) Charity and (7) Other: (specify).
Metrics Tracked: For assessment purposes, we intend to track the percentage of respondents who choose at least one of the answer options. Our aim is to increase this percentage as an indication of program improvement.
Realization/Achievement Standard for this objective is that when averaged over a 3-year period, less than 10% of the respondents should indicate the absence of any involvement with community.

The remaining entries on the ECE Alumni survey relate to the set of six secondary program objectives from among which each graduate is expected to achieve at least one. The data collected via these entries is used to track the percentage of respondents who report having achieved at least one of the secondary objectives. Our basic aim is to increase this percentage as an indication of program improvement. The achievement standard associated with this achievement metric is that when averaged over a 3-year period, less than 10% of the respondents should report having neither achieved nor intending to achieve any of the secondary objectives.

The alumni survey has been posted on our web site for one year at the time of submission of this report. So far, we have received 30 completed surveys. The response rate has been small primarily because the contact information for many of the alumni is not up to date. The College of Engineering has begun an effort recently to keep such information updated. A tabulation of the responses to Questions 3, 4, 12, and 13 is given below:

Question 3: Strongly Related: 57%, Not Related: 10%

Question 4: Competitive: 86%, Not Competitive: 6%

Question 12: Currently IEEE Member: 20%

Question 13: Community Activity Reported: 67%

Upon reviewing this preliminary data, the ECE undergraduate committee has identified involvement in a professional organization (IEEE) as an aspect of the program objectives that needs significant improvement. Toward this end, the ECE Department has already initiated a membership drive in conjunction with the BU IEEE Student Section and encouraged the chapter to take a more active role in campus activities. During the 2001-2002 academic year the BU IEEE section organized 11 lectures/presentations, including two IEEE-GOLD presentations. The section also organized student tours of BAE Systems, Nextel, and Bose Corporation and it had recruiting booths at the BU Engineering Student Activities Fair, Fall and Spring Engineering Career Fairs at BU, and during National Engineer's Week. The BU IEEE Student Section also completely revamped its website and won *first place* in the IEEE Worldwide Student Branch Web Site Contest. Information on 2002-2003 activities is available in Section 3.13.

3.9 Achievement of Outcomes

The primary units responsible for the achievement of program outcomes are the courses within the EE/CSE curriculum. While an ECE course instructor has the general flexibility to teach a course in accordance with his/her own best assessment of how to obtain the best learning outcomes in the course, the instructor is also held responsible for ensuring that the course fulfills its role within the curriculum of the overall program. It is the responsibility of the ECE Undergraduate Committee to play the oversight role with respect to the curriculum by having the following in place:

- A process for maintaining minimum standards for the emphasis placed on each outcome category in individual undergraduate courses.
- A process for monitoring individual courses for the actual emphasis placed on outcomes with respect to the minimum standards.
- A process for initiating corrective actions when for a particular course either an outcome emphasis standard is not being achieved OR when a change in an outcome emphasis standard is required for a particular course.

Although courses are the primary units responsible for the achievement of program outcomes, there are other types of units involved in program outcomes achievement as well, including Faculty Advising System for Students; Career Services; Library Services; Availability of Study Spaces; Availability of Laboratory Facilities; Membership Opportunities in Professional Organizations and Honor Societies; Attendance Opportunities in Seminars, Workshops, and Conferences; Research Opportunities; and Co-op Opportunities. When contemplating corrective actions aimed at improving the achievement of program outcomes, the ECE Undergraduate Committee also takes these other types of units into account.

Maintaining Outcome Emphasis Standards: The ECE Undergraduate Committee has formulated outcome emphasis standards for required and restricted-elective EE and CSE undergraduate courses taught within the ECE Department. These standards specify the minimum emphasis rating (on a scale from 1 to 5, where 1 represents little or no emphasis and 5 represents a great deal of emphasis) a course may place on a particular outcome. These minimum standards must be satisfied by each course offered each semester unless there is a compelling reason not to do so. In such situations the course instructor or course coordinator must present a case to the ECE Undergraduate Committee for changing a minimum standard either permanently or temporarily. The ECE committee may approve or not approve such a change depending upon its analysis of the effects on the overall programs offered by the ECE Department.

The current minimum standards for degree of emphasis on outcomes in various ECE courses are given in the following Tables 1, 2 and 3. Table 2 gives the minimum emphasis standards for the "Core" – courses required in both programs (EE and CSE). Tables 2 and 3 respectively show the minimum standards for the non-Core EE and non-Core CSE courses that are either required or are restrictive electives. The leftmost column in each table specifies the various course numbers and names while the topmost row specifies outcome categories. The Emphasis rating used in the three tables is interpreted as follows: Multiplying the emphasis score for a course by the corresponding "weight" of an outcome category yields the minimum number of hours per week a student is expected to spend on learning activities related to that outcome. For example, the course EK307 has an emphasis score of 4 in the Laboratory column that in turn has a weight of 1.0 as indicated in parentheses at the top of the column. Thus, a student in EK307 is expected to spend at least 4 x 1 = 4 hours per week on laboratory-related learning activities.

TABLE 1: Minimum Outcome Emphasis Standards for EE/CSE Core

Category (Weight)	Understanding abet a,e (2.0)	Communication abet g (0.6)	Collaboration abet d (1.0)	Laboratory abet b,k (1.0)	Integrated View non-abet m (0.2)	Design abet c (1.0)	Discovery abet i (0.2)
EK307 Electric Circuit Theory	5	1	2	4	1	3	1
SC311 Logic Design	4	2	1	4	1	4	1
SC401 Signals and Systems	5	2	1	2	3	2	2
SC410 Electronics	5	2	1	4	2	3	2
SC463 Senior Design Project I	2	5	5	2	5	3	5
SC464 Senior Design Project II	1	5	5	5	5	5	5

Emphasis Rating and Outcome Weights: Multiplying the emphasis score for a course by the corresponding "weight" (indicated inside parentheses at the top of the column for each outcome) of an outcome yields the minimum number of hours per week a student is expected to spend on learning activities related to that outcome.

TABLE 2: Minimum Outcome Emphasis Standards for EE Non-Core

Category (Weight)	Understanding abet a,e (2.0)	Communication abet g (0.6)	Collaboration abet d (1.0)	Laboratory abet b,k (1.0)	Integrated View non-abet m (0.2)	Design abet c (1.0)	Discovery abet i (0.2)
SC455 Electromagnetic Systems I	5	2	1	2	4	3	1
SC402 Control Systems	5	2	1	3	3	3	2
SC415 Communication Systems	5	2	1	3	3	3	3
SC416 Digital Signal Processing	5	2	1	3	3	3	3
SC471 Physics of Semiconductor Devices	5	2	1	3	3	2	2
SC456 Electromagnetic Systems II	5	2	1	2	3	2	3
SC412 Electronics II	5	2	1	2	3	4	3
SC450 Microprocesssors	4	2	2	3	3	4	3
SC571 VLSI Design	4	2	1	4	3	4	3
SC312 Computer Organization	4	2	2	4	3	4	1
CS112 Data Structures	4	1	1	3	1	4	1

Emphasis Rating and Outcome Weights: Multiplying the emphasis score for a course by the corresponding "weight" (indicated inside parentheses at the top of the column for each outcome) of an outcome yields the minimum number of hours per week a student is expected to spend on learning activities related to that outcome.

TABLE 3: Minimum Outcome Emphasis Standards for CSE Non-Core

Category (Weight)	Understanding abet a,e (2.0)	Communication abet g (0.6)	Collaboration abet d (1.0)	Laboratory abet b,k (1.0)	Integrated View non-abet m (0.2)	Design abet c (1.0)	Discovery abet i (0.2)
SC571 VlSI Design	4	2	1	4	3	4	3
SC447 Software Design	3	3	3	4	3	3	3
SC546/441 Computer Commication & Networks	4	3	2	3	3	3	3
SC450 Microprocessors	4	2	2	3	3	4	3
SC440 Operating Systems	4	2	1	3	3	3	1
CS112 Introduction to Computer Science II	4	1	1	3	1	4	1
SC312 Computer Organization	4	2	2	4	3	4	1
SC330 Applied Algorithms	4	2	2	3	2	4	3

Emphasis Rating and Outcome Weights: Multiplying the emphasis score for a course by the corresponding "weight" (indicated inside parentheses at the top of the column for each outcome) of an outcome yields the minimum number of hours per week a student is expected to spend on learning activities related to that outcome.

The Educational Breadth outcome category (ABET h, f, and j) is not listed in the previous three tables for outcome emphasis standards. The ECE Undergraduate Committee decided that while many ECE courses individually contribute to this outcome, each ECE course's contribution is fairly small as compared to the contributions made by courses in the humanities, social science, and Senior Design. The outcome standards for Educational Breadth in the Senior Design Project sequence are given below.

Minimum Emphasis Standards for Educational Breadth Outcomes

Category(Weight)	ABET **h** (0.1)	ABET **f** (0.1)	ABET **j** (0.1)
SC463: Senior Design I	5	5	5
SC464: Senior Design II	3	5	3

Index: ABET **h** - technology & society; ABET **f** - ethics & professional responsibility; ABET **j** - contemporary issues.

The ECE Undergraduate Committee has also recommended that starting in Fall 2003 each of the remaining required EE courses should have an emphasis of at least 2.0 in each of the three educational breadth categories. That translates for each outcome category to an expectation in each course of at least two hours of student learning per semester.

Monitoring Actual Outcome Emphasis in Courses: The ECE Undergraduate Committee requires that before the start of a semester every ECE undergraduate course instructor must submit a course syllabus specifying the actual emphasis to be placed on each program outcome category (including the ABET a-k categories). Furthermore, the syllabus is required to include specific course outcomes that contribute to the program outcomes. Near the end of the semester, students in each course are asked to fill out a survey to seek their opinion on how much emphasis was placed on each of the program outcomes. This data along with faculty input is available to the ECE Undergraduate Committee to help in monitoring actual outcome emphasis taking place in the courses.

Initiating Corrective Actions: Upon receipt of a course syllabus prior to the start of a course offering, the ECE Undergraduate Committee reviews the syllabus to ensure that the outcome emphasis standards are met. If this is not the case, the ECE Undergraduate Committee establishes communication with the course instructor in order to arrive at a satisfactory solution. Such communication also takes place with a course instructor if the end-of-semester student surveys indicate a serious discrepancy between the instructor's reported emphasis and that perceived by the students for the same outcome category. The main aim is to alert the instructor to the perceived discrepancy and to suggest that the instructor seek possible remedies if and when the instructor teaches that course again.

The ECE Undergraduate Committee also initiates corrective actions that are recommended by a process for Program Improvement Analysis. Typically, such recommendations may include not only changes in emphasis standards but also specific ways in which courses may be restructured in order to increase the likelihood that the outcome standards will be met. The restructuring recommendations are discussed in detail with the course instructor or coordinator in order to arrive at a mutually acceptable arrangement.

In some cases, the corrective actions for the program involve courses taught outside the ECE Department. The process for dealing with such situations is through the College of Engineering Undergraduate Committee. The Associate Dean for Undergraduate Programs chairs this committee whose membership also includes the Associate Chairs for Undergraduate Programs from all four engineering departments. The Committee is responsible for recommending changes to the College Faculty based upon its study of the issues involved and possible negotiations with departments outside the College.

3.10 Assessment of Outcomes

The ECE Undergraduate Committee has decided to use two metric goals (based on student surveys) to arrive at a preliminary decision about whether or not each outcome is "currently being achieved." To reach a final conclusion, the Committee also uses the qualitative assessments reported by the ECE faculty, the ECE Industrial Advisory Board, student forums, and alumni correspondence. The ECE Undergraduate Committee subsequently conducts a process for Program Improvement Analysis in order to identify a specific area where the program may be improved that year in light of the assessment results. Finally, the ECE Undergraduate Committee prepares a proposal for corrective actions to be taken within the processes for Achieving Program Outcomes.

Our primary quantitative assessment tool is the EBI (Educational Benchmarking Incorporated) Survey of student satisfaction that, starting with the graduating class of 2002, includes questions relating to how satisfied the graduating seniors of many programs across the country are with the achievement of ABET a-k outcomes in their respective programs. The EBI Survey seeks student responses on a 1-7 integer scale in which a score of 1 stands for little or no achievement and a score of 7 stands for maximum achievement. An outcome's EBI score for a particular program is defined as the average of the responses for that outcome from all of that program's graduating seniors who participated in the survey. We have decided to use the following EBI Score Metric Goal as part of our plans to assess the achievement of each of our outcomes that has a corresponding ABET a-k classification.

Metric Goal #1:
For each outcome, our aim is to ensure that in each of the last three years our program's EBI Score is superior to the mean of the EBI scores of all the EE programs in the Research-Doctoral Carnegie Class included in the EBI Survey.

Rationale: We consider this a relevant metric goal because of our stated program objective to have our graduates be competitive in the EE job market, where they would generally be competing against graduates of other EE programs across the country. If at some point it turns out that we are consistently achieving this metric goal for each and every one of our outcomes, we shall raise the "achievement bar" by an appropriate increment with respect to the Carnegie Class mean of EBI scores.

A second metric goal we have adopted is based upon an internal (conducted at BU) ECE Senior Graduation Survey and an internal ECE Junior Student Survey at the end of the Junior year. A sample of the ECE Senior Graduation Survey is provided at the end of this section. These surveys seek student perceptions of their level of preparation in relation to the various program outcomes. The survey responses are on a 1-5 scale in which 1 stands for little or no preparation and 5 stands for maximum preparation. The BU score for a particular outcome is defined as the average of the responses for that outcome from all of the students participating in the survey. We have decided to use the following BU Score Metric Goal as part of our plans to assess the achievement of each of our outcomes.

Metric Goal #2:
For each outcome, our aim is to ensure that in each of the last three years the BU Score for our graduating senior class is superior to the BU score for the class at the end of its junior year.

Rationale: We consider this a relevant metric goal because we expect the 2-semester Capstone Design Project in the senior year to make a major difference to each outcome. The students are expected to not only add to their knowledge and skills during the Senior Project experience but also to gain a greater awareness of the importance of each outcome to the practical realities of an actual project performed for a real customer. Furthermore, the technical electives taken during the senior year are expected to reinforce the students' integrated view of ECE and allow them to further refine their engineering knowledge and skills in the context of subject areas that are of particular interest to them.

This metric measures the difference in scores for two distinct cohorts of students, the current seniors and juniors. We are not testing the improvement in BU Scores with the same student group. Rather we are comparing the BU Scores for the graduating seniors with the BU Scores of the current juniors. (Therefore, a change in program only affecting juniors could/should improve BU scores, and might lead to the situation where the juniors have higher BU Scores (with the changes) than the seniors (not benefiting from the changes). For example, our success at improving technical writing in junior labs could make us fail our Metric Goal #2 because the juniors would be happier and more skilled than the seniors. It is with this type of "failure" in mind that we consider such metric-based assessments to be tentative or preliminary in nature. The ECE Undergraduate Committee makes the final determination of Metric Goal #2's relevance using knowledge of the curricular forces affecting student responses and reporting on extenuating programmatic circumstances.

In the case of our Integrated View outcome (non-ABET m) the BU-based criterion will be the only metric goal since non-ABET m is not currently included on the EBI survey. It is on the Fall 2003 agenda of the ECE Undergraduate Committee to select questions that essentially capture this information in the EBI survey.

Once the survey data has been used to check whether or not the two metric goals described above have been individually achieved for each program outcome, the ECE Undergraduate Committee uses these results along with other input to arrive at its final conclusions about outcome achievement. Specifically, the committee first makes a preliminary assessment decision for each outcome by requiring that an outcome's data must satisfy both of the metric goals in order to be considered as having been achieved during the academic year under consideration. The ECE Undergraduate Committee may then utilize input from ECE faculty, the ECE Industrial Advisory Council, and ECE Alumni to re-evaluate the preliminary assessment decisions. Input from ECE faculty comes through the membership of the ECE Undergraduate Committee as well as through ECE Faculty Meetings and Workshops. Input from the Industrial Advisory Council takes the form of a report issued after their annual meeting. Input from ECE Alumni generally takes the form of e-mail messages. Whenever the ECE Undergraduate Committee decides to change a preliminary assessment decision of an outcome, it is required to issue a report describing its reasons for doing so and providing supporting evidence. A major reason for including the possibility of changing the preliminary assessment is that it is based only upon student perceptions of outcome achievement. Thus, for example, students may perceive that an outcome is being achieved, but the ECE faculty may gauge (based on exam performance, etc.) their preparation to be inadequate. Another reason for not relying solely on the surveys is that they are not statistically reliable indicators of student perceptions. For example, the EBI Survey has very low response rates at some schools. Thus, the ECE Undergraduate Committee has to exercise great care in not reading too much into the survey data.

3.11 Program Improvement Analysis

Our process for Program Improvement Analysis (PIA) examines how resources could be most effectively directed to produce high achievement in all outcomes, assuming the minimum goals have already been reached.

Figure 3 depicts the major components of the program improvement analysis carried out by the ECE Undergraduate Committee. First, quantitative student survey data is used to identify a "target" outcome for improvement. The gathering and analysis of additional data for the target outcome is then used to hypothesize specific measures for improving upon that outcome's achievement level. The ECE Undergraduate Committee also seeks input from the various constituencies before presenting a proposal to the ECE faculty for implementing the improvement measures.

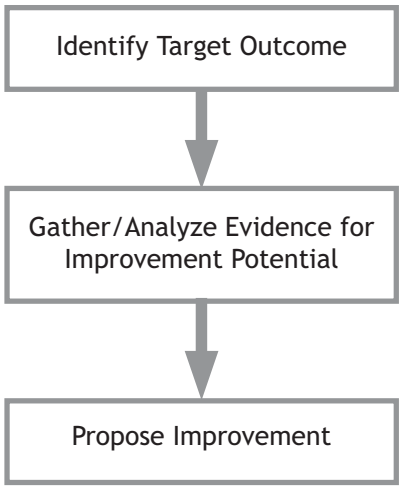


Figure 3: Flowchart Representing Process for Program Improvement Analysis

The procedure being currently used by the ECE Undergraduate Committee for identifying a target outcome for each academic year is outlined in Figure 4.

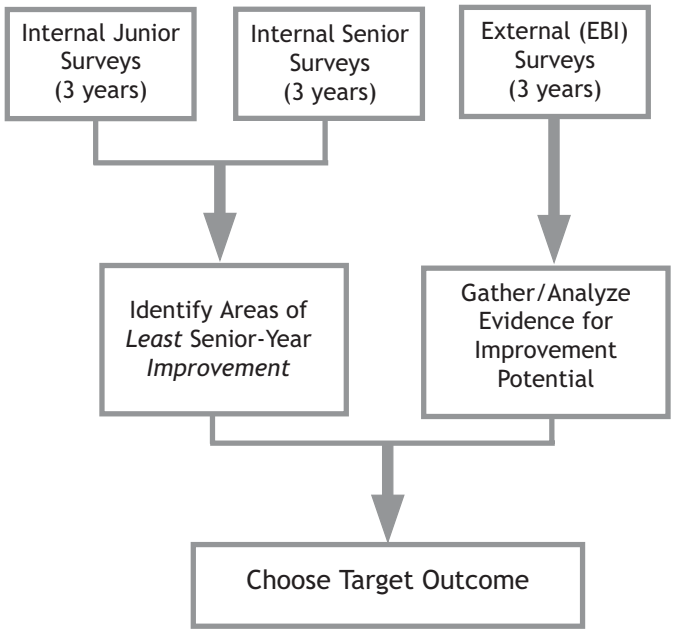


Figure 4: Flowchart for Identification of Target Outcome

The underlying quantitative data (the EBI student survey data and the internal student survey data for the past three years) used here is the same as that used for the quantitative portion of outcome assessment. The ECE Undergraduate Committee reviews this data with the goal of identifying a target outcome. While the committee has not adopted a specific algorithm for picking the target outcome, it is guided in its selection by two primary criteria:

1) On the EBI Survey, the target outcome should be among the outcomes that compare least favorably to their Carnegie Class Means.
2) On the Internal Student Surveys, the target outcome should be among the outcomes that show the least improvement from Junior to Senior year.

The Committee has purposely decided not to be too rigid in applying these criteria to target outcome selection. In making its final decision, it is also guided by other forms of input from the various constituencies. However, in case the target outcome does not satisfy either or both of the two primary criteria, the ECE Undergraduate Committee will issue a report giving its reasons for not satisfying either or both criteria. We are pleased to report that the target outcome (Understanding laws & principles – ABET a) selected during the 2002-2003 academic year met both the primary criteria.

Once a target outcome has been selected, the ECE Undergraduate Committee considers several types of measures that could potentially be taken to improve upon the outcome's achievement level. These include (but are not limited to) course actions, program actions, extracurricular actions, facilities actions, and administrative actions.

Course Actions:

1) Increasing the minimum emphasis standard for the target outcome in an ECE course.
2) Requesting an increased emphasis on the target outcome in a non-ECE course.
3) Requiring an ECE course to consider alternative learning and teaching strategies for achieving its current emphasis standard for the target outcome.
4) Requesting a non-ECE course to consider alternative learning and teaching strategies for achieving the target outcome without necessarily increasing the emphasis placed on the outcome.
5) Requiring changes in the listed pre-requisites for a course to improve its ability to increase its emphasis on the target outcome.

6) Requesting changes or additions to the instruction staff (professors, teaching assistants, graders, etc.) of one or more ECE courses or requiring the staff to undergo specific training related to the achievement of the target outcome.

Program Actions:

7) Replacing a program requirement of a particular course by a requirement for another course that places greater emphasis on the target outcome.
8) Adding another required course (that places greater emphasis on the target outcome) to the program.
9) Replacing a program elective by another elective in which each of the possible course choices places greater emphasis on the target outcome.
10) Adding another elective in which each of the course choices places greater emphasis on the target outcome to the set of electives in the program.

Extracurricular Action:

11) Requesting changes or additions to non-course aspects of the curriculum such as advising, membership opportunities in professional or honor societies, research opportunities, departmental seminars/ workshops, etc. to better suit the target outcome.

Facilities Action:

12) Requesting changes or additions to instructional facilities such as classrooms, laboratories, libraries, study lounges, etc.

Administrative Action:

13) Requesting changes or additions to administrative procedures such as course registration, course scheduling etc.

In order to decide what the most appropriate measures would be in a particular case, the ECE Undergraduate Committee would collect additional relevant data. For example, it may design and carry out a special-purpose survey to gauge the opinions of one or more of the program constituencies. It may also request relevant data from course instructors, the Department Chairman, or other administrative officials of the University.

3.12 Assessment & Improvement Analysis Results

The 2002-2003 academic year marked the first time our fully defined processes for outcome assessment and program improvement analysis were first implemented. In this section, we describe the results obtained that year from these processes. In short, seven of our twelve outcomes were declared "achieved" and the "Understanding Laws & Principles" outcome (ABET **a**) was identified as a target outcome for improvement. As a result of its Program Improvement Analysis process, the ECE Undergraduate Committee recommended changing the course used to fulfill the EE and CSE probability & statistics requirement from one taught by the Mathematics Department in the College of Arts & Sciences to one taught by the Department of Manufacturing Engineering. The rationale for this change was two-fold: (1) the engineering course places a greater emphasis on engineering applications and (2) the engineering course participates in the continual improvement process for ABET outcomes a-k.

Our EBI-Based Metric Goal specifies the use of EBI Survey data for the three most recent graduating classes. Since data was available at the time only for one graduating class, we evaluated the EBI-Based Metric Goal on that limited data.

Preliminary Assessment of EE Outcomes Using Metric Goals:

Our EBI-Based Metric Goal specifies the use of EBI Survey data for the three most recent graduating classes. Since data was available at the time only for one graduating class, we evaluated the EBI-Based Metric Goal on that limited data. Seven of the ABET a-k outcomes satisfied that Metric Goal: technology & society (ABET h), ethics & professional responsibility (ABET f), problem solving and formulation (ABET e), collaboration for teamwork (ABET d), experiments (ABET b), tools (ABET k), and design (ABET c). The four that did not satisfy this Metric Goal are: contemporary issues (ABET j), laws & principles (ABET a), communication (ABET g), and discovery (ABET i). Our second Metric Goal uses BU-based survey data to determine if the graduating seniors rate their own learning outcomes to be higher than do the students completing their junior year. Each of the outcomes, including the non-ABET Integrated View outcome, satisfied this metric goal.

Preliminary Assessment of CSE Outcomes Using Metric Goals:

Five of the twelve ABET a-k outcomes satisfied the EBI Based Metric Goal: technology & society (ABET h), ethics & professional responsibility (ABET f), Contemporary issues (ABET j), problem solving and formulation (ABET e), collaboration for teamwork (ABET d), and design (ABET c). The six that did not satisfy this Metric Goal are: laws & principles (ABET a), problem solving and formulation (ABET e), Communication (ABET g), experiments (ABET b), tools (ABET k), and discovery (ABET i). Our second Metric Goal uses BU-based survey data to determine if the graduating seniors rate their own learning outcomes to be higher than do the students completing their junior year. Each of the outcomes, including the non-ABET Integrated View outcome, satisfied this metric goal.

Final Assessment of EE Outcomes

The ECE Undergraduate Committee found that the EBI-Based Metric Goal not being satisfied by our ABET a outcome (Understanding - Laws & Principles) is consistent with the input received from EE Program constituents. It should also be

noted that in the case of this outcome the EBI Score for BU was 8% below the mean EBI Score for the Research/Doctoral-Extensive Carnegie Class. In contrast, BU's EBI Scores missed the Carnegie Class mean by at most 3% in the case of the other three outcomes that were found to not satisfy the EBI-Based Metric Goal. The ECE Undergraduate Committee decided that for two of these outcomes (Contemporary Issues [ABET j] and Discovery [ABET i]) there was insufficient evidence to make conclusions about their achievement status. However, in the case of the Communication (ABET g) outcome, the Committee voted unanimously to declare it "not achieved" because the ECE faculty has often expressed dissatisfaction with the students' communication skills.

Final Assessment of CSE Outcomes

The ECE Undergraduate Committee found that the EBI-Based Metric Goal not being satisfied by our ABET a outcome (Understanding Laws & Principles) nor by our ABET g outcome (Communication) is consistent with the input received from CSE Program constituents and thus declared these outcomes "not achieved." It should also be noted that in the case of these two outcomes the EBI Score for BU was more than 6% below the mean EBI Score for the Research/Doctoral-Extensive Carnegie Class. In contrast, BU's EBI Scores missed the Carnegie Class mean by at most 4% in the case of remaining four outcomes [problem solving and formulation (ABET e), experiments (ABET b), tools (ABET k), and discovery (ABET i)] that were found to not satisfy the EBI-Based Metric Goal. The committee decided that there was insufficient data in these four cases to make a conclusion about outcome achievement at this time.

Program Improvement Analysis for EE and CSE Programs

During the 2002-2003 academic year, the ECE Undergraduate Committee also conducted an analysis to determine a "target outcome" for improvement in the EE and CSE program and to propose an improvement strategy.

The "Understanding - Laws & Principles" outcome (ABET a) showed the least improvement in perceived achievement level as we move from the juniors to the seniors in ECE. This same outcome was in both programs among the three worst performing outcomes relative to their Carnegie Class means on the EBI Survey data. The ECE Undergraduate Committee consequently decided to select "ABET a" as the target outcome for both programs in the 2002-2003 academic year. It should be noted that while the quantitative data is used by the ECE Undergraduate Committee to guide its decision, the Committee is not required to choose as its "target outcome" the outcome that has the "worst" performance according to this data. Other factors that may influence the decision include results from past years, input from ECE faculty, the ECE Industrial Advisory Committee, student forums, and alumni correspondence.

As the ECE Undergraduate Committee discussed possible ways of improving the outcome achievement level for ABET a, a consensus emerged that the students did not have adequate preparation in the area of Probability & Statistics. To test this hypothesis, the committee asked seniors to fill out a survey form to gauge their perceptions of the possible areas needing improvement in their mathematical preparation. *(See opposite page.)*

Nineteen seniors in the ECE Department answered the survey during the spring 2003 semester. The results shown below appear to confirm the hypothesis that our seniors are quite dissatisfied with their experience in the required Probability & Statistics course (CAS MA 381) in comparison to their experience in Calculus classes. Similar dissatisfaction was shown for the linear algebra course.

Mini-Survey Results Pertaining to Probability and Statistics Relative to Calculus

Important for ENG (5.0=very important)		
	Probability & Statistics	3.4/5.0
	Calculus:	4.4/5.0
Personal Preparation (5.0=excellent preparation)		
	Probability & Statistics	2.9/5.0
	Calculus:	4.3/5.0
Use in ENG courses (5.0=extensive use)		
	Probability & Statistics	2.9/5.0
	Calculus	4.6/5.0

The ECE Undergraduate Committee concluded on the basis of this data in conjunction with the CAS MA 381 course description and anecdotal evidence from faculty and students that CAS MA 381 was not preparing our students adequately for application to engineering problems. Instead, the Committee recommended a course (ENG MN308) that is taught within the College of Engineering by the Department of Manufacturing Engineering. The Committee felt that this course better emphasized the importance of probability and statistics in engineering by using illustrative examples from engineering applications. The Committee also felt that since MN308 is taught within the College of Engineering there would be a greater opportunity to monitor and influence the course using an outcomes-based approach. Furthermore, the Committee has recommended that ECE courses such as Signals & Systems (SC401), Communication Systems (SC415), and Digital Signal Processing (SC416) should place greater emphasis on their probability and statistics content. The recommendations of the ECE Undergraduate Committee will be considered and voted upon by the ECE faculty in Fall 2003.

ECE Mini Survey

Boston University

Spring 2003

YOUR MAJOR (EE or CSE):_____

A. Importance for Engineering

1) Probability and statistics are important for engineering.
(Strongly Disagree) 1 2 3 4 5 (Strongly Agree)

2) Linear Algebra is important for engineering.
(Strongly Disagree) 1 2 3 4 5 (Strongly Agree)

3) Calculus is important for engineering.
(Strongly Disagree) 1 2 3 4 5 (Strongly Agree)

4) Differential Equations are important for engineering.
(Strongly Disagree) 1 2 3 4 5 (Strongly Agree)

5) Discrete Mathematics is important for engineering .
(Strongly Disagree) 1 2 3 4 5 (Strongly Agree)

B. Personal Preparation

1) I feel well prepared to apply probability and statistics to engineering problems.
(Strongly Disagree) 1 2 3 4 5 (Strongly Agree)

2) I feel well prepared to apply Linear Algebra to engineering problems.
(Strongly Disagree) 1 2 3 4 5 (Strongly Agree)

3) I feel well prepared to apply Calculus to engineering problems.
(Strongly Disagree) 1 2 3 4 5 (Strongly Agree)

4) I feel well prepared to apply Differential Equations to engineering problems.
(Strongly Disagree) 1 2 3 4 5 (Strongly Agree)

5) I feel well prepared to apply Discrete Mathematics to engineering problems.
(Strongly Disagree) 1 2 3 4 5 (Strongly Agree)

C. Use in Engineering Courses

1) I have used my knowledge of probability and statistics in engineering courses.
(Strongly Disagree) 1 2 3 4 5 (Strongly Agree)

2) I have used my knowledge of Linear Algebra in engineering courses.
(Strongly Disagree) 1 2 3 4 5 (Strongly Agree)

3) I have used my knowledge of Calculus in engineering courses.
(Strongly Disagree) 1 2 3 4 5 (Strongly Agree)

4) I have used my knowledge of Differential Equations in engineering courses.
(Strongly Disagree) 1 2 3 4 5 (Strongly Agree)

5) I have used my knowledge of Discrete Mathematics in engineering courses.
(Strongly Disagree) 1 2 3 4 5 (Strongly Agree)

four: Graduate Programs

4.1 Course and Program Development

During the 2002-03 academic year, the MS in Photonics degree program was launched. This program, which started in September 2002, currently has 3 full time students and the MS in Photonics was included as a program option for new applicants for the first time this year. We expect a rapid increase in the number of students in this program and we are hopeful that it will show continued growth. Students who were primarily interested in studying photonics constituted 5% of the applications received this year.

We have continued to improve our graduate program by adding new courses. One of the significant modifications was to discontinue SC546 Computer Communication Networks, which was attended by both undergraduate and graduate students. A new undergraduate course was created, SC441, which is a prerequisite for the graduate course SC541 Computer Communications and Networks, taught by Professor Murat Alanyali for the first time Spring 2003. This curricular change will be essential for better training of our graduate students in the rapidly growing Networks area in ECE.

A number of new courses have been approved by the College of Engineering and formally added to our program after being successful during their first offering. New Courses added to the inventory this year include the following:

- **SC551** Advanced Digital Design with Verilog and FPGA, developed by Professor Taubin
- **SC582** RF/Analog IC Design Fundamentals for Mixed Signal Applications, developed by Professor Knepper
- **SC720** Digital Video Processing, developed by Professor Konrad
- **SC724** Advanced Optimizaton Theory and Methods, developed by Professor Paschalidis (meets with MN724)
- **SC733** Discrete Event and Hybrid Systems, developed by Professor Cassandras (meets with MN733)
- **SC744** Mobile Adhoc Networking and Computing, developed by Professor Little
- **SC751** Design of Asynchronous Circuit and Systems, developed by Professor Taubin

We have also developed new courses either offered during Spring 2003 or to be offered in Fall 2003 as special topics, a designation we utilize for the first offering of graduate courses. For example, SC700 Personal Knowledge Engineering will be taught by Professor Tommaso Toffoli during Fall 2003.

4.2 Graduate Student Recruitment

This year a new scholarship, the Dean's Research Fellowship, was created. The Dean's office provided one year of funding to those applicants selected from nominated departments. DRFs cover 8 credit hours per semester and allow the students to be engaged in research early in their graduate studies and to prepare for PhD qualifying exams. In order to increase the number of offers made and to provide an early research opportunity for the new students, many of these Fellowships were split into half; and the balance of the funding was in the form of a Research Assistant supported by individual faculty members. In this manner faculty members that provided the half-RA positions were actively involved in the recruiting effort and we enjoyed strong fellowship recruitment with 8 students accepting the offer at an acceptance rate of 80%.

ECE held the traditional graduate student recruiting event in April. The open house weekend gave the opportunity for professors and potential students to meet and evaluate one another. Of the 20 non-BU students invited, 10 were offered financial aid, of which 7 accepted the offer. All but one of the awards were Dean's Research Fellowships and all candidates had the enthusiastic support of the faculty.

Another enticement to assist in the recruitment of high-quality graduate students is the new University-wide agreement to subsidize medical insurance for full-time Teaching Fellows and Research Assistants. Starting with the 2003/2004 academic year, financial aid packages will now include coverage of the student's participation in the Boston University Medical Insurance Plan. The cost is about $975 and this benefit will be extended to continuing graduate students as well as new students.

4.3 Graduate Teaching Fellow & Undergraduate Teaching Fellow Programs

Each department's Graduate Teaching Fellow (GTF) allocation within the College of Engineering is determined by the College's Undergraduate Committee and is based on specific course and laboratory requirements. ECE's allocation of the College of Engineering's 53 GTF slots will decrease from 22 in Fall 2002 to 21 for Fall 2003. ECE also provides an additional GTF (and a professor) to teach the Electric Circuits course in the BU Metropolitan College Science and Engineering Program, most of whose students join the College of Engineering formally in their junior year. We had additional

teaching positions during the last academic year due to 2 scholarship awards that were converted to GTFs and therefore the actual reduction will be more significant and the continued successful use of Undergraduate Teaching Fellows (UTFs) will be vital. During the Spring 2003 semester, we introduced a formal procedure for recruiting and tracking UTFs and we had 6 undergraduates participating. The feedback from students and faculty has been both positive and encouraging. This program will help provide teaching support in the future, especially with the reduction of GTF positions awarded. ECE has set an example for other engineering departments that are starting their own UTF programs.

4.4 Qualifying Exams

The College of Engineering Math Qualifying Exam was offered in January and May as usual. ECE graduate students have been very successful in general and were recognized for having the top 3 scores in the most recent Math Exam. The ECE Subject Qualifying Exam was conducted on April 5, 2003. This particular date (the first Saturday in April) was chosen to allow new students sufficient time to prepare for the exam by taking courses in the Spring as well as the Fall Semester. This also gives the students nearly one month before the May Math Exam. Starting in the 2003/2004 academic year, ECE will require all new PhD students that enter the program in the Fall to take both the ECE and Math qualifying exams within their first year. During the transition period in Spring 2003, post-BS PhD students were allowed to petition to defer the ECE exam by one year. Most of the post-BS PhD students opted to take the exam and passed. The overall performance of the record number (29) of students attempting the ECE Qualifying Exam was indicative of an improving program.

4.5 Colloquia and Seminars

The ECE Colloquium Series continued for a fifth successful year. Prominent speakers from both inside and outside the University gave research talks on current issues. We encourage graduate students to attend these talks.

During the Spring 2003 semester, ECE Department has started a new seminar series called *Research Spotlight Seminars* (RSS) to encourage collaboration among faculty from different disciplines. Although the intended audience was ECE faculty, graduate students often attended these seminars and contributed to discussions. We expect continued participation of graduate students in RSS in the future.

A list of speakers for the academic year for these two seminar series, as well as other relevant seminars, is given on pages 4-11 through 4-14.

4.6 New Matriculants

New Students Entering 2002-2003

		Male	Female	FT	PT	GTF	RA	Fellow	Other
MS	US	20	6	23	1	1	5	0	0
	Intl.	8	6	12	4	1	1	0	0
Ph.D.	US	7	1	8	0	2	2	0	1
	Intl.	18	8	24	2	9	5	0	1
Total		**53**	**21**	**67**	**7**	**13**	**13**	**0**	**2**

Fall 2002 Mean GRE Scores

		Verbal	%	Quantitative	%	Analytical	%
MS	US	503	59	725	80	661	72
	Intl.	468	48	745	85	645	69
PhD	US	532	67	752	86	702	80
	Intl.	468	48	777	93	675	75
Mean		**485**	**53**	**752**	**86**	**667**	**73**

Spring 2003 Mean GRE Scores

		Verbal	%	Quantitative	%	Analytical	%
MS	US	518	63	728	81	693	80
	Intl.	514	62	728	79	675	75
PhD	US	570	76	665	67	800	98
	Intl.	518	53	768	89	680	75
Mean		**522**	**61**	**735**	**81**	**694**	**77**

4.7 MS Students

Student Name	Advisor	Research Area or Thesis Title
Aeron, Shuchin	Saligrama	Electrical Engineering
Agniel, Philippe	Konrad	Electrical Engineering
Albanese, Marc	Morse	Electrical Engineering
Anandaraman, Deepa	Levitin	Computer Systems Engineering
Bycenski, Kenneth*	Moustakas	Physics
Campbell, Darryn	Alanyali	Computer Systems Engineering
Castelli, Thomas	Trachtenberg	Computer Systems Engineering
Cataldo, Brian	Kincaid	General Engineering
Chan, Kin Fan	Carruthers	Electrical Engineering
Chen, Kevin	Saligrama	Electrical Engineering
Ciriello, Sarah	Kincaid	Electrical Engineering
Clark, James	Kincaid	Electrical Engineering
Coles, Michael	Kincaid	General Engineering
Corporon, Jay	Saleh	Phontonics
Dai, Haito*	Starobinski	Computer Systems Engineering
Dain, Oliver	Knepper	Computer Systems Engineering
Deans, Tara	Jackson	General Engineering
Diaz, Marcos	Oliver	Electrical Engineering
Driscoll, Kristina	Saleh	Electrical Engineering
Dougherty, Paul*	Carruthers	Computer Systems Engineering
Dunklee, Jason	Kincaid	General Engineering
Egnaczyk, Jeff	Skinner	Computer Systems Engineering
French, Adam	Kincaid	General Engineering
Fu, Zhicong	Levitin	Computer Systems Engineering
Gali, Srikrishna	Carruthers	Computer Systems Engineering
Gazder, Aspiyan*	Hubbard	Electrical Engineering
Gervais, David	Sergienko	Electrical Engineering
Ghosh, Soma	Starobinski	Computer Systems Engineering
Gore, Tyler	Hubbard	Electrical Engineering
Gregorowicz, Andrew	Karl	Electrical Engineering
Grogan, Aaron	Kincaid	General Engineering
Gupta, Shameek*	Karpovsky	Computer Systems Engineering
Hitchings, Darin	Konrad	Electrical Engineering
Imhausen, Brian	Ünlü	Extending the Smart Pixel Paradigm: Integrated Image Acquisition and Imaging Processing Circuitry
Iwai, Yasuko	Herbordt	Computer Systems Engineering
Iyer, Sandeep*	Moustakas	Electrical Engineering
Jow, An-Ching*	Starobinski	Computer Systems Engineering
Kulkarni, Mugdha*	Brackett	Computer Systems Engineering
Lalooses, Francine*	Herbordt	Computer Systems Engineering
Lancia, David	Alanyali	Computer Systems Engineering
Lanni, Edward	Kincaid	General Engineering
LaPlume, Paul*	Ruane	Electrical Engineering
LaRosa, Gregory	Kincaid	General Engineering
Leonard, Edward	Ruane	Electrical Engineering
Lichtenstein, Lee	Toffoli	Computer Systems Engineering
Lim, Eric*	Nawab	Electrical Engineering
Lin, Pei-Chao*	Starobinski	Computer Systems Engineering
Liu, Ying-Tsang*	Sergienko	Electrical Engineering
Mcknight, Andrew*	Knepper	Electrical Engineering
Mitchell, Brian	Carruthers	Electrical Engineering
Mueller, Alexander	Kincaid	Electrical Engineering
Nautiyal, Archana*	Karpovsky	Computer Systems Engineering
Nourzad, Marianne*	Knepper	Electrical Engineering
Owen, Russell	Bellotti	Electrical Engineering
Pant, Pavan	Carruthers	Computer Systems Engineering
Parrin, Jill	Kincaid	General Engineering
Pasnoor, Sulakshana*	Bellotti	Electrical Engineering

Student Name	Advisor	Research Area or Thesis Title
Patel, Mitul	Karpovsky	Computer Systems Engineering
Pinkney, Errol	Knepper	Computer Systems Engineering
Praino, Julie	Saleh	Photonics
Price, Gavrielle	Kincaid	General Engineering
Raman, Supriya	Carruthers	Electrical Engineering
Raybardhan, Amit	Taubin	Electrical Engineering
Riggott, Gary	Moustakas	Electrical Engineering
Saeteng, Nipha	Saleh	Electrical Engineering
Sarkhili, Sara	Kincaid	Electrical Engineering
Satheesh, Chindu	Castañón	Electrical Engineering
Shah, Jay*	Oliver	Electrical Engineering
Shaw, Matthew	Sergienko	Electrical Engineering
Sleiman Haidar, Jaafar	Kincaid	General Engineering
Smith, Gregg	Kincaid	General Engineering
Solanki, Parikha	Bigio	Electrical Engineering
Stewart, Jason	Teich	Electrical Engineering
Stone, Patrick	Sergienko	Quantum Imaging of MEMS Micromirror Phase Objects using Entangled Photons
Sukumar, Sumithira	Konrad	Electrical Engineering
Sweetser, Russell	Castañón	Computer Systems Engineering
Tong, Yunjie*	Ünlü	Electrical Engineering
Ungrangsi, Rachanee*	Starobinski	Location Detection in Emergency Sensor Networks using Robust Identifying Codes
Vajda, Viktor	Hubbard	Computer Systems Engineering
Vamivakas, Anthony	Teich	Electrical Engineering
Varghese, Joseph*	Carruthers	Computer Systems Engineering
Vellanki, Harshavardhan	Sergienko	Electrical Engineering
Williams, Genja	Hubbard	Computer Systems Engineering
Wright, Kristin	Jackson	General Engineering
Wu, Jing	Knepper	Electrical Engineering
Yiu, Hung-Wei	Kincaid	General Engineering
Yu, Qingying*	Trachtenberg	Computer Systems Engineering
Zachariah, Ranjith	Kincaid	General Engineering
Zhai, Qingtai	Fritz	Electrical Engineering
Zhang, Wei	Oliver	Computer Systems Engineering

* degree received in 2002/2003

Above: *Graduating MS Students Saikat Ray, Rachanee Ungrangsi, and Nicolas Arcolano*

4.8 PhD Students

Student Name	Advisor	Research Area or Dissertation Title
Al-Awadhi, Ayman*	Carruthers	Integrating Wireless And Wireline Networks: Seamless User-centric Voice/Data Networks Using Intelligent Glue Horizontal Integration
Abell, Joshua	Moustakas	Electrical Engineering
Abu Ayyash, Salma	Carruthers	Signal Processing
Agarwal, Sachin†	Trachtenberg	Computer Engineering
Ahner, Darryl	Caramanis	Systems Engineering
Arcolano, Nicholas†	Saligrama	Cross-layer Modeling Of Influence Phenomena In Wireless Ad Hoc Networks
Bach, Edward	Toffoli	Computer Engineering
Basu, Prithwish*	Little	A Task Based Approach For Modeling Distributed Applications On Mobile Ad Hoc Networks
Bergstein, David	Ünlü	Electrical Engineering
Bhattacharyya, Anirban	Moustakas	Electrical Engineering
Booth, Mark	Teich	Biomedical Engineering
Bozinovic, Nikola	Konrad	Electrical Engineering
Bynoe, Wayne	Carruthers	Broadband Wireless LAN's
Cabalu, Jasper	Moustakas	Electrical Engineering
Carroll, Sarah	Carruthers	Wireless Communication Networks
Chaand, Anuja		
Chandrasekaran, Ramya	Moustakas	Electrical Engineering
Chang, Shey-Sheen*	Nawab	Electrical Engineering
Chauhan, Vikas	Trachtenberg	Computer Engineering
Chen, Fangyi	Hubbard	Electrical Engineering
Chen, Tai-Chou	Moustakas	Electrical Engineering
Chivas, Robert	Morse	Electrical Engineering
Colerico, Marlene	Mendillo	Electrical Engineering
Collier, Patrick	Morse	Electrical Engineering
Crager, Joseph	Horenstein	Electrical Engineering
Davis, Brynmor	Karl	Electrical and Computer Engineering
Dobson, Jennifer	Bigio	Electrophysics
Dosunmu, Olufemi	Ünlü	Electrical Engineering
Egorov, Roman	Levitin	Computer Engineering
Emsley, Matthew*	Ünlü	Silicon Resonant Cavity Enhanced Photodetector Arrays For Optical Interconnects
Eraslan, Mesut	Ünlü	Electrical Engineering
Graff, John*	Ünlü	Development Of High Performance Light Emitting Diodes For Solid-state Lighting
Hasan, Qader-Ul	Levitin	Computer Engineering
He, Zhihua	Bystrom	Electrical Engineering
Hinck, Todd*	Hubbard	Extending the Smart Pixel Paradigm: Integrated Image Acquisition and Imaging Processing Circuitry
Hu, Lan	Toffoli	Computer Engineering
Huang, Chien Chih	Knepper	Electrical Engineering
Ince, Serdar	Konrad	Electrical Engineering
Ippolito, Stephen	Ünlü	Electrical Engineering
Jastrzebski, Piotr	Lee	Electrical Engineering
Kang, Seong-Cheol	Paschalidis	Systems Engineering
Karl, Christian	Hubbard	Electrical Engineering
Kaur, Parminder	Trachtenberg	Computer Engineering
Ke, Wang	Little	Multimedia Networks, Video-on-Demand Systems
Kim, Duk Joong	Hubbard	Electrical Engineering
Kim, Soo Il	Nawab	Electrical Engineering
Krishnan, Rajesh	Starobinski	Efficient Self-Organization of Large Wireless Sensor Networks

Student Name	Advisor	Research Area or Dissertation Title
Kunapareddy, Nagapratima	Moustakas	Electrical Engineering
Laurent, Sophie	Mendillo	Tomography on Auroras
Li, Ning	Morse	Electrical Engineering
Li, Wei	Moustakas	Microelectronics
Li, Xiaojun	Morse	High Power Fiber Laser
Li, Yan	Saleh	Electrical Engineering
Litvin, Andrey	Karl	Space Physics
Liu, Huajun	Perreault	Networking, Microcomputer systems
Lu, Shan	Hubbard	Computer Engineering
Lu, Ye	Bystrom	Electrical Engineering
MacKenzie, Alexander	Nawab	Electrical Engineering
Marotta, Sebastian	Toffoli	Computer Engineering
Martin, Benjamin	Castañón	Electrical Engineering
Mathur, Raman†	Karpovsky	Electrical Engineering
McNerney, Peter	Konrad	Computer Systems
Mei, Kao-Chi	Karpovsky	Computer Engineering
Miao, Lei	Karpovsky	Electrical Engineering
Mustafa, Mehmet	Karpovsky	Reliable Computing
Nasr, Magued	Saleh	Quantum Optics
O'Hare, Brendan	Cassandras	Electrical Engineering
Pan, Haidong	Caramanis	Systems Engineering
Pavlovich, Julia	Karl	Electrical Engineering
Perreault, Julie	Bifano	MEMS
Polimeni, Jonathan	Schwartz	Computational Neuroscience, Computer Vision, AVLSI
Ray, Saikat†	Oliver	Transmission Strategies in Wireless Networks
Ristivojevic, Mirko	Konrad	Electrical Engineering
Ruan, Dan	Konrad	Electrical Engineering
Rykalova, Yelena	Levitin	Computer Engineering
Savas, Onur	Alanyali	Electrical Engineering
Schea, Jeremy	Chakrabarti	Computer Engineering
Shen, Yang	Paschalidis	Systems Engineering
Shi, Yonggang	Karl	Signal Processing
Singh, Rajwinder*	Eddy	Electrical Engineering
Smirnov, Alexander	Taubin	Computer Engineering
Toussaint, Kimani	Sergienko	Electrical Engineering
Vamivakas, Anthony	Teich	Electrical Engineering
Van Court, Thomas	Herbordt	Computer Engineering
Vitolo, Thomas	Caramanis	Systems Engineering
Walton, Zachary	Toffoli	Computer Engineering
Wang, Meimei	Cassandras	Systems Engineering
Wang, Yang	Bellotti	Physics
Weisenseel, Robert	Karl	Sensor Fusion for Subsurface Object Detection
Williams, Adrian	Oliver	Electrical Engineering
Wotiz, Robert	Nawab	Knowledge Based Signal Processing
Wu, Tao	Starobinski	Electrical Engineering
Wynne, Rosalind	Morse	Physics
Xu, Tao	Moustakas	Electrical Engineering
Yang, Zibing	Hubbard	VLSI Circuit Design
Yarnall, Timothy	Teich	Electrical Engineering
Yoon, Ji Sun	Hubbard	Electrical Engineering
Zhao, Wei	Saligrama	Electrical Engineering

* received degree in 2002/2003

† received MS as part of program in 2002/2003

4.9 Degrees Awarded

MS Degrees Awarded	
Electrical Engineering	17
Computer Systems Engineering	18
TOTAL	**35**

PhD Degrees Awarded	
Electrical Engineering	5
Computer Systems Engineering	2
TOTAL	**7**

4.10 Graduate Teaching Fellows

Fall 2002

Student Name	Course
Abu Ayyash, Salma	MET EK317
Aeron, Shuchin	SC401
Chang, Shey-Sheen	SC416
Eraslan, Mesut	SC410
Chatterjee, Santanu	EK307
Gali, Srikrishna	SC312
Gazder, Aspiyan	SC312
Ghosh, Soma	SC440, SC447
Ince, Serdar	SC463, SC464
Kulkarni, Mugda	SC463, SC464
Kunapareddy, Nagapratima	SC410
Li, Ning	SC410
Mackenzie, Alexander	SC450
Mathur, Raman	SC410
McNerney, Peter	SC330
Miao, Lei	SC415
Nourzad, Marianne	SC311
Pasnoor, Sulakshana	SC571
Rykalova, Yelena	SC311
Shaw, Matthew	SC560
Ungrangsi, Peary	SC567
Vellanki, Harshvardhan	SC463, SC464
Williams, Adrian	SC410
Xu, Tao	SC471

Spring 2003

Student Name	Course
Aeron, Shuchin	SC415
Agniel, Philippe	EK307
Chandrasekaran, Ramya	SC450
Chang, Shay-sheen	SC416
Eraslan, Mesut	SC463, SC464
Gazder, Aspiyan	SC412
Ghosh, Soma	SC440, SC447
Huang, Chien	SC463, SC464
Imhausen, Brian	EK307
Ince, Serder	SC463, SC464
Kunapareddy, Nagapratima	SC311
Li, Ning	SC410
Li, Xiaojun	SC563, SC570
Mackenzie, Alexander	SC450
Mathur, Raman	SC500
McNerney, Peter	SC330
Miao, Lei	EK307
Mueller, Alexander	EK307
Nourzad, Marianne	EK307
Pasnoor, Sulakshana	SC571
Rykalova, Yelena	SC311
Savas, Onur	EK307
Sukumar, Sumithira	SC401
Ungrangsi, Rachanee	SC441
Vellanki, Harshavardhan	SC312
Xu, Tao	SC471

Summer 2003

Student Name	Course
Chang, Shay-sheen	SC401
McNerney, Peter	SC447
Miao, Lei	EK307
Vellanki, Harshavardhan	SC410

4.11 Research Assistants

Student Name	Advisor
Abell, Joshua	Moustakas
Abouraddy, Ayman	Saleh
Abu Ayyash, Salma	Little
Agarwal, Sachin	Trachtenberg
Albanese, Marc	Bifano
Arcolano, Nicholas	Venkatesh
Bach, Edward	Toffoli
Basu, Prithwish	Little
Bergstein, David	Ruane
Bhattacharyya, Anirban	Moustakas
Blasche, Gregory (Physics)	Unlu
Booth, Mark (BME)	Teich
Bozinovic, Nikola	Konrad
Cabalu, Jasper	Moustakas
Carroll, Sarah	Carruthers
Chauhan, Vikas	Trachtenberg
Chen, Fangyi	Hubbard
Chen, Tai-Chou	Moustakas
Chen, Tai-Chou	Moustakas
Chivas, Robert	Morse
Colerico, Marlene	Mendillo
Collier, Patrick	Unlu
Crager, Joseph	Horenstein
Dain, Oliver	Oliver
Davis, Brynmor	Swan
Diaz, Marcos	Oliver
Dobson, Jennifer	Bigio
Dogan, Mehmet (Physics)	Swan
Dosunmu, Olufemi	Unlu
Emsley, Matthew	Unlu
Friel, Ian	Moustakas
Gore, Tyler	Hubbard
He, Zhihua	Bystrom
Hitchings, Darin	Castañón
Hu, Lan	Mountain
Ippolito, Stephen	Unlu
Karl, Christian	Hubbard

Student Name	Advisor
Kaur, Parminder	Costello
Ke, Wang	Little
Kim, Duk Joong	Hubbard
Laplume, Paul	Chakrabarti
Laurent, Sophie	Mendillo
Li, Wei	Moustakas
Li, Wei	Castañón
Lichtenstein, Lee	Mountain
Litvin, Andrey	Karl
Lu, Ye	Bystrom
Marotta, Sebastian	Toffoli
Moiseev, Lev (Physics)	Swan
Nasr, Magued	Teich
Pavlovich, Julia	Karl
Perreault, Julie	Bifano
Polimeni, Jonathan	Schwartz
Praino, Julie	Saleh
Raman, Supriya	Nugent (MED)
Ray, Saikat	Starobinski
Ristivojevic, Mirko	Konrad
Ruan, Dan	Castañón
Schea, Jeremy	Chakrabarti
Shi, Yonggang	Karl
Smirnov, Alexandre	Taubin
Stewart, Jason	Teich
Stone, Patrick	Sergienko
Vamivakas, Anthony	Teich
Van Court, Thomas	Herbordt
Walton, Zachary	Sergienko
Wang, Yang	Bellotti
Weisenseel, Robert	Karl
Williams, Genja	Hubbard
Wotiz, Robert	De Luca
Yang, Zibing	Hubbard
Yin, Yan (Physics)	Unlu
Zhai, Qingtai	Fritz
Zhang, Wei	Oliver

4.12 Graduate Courses

Course Number and Title		Fall 02	Spring 03	Summer 03
SC500	Special Topics in ECE	Knepper		
SC500	Special Topics in ECE		Taubin	
SC500	Special Topics in ECE		Toffoli	
SC500	Special Topics in ECE		Saleh	
SC501	Dynamic Systems Theory	Dupont		
SC504	Advanced Data Structures	Trachtenberg		
SC505	Stochastic Processes	Karl	Saligrama	
SC511	Software Design System	Brackett		
SC513	Computer Architecture	Skinner		
SC514	Simulation for Manufacturing	Vakili		
SC515	Digital Communication	Venkatesh		
SC516	Digital Signal Processing	Mani		
SC518	Software Project Mangement		Brackett	
SC520	Image Processing and Communication	Konrad		
SC524	Optimization Theory and Methods	Paschalidis		
SC533	Introduction to Discrete Mathematics	Levitin		
SC534	Discrete Stochastic Models		Levitin	
SC541	Computer Communication Networks		Alanyali	
SC546	Computer Communications and Networks	Starobinski	Starobinski	
SC560	Introduction to Photonics	Saleh		
SC561	Error-Control Codes	Karpovsky		
SC563	Fiber-Optic Communication Systems		Morse	
SC568	Optical Fiber Sensors	Morse		
SC570	Lasers and Applications		Teich	
SC571	VLSI Principles and Applications	Hubbard	Hubbard	
SC572	VLSI Design Project	Hubbard		
SC575	Semiconductor Devices	Bellotti		
SC579	Microelectronic Device Manufactruing		Cole	
SC700	Advanced Topics in ECE	Alanyali	Alanyali	
SC700	Advanced Topics in ECE	Trachtenberg		
SC710	Dynamic Programming and Stochastic Control		Caramanis	
SC711	Software Architecture	Brackett		Brackett
SC712	Advanced Software		Skinner	
SC713	Parallel Computer Architecture		Herbordt	
SC715	Wireless Communication		Carruthers	
SC716	Advanced Digital Signal Processing	Nawab		
SC717	Image Reconstruction and Restoration		Karl	
SC719	Statistical Pattern Recognition	Castañón		
SC724	Advanced Optimization Theory and Methods		Paschalidis	
SC725	Queing Systems	Hu		
SC730	Informational-Theoretical Design of Algorithms		Levitin	
SC744	Mobile Ad hoc Networking and Computing		Little	
SC749	Interconnection Networks for Mulicomputers	Karpovsky		
SC751	Design of Asynchronous Circuit and Systems		Taubin	
SC753	Fault-Tolerant Computing		Karpovsky	
SC761	Information Theory and Coding	Levitin		
SC764	Optical Measurements		Sergienko	
SC765	Biomed Optics and Biophtn	Bigio		
SC770	Intergrated Optoelectronics		Unlu	
SC772	VLSI Graduate Design Project	Hubbard		
SC775	VLSI Devices and Device Models		Bellotti	
SC850	Graduate Teaching Seminar	Nawab	Nawab	

Course Number and Title		Fall 02	Spring 03	Summer 03
SC892	Seminar:Electro-Physics	Moustakas	Moustakas	
SC892	Seminar:Electro-Physics	Unlu	Unlu	
SC900	Research	Faculty	Faculty	Faculty
SC901	Thesis	Faculty	Faculty	Faculty
SC910	Computer Engineering Design Project	Faculty	Faculty	Faculty
SC911	Systems Engineering Design Project	Faculty	Faculty	
SC912	Software Engineering Project		Brackett	
SC913	Electrical Engineering Design Project	Faculty	Faculty	
SC939	Continuing Study	Faculty	Faculty	
SC951	Independent Study	Faculty	Faculty	
SC991	Dissertation	Faculty	Faculty	Faculty

4.13 Colloquia & Seminars

Date	Speaker	Title
September 13[d]	Qianchuan Zhao Center for Intelligent & Networked Systems Harvard University	The No Free Lunch Theorem and Performance Limits to Complexity and System Security
September 18[a]	Jack Wolfe Department of Electrical and Computer Engineering University of Houston	High-energy Atomic Beam Nanolithography
September 26[c]	Timothy Kohl BU Math Department	Hopf Algebras: Basic Notions
October 2[a]	Bahaa Saleh BU ECE Department	Stochastic Models of Noise in Photonic Devices
October 3[c]	Timothy Kohl BU Math Department	Hopf Algebras: Radical Notions
October 9[c]	Bjorn Sjodin Donna Voiland COMSOL	Electromagnetics Modeling with FEMLAB
October 10[c]	Ardelle Legg BU Sci. & Eng. Library	Overview of, and Round Table Discussion about Electronic Resources in the Science and Engineering Library
October 11[d]	Murat Alanyali BU ECE Department	Stability of Noncooperative Interaction with Local Information
October 16[a]	Todd W. Murray BU Department of Aerospace and Mechanical Engineering	Laser Generation and Detection of Ultrasound: Modeling and Applications
October 17[c]	Victor Yakhot BU Department of Aerospace and Mechanical Engineering	A Hydro-kinetic Equation for Description and Simulation of Strongly Non-linear Fluids
October 21	Giovanni Ghione Dipartimento di Elettronica Politecnico di Torino	Modeling And Simulation Of High-Speed Traveling-Wave Modulators For Fiber-Optic Communication Systems

October 24[c]	John Stachel BU Physics & Philosophy	Einstein's Intuition and the Post-Newtonian approximation
October 30[a]	Muriel Medard EECS Department Massachusetts Institute of Technology	Network Coding and Network Management – Towards Fundamental Limits?
October 31	Patrick Taylor Lincoln Laboratory Massachusetts Institute of Technology	MBE Growth and Characterization of GaN and GaAs for Advanced Semiconductor Devices
October 31[c]	Moe Wasserman BU ECE Department	Visual Aids for Teaching Electronics, and Possibly Other Courses, Using SuperCard
November 6[a]	Filbert Bartoli Program Director Electrical and Communication Systems National Science Foundation	Enabling Technologies for High-Capacity Optical Communications - A Role for Nanophotonics
November 8[d]	Haim Shore Dept of Mathematics & Statistics McMaster University	Response Modeling Methodology (RMM)-A New Approach to Model a Response in a Normal/Non-Normal Environment
November 14[c]	Assad Oberai BU AME Department	Algorithms for Inverse Problems in Elasticity Imaging
November 21[c]	Dirk Kreimer BU Math Department	Remarks on Chen's Iterated Integrals in Quantum Field Theory
November 22[d]	Bruce Tidor Dept of Electrical Engineering and Computer Science Massachusetts Institute of Technology	Solvation Effects on Protein Folding, Binding, and Design: Exploring the Electrostatic Balance
December 4[a]	Azer Bestavros BU Department of Computer Science	Practical and Efficient Construction of Network Caricatures
December 5[c]	Tom Toffoli BU ECE Department	Better than the Gaussian?
December 6[d]	Les Servi Lincoln Laboratories Massachusetts Institute of Technology	Analysis of Exponential Coverage Processes with Application to Optical Communication which Avoids Clouds
December 13[d]	Martin Skutella Institute of Mathematics Berlin University of Technology	Flows Over Time-Complexity, Approximation, and Modeling
January 15	Roberto Paiella Agere Systems	High-Speed Quantum Cascade Lasers
January 27[d]	David Hill BU Photonics Center	Global Control of Power Systems – Towards Complex Systems Control
January 29[a]	Kamil Ekinci BU Department of Aerospace and Mechanical Engineering	Challenges, prospects and an emerging application in Nano-electro-mechanical Systems (NEMS)
January 31[b]	Allyn Hubbard BU ECE Department	A Miniature Biomimetic Acoustic Sensor Being Developed For DARPA

February 7[d]	Stephen D. Patek Dept of Systems and Information Engineering University of Virginia	On Improving the Performance of Simulation-Based Algorithms for Average Reward Processes with Application to Network Pricing
February 12[a]	Karl M. Fant Founder and CTO Theseus Logic, Inc.	NULL Convention Logic and the implications of fully logically determined system expression
February 14[b]	Theodore Moustakas BU ECE Department	UV emitters based on III-V nitride Semiconductors
February 14[d]	Pirooz Vakili	Dynamic Development of New Product Development Projects A Modeling Framework and Value of Management Flexibility
February 21[b]	Eric Schwartz Department of Cognitive and Neural Systems ECE Department Boston University	Brain imaging and computer vision
February 27[d]	Shinja Hara Dept of Information Physics and Computing University of Tokyo	Characterization of Easily Controllable Mechanical Systems Towards Structure/Control Design Integration
February 28[b]	M. Selim Ünlü¸ BU ECE Department	Advanced Characterization Techniques in Optics for Nanostructures
March 7[b]	David Starobinski Ari Trachtenberg BU ECE Department	Networking and Information Systems Laboratory
March 7[d]	Garrett B. Stanley Division of Engineering and Applied Sciences Harvard University	Neuronal Representations of the Mechanical World
March 8[d]	Nejat Olgac Mechanical Engineering Department University of Connecticut	Stability and Applications of the Linear Time Invariant, Time-Delayed Systems LTI-TDS
March 21[b]	David Castañón BU ECE Department	From Signals to Actions: A Systems Perspective
March 28[b]	Richard Brower BU ECE Department	Multi-Teraflops Computing: Algorithms —> Hardware —> Software (or the engineering challenge of the cost effective delivery of 100,000,000,000,000,000,000 floating point ops to a single program)
March 28[d]	Steve Marcus Electrical & Computer Engineering Department University of Maryland, College Park	An Adaptive Sampling Algorithm for Solving Markov Decision Processes
April 4[b]	Martin Herbordt BU ECE Department	Reconfigurable Computing for Bioinformatics and Computational Biology
April 4[d]	John Klepeis Dept. of Chemical Engineering Princeton University	Systems Approaches in Computational Biology: Exploring the Frontier of Structural and Functional Genomics

April 7	Seda Memik Computer Science Department University of California, Los Angeles	Design Planning for Synthesis
April 11[b]	Alexander Taubin BU ECE Department	Automated Design Flow for Asynchronous Fine-Grain Pipelining and its Application to Devices Resistant to Attacks
April 11[d]	Eytan Modiano Laboratory for Information and Protection Design Decisions Massachusetts Institute of Technology	Toward the Joint Design of Electronic and Optical Layer
April 15[c]	Gerald Kaiser Center for Signals and Waves	The secret lives of complex-source pulsed beams: Their source distributions in the Spacetime and Fourier domains
April 16[a]	Peter B. O'Connor Biochemistry Department Boston University School of Medicine	Advantages and Challenges in the design and application of MALDI-Cryogenic FTMS for Proteomics
April 18[b]	William Oliver BU ECE Department	Center For Space Physics:† Areas Of Engineering Collaboration
April 18[d]	Sekhar Tatikonda Department of Electrical Engineering Yale University	Inference on Graphs with Cycles
April 23[a]	Alfred O. Hero III Professor University of Michigan	Entropic Graphs
April 25[b]	Janusz Konrad BU ECE Department	Towards natural, efficient and flexible visual communications
April 28	Peter Kozodoy Electrical and Computer Engineering Department University of California, Santa Barbara	P-type GaN for Electronic and Optoelectronic Device Applications
April 30[a]	Wm. Randolph Franklin Electrical, Computer, and Systems Engineering Department Rensselaer Polytechnic Institute	Geometric Operations on Hundreds of Millions of Objects
May 16[d]	Petros G. Voulgaris Department of Aeronautical and Astronomical Engineering University of Illinois, Urbana-Champaign	A Robust Control Systems Approach to Digital Communications

[a] ECE Colloquium Series
[b] Research Spotlight Seminar
[c] Electro-Physics and Computation Brown Bag Lunch
[d] CISE Seminar

5.1 Areas of Research

Electro-Physics

Coordinator: Michael Ruane

Solid-State Materials and Devices

- Bellotti
- Campbell
- Eddy
- Humphrey
- Knepper
- Moustakas
- Schubert
- Skocpol

Photonics

- Bellotti
- Bigio
- Carruthers
- Eddy
- Goldberg
- Kincaid
- Levitin
- Luo
- Morse
- Moustakas
- Ruane
- Saleh
- Schubert
- Sergienko
- Swan
- Teich
- Ünlü

Electromagnetics

- Fahim
- Felsen
- Fritz
- Giles
- Horenstein
- Humphrey
- Kotiuga
- Lee
- Mendillo
- Oliver

Information Systems & Sciences

Coordinator: W. Clem Karl

Signal & Image Processing

- Bystrom
- Carruthers
- Castañón
- Karl
- Kincaid
- Konrad
- Mendillo
- Nawab
- Oliver
- Saligrama
- Teich

Systems & Control

- Baillieul
- Castañón
- Karl
- Saligrama

Computer Engineering

Coordinator: Martin Herbordt

Computer & Communication Networks

- Alanyali
- Carruthers
- Cassandras
- Hubbard
- Karpovsky
- Levitin
- Roziner
- Starobinski
- Toffoli
- Trachtenberg

Software Applications

- Brackett
- Brower
- Castañón
- Giles
- Knepper
- Kotiuga
- Levitin
- Little
- Nawab
- Schwartz
- Skinner
- Toffoli
- Trachtenberg

Hardware

- Herbordt
- Hubbard
- Karpovsky
- Knepper
- Taubin
- Toffoli

5.2 Research Labs

Applied Electromagnetics Laboratory

This laboratory is devoted to problems in experimental electromagnetics with a primary focus on industrial electrostatics, sensors, and micro-electromechanical systems (MEMS). Current projects include a study of spark energies from insulating surfaces, studies of the electrostatic properties of insulating materials, development of a circular electrode array plasma-torch system, and charge-control systems for MEMS actuators. *Horenstein*

Biological Information Processing Laboratory

Work carried out in this laboratory is principally concerned with the wavelet analysis of biological signals. Particular examples include the analysis of fractal behavior of neural spike trains in hearing and vision; the analysis of the human heart rate and the differentiation of pathological from normal heart rhythms; and information transmission in biological sensory systems. *Teich*

Biomedical Optics and Biophotonics Laboratory

The core theme of biomedical optics/photonics is minimally invasive optical diagnostics and therapeutics. This laboratory focuses on the development of optics-based technologies for clinical applications and biomedical research. Current research topic areas include:

- Advanced spectroscopic technologies for tissue diagnosis
- Noninvasive measurement of drug concentrations in tissue
- Interstitial laser thermotherapy and photodynamic therapy
- Computational methods for modeling optical transport in tissue
- Optical interferometry for imaging nerve activation

Bigio

Broadband Wireless Communications Laboratory

This laboratory supports research projects on the design, theory, and prototyping of broadband wireless communication systems. The major focus is on the use of infrared light as the transmission medium for high-data-rate indoor wireless local-area networks. The laboratory includes facilities for the fabrication and testing of experimental prototypes as well as computing resources for system design and analysis. *Carruthers*

Computational Electronics Laboratory

The Computational Electronics Laboratory (CEL) is equipped with state-of-the-art computing tools. The lab has two computer clusters, one XP1000 Alpha Cluster (8 CPUs) running True UNIX 64, and an AMD Athalon MP Cluster (13 CPUs) running Linux. The lab also operates a variety of high performance PCs and printers. The Computational Electronics Group develops software to study semiconductor materials and to perform electronics and optoelectronics device simulation. Commercial simulation packages, such as ISE Genesis and Silvaco Virtual Wafer Fab are currently employed. *Bellotti*

Computer Architecture and Automated Design Laboratory

Work focuses on experimental computer architecture, particularly on the application of emerging technology to computationally intensive application. Projects include developing design tools for application specific coprocessors, designing MPP router switches, vision computers, and the application of configurable computing to bioinformatics. *Herbordt*

Functorial Electromagnetics Laboratory

The Functorial Electromagnetic Analysis Lab considers the difficulties encountered in the finite element analysis of three-dimensional electromagnetic fields that cannot be anticipated through experience with two-dimensional simulations. The lab has focussed its efforts in the development of Whitney form techniques, homology calculations, algorithms for total magnetic scalar potentials in multiply-connected regions, helicity functional techniques, and data structures based on semi-simplicial objects. Torsion invariants of complexes and rational homotopy theory are currently being exploited in the context of direct and inverse three-dimensional problems such as impedance tomography and magnetic field synthesis. *Kotiuga*

Imaging Science Laboratory (ISL)

Affiliated with the Boston University Center for Space Physics, the ISL applies state-of-the-art optical imaging technology to the study of the Earth, Moon, planets and comets. Activities include equipment design and fabrication, field campaigns to observing sites world-wide, and digital signal processing. *Mendillo*

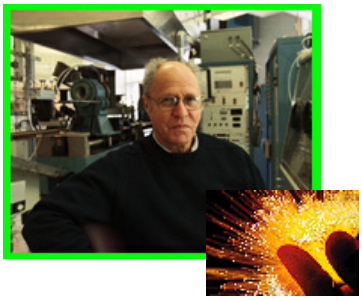
Integrated DSP Environments and Architectures Laboratory (IDEA)

This laboratory conducts research in digital signal processing and its integration into application systems. Issues of interest include DSP algorithms, knowledge-based systems, software architectures for integrated DSP, software environments for the development of integrated DSP systems, integration of numeric and symbolic processing, statistical signal processing, and multidimensional signal processing. This research is carried out in the context of many applications, ranging from the interpretation of musical signals to the

analysis of spread spectrum signals and the knowledge-based decomposition of electromyographic (EMG) signals. *Nawab*

Lightwave Technology Laboratory

This lab is one of the few university laboratories capable of designing, fabricating, and characterizing silica optical fibers. The research activities of this laboratory focus on new processing techniques for optical fibers and planar waveguides, high power optical fiber lasers, and a variety of optical fiber sensors. The components of this facility



consist of a fabrication laboratory with three glass lathes including a new state-of-the-art Nextrom MCVD system, an optical laboratory with numerous pump lasers for fiber lasers, five isolation tables, and an 8m optical fiber draw tower, newly outfitted with Nextrom widing and control equipment. In addition, there is a CVD laboratory for studies of thin films. *Morse*

Magnetic and Optical Devices Laboratory (MODL)

Properties and applications of magnetic and magneto-optical materials are studied using optical, electrical, and computational methods in the MODL. Recent work has included micromagnetics modeling, using supercomputer facilities, for commercial read/write heads, GMR memory devices, and nana-structured magnetic materials. Kerr and Faraday effect imaging are used to measure the structure and dynamics of magnetic thin films and hard magnetic wires. *Ruane, Humphrey*

Multi-Dimensional Signal Processing (MDSP) Laboratory

The MDSP Lab conducts research in the areas of multidimensional and multiresolution signal and image processing and estimation, and geometric-based estimation. The applications that motivate this research include, but are not limited to, problems arising in automatic target detection and recognition, geophysical inverse problems (such as finding oil and analyzing the atmosphere), and medical estimation problems (such as tomography and MRI). The general goal is to develop efficient methods for the extraction of information from diverse data sources in the presence of uncertainty. The lab's approach is based on the development of statistical models for both observations, prior knowledge, and the subsequent use of these models for optimal or near-optimal processing. *Karl*

Multimedia Communications Laboratory

The focus of this laboratory is the enabling technology for distributed and multimedia applications. Research includes investigation of distributed modes interaction among wireless computers; aggregation and clustering techniques for scaling large-scale Mobile Ad Hoc Networks (MANETs) and Sensor Networks; communication systems for continuous media; and conceptual and physical database organizations. The laboratory is equipped a high-performance simulation environment and a wireless testbed for proof-of-concept prototype development. *Little*

Near-Field Spectroscopy Laboratory

Near-Field Microscopy/Spectroscopy is being developed as a new technique to extend the resolution of optical imaging beyond the diffraction limit, bringing a new level of optical characterization. Near-field optical microscopy has application to many areas of materials and device development, and this laboratory will serve as a resource for researchers throughout Boston University as well as industry partners. Emphasis is currently placed on the optical characterization of semiconductor devices and biological materials. In particular, this includes imaging laser diode emission and material-defect and compositional analysis for semiconductor applications. *Goldberg, Ünlü*

Laboratory of Networking and Information Systems

This lab is involved in providing novel perspectives on modern networking issues, including scalability, heterogeneity, and performance. The lab is equipped with sophisticated hardware and software and promotes research into the fields of network synchronization, mobile computing, Internet traffic engineering, distributed Web caching, and coding theoretic approaches to real-time information reconciliation. *Starobinski, Trachtenberg*

Picosecond Spectroscopy Laboratory (PSL)

This state-of-the-art optical characterization facility was recently established. The Picosecond Spectroscopy Laboratory provides excitation sources, spectrometers, and microwave electronic test equipment for the investigation of the linear and non-linear optical properties of materials and devices. The research emphasis in this laboratory is on high-speed photodetectors, particularly time-resolved characterization of photodiodes. *Ünlü*

Quantum Imaging Laboratory

Research in the Quantum Imaging Laboratory focuses on photonic imaging systems that make use of the special properties of nonclassical light. Experiments are conducted on nonlinear optical parametric down-conversion; quantum coherence; quantum imaging; quantum interferometry and microscopy; and quantum communications and cryptography. *Saleh, Sergienko, Teich*

Radio Communications and Plasma Research Laboratories

Field experiments are conducted in this lab using ground-based facilities and spacecraft-borne instruments to investigate radio-wave propagation and interactions with ionospheric plasmas, with applications to establishing artificial radio communication paths. Laboratory experiments with a large, toroidal plasma device are also conducted to study the microwave interactions with magnetoplasmas, simulating and cross-checking the results obtained in the field experiments. *Lee*

Reliable Computing Laboratory

Members of the Reliable Computing Laboratory conduct research on a broad variety of topics, including the design of computer chips; efficient hardware testing at the chip, board, and system levels; functional software testing; efficient signal processing algorithms; coding and decoding; fault-tolerant message routing for multiprocessor systems; and the design of reliable computer networks. *Karpovsky, Levitin, Roziner*

Software Engineering Laboratory (SEL)

An instructional and research lab, the Software Engineering Laboratory (SEL) supports courses and research on the economical design of reliable software for large-scale and embedded computer-based systems. The lab is comprised of more than twenty-five Silicon Graphics and Gateway 2000 networked workstations, plus four Motorola embedded computer development systems. The laboratory provides a network of workstations running Windows XP and provides students with state-of-the art development and modeling tools for the design, implementation and testing of distributed software systems. *Brackett*

Visual Information Processing (VIP) Laboratory

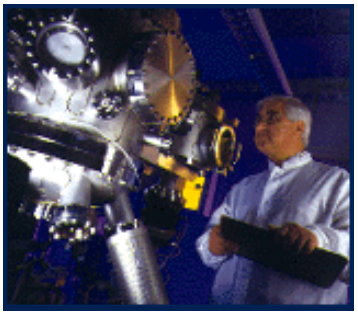
The VIP Laboratory provides computational and visualization infrastructure for research in the area of visual information processing. The particular topics of interest are: manipulation, compression, transmission and retrieval of visual information, whether in the form of still images, video sequences, or multimedia data. In addition to standard monoscopic (2-D) images, also stereoscopic and multiscopic (3-D) images are studied. The primary application of this research is in the next-generation multimedia communications: life-like (3-D), efficient (low bit rate), reliable (error-resilient), and flexible (object-based). The VIP Laboratory is equipped with a network of state-of-the-art workstations to serve computational needs, while its visualization infrastructure includes 2-D and 3-D digital cameras and capture systems, as well as 3-D displays (shuttered and 9-view automultiscopic "Synthagram"). *Konrad*

VLSI and Neural Networks Systems (VNNS) Laboratory

The VNNS group designs, builds, and tests innovative architectures that span a wide variety of VLSI applications in electrical and biological fields. Chips designed using digital, analog, and subthreshold methodologies are realized using CMOS BiCMOS and Bipolar technologies. Applications include neural-net image processing, integrated photonic devices and parallel photonic testing, automatic partial-valued dynamic logic synthesis, single-chip large-molecule and DNA analyzers, and neural tissue interface chips. The group is equipped with a full suite of design tools and testing instrumentation for analog and digital systems. *Hubbard*

Wide Band Gap Semiconductors Laboratory

In this laboratory, we investigate the growth, fabrication and characterization of devices based on the family of III-Nitride semiconductors. The materials are grown by MBE, MOCVD, HVPE and Gas cluster Ion-beam deposition (GCIB). The current focus is in the development of Optical Devices (UV-LEDs, UV-LDs, Optical Modulators, Detectors), Electronic Devices (High Power Diodes, Transistors and Thyristors) and Electromechanical Devices (SiC/III-Nitride MEMS sensors). Materials physics issues are also addressed and the group collaborates closely with Professor Enrico Bellotti in the area of theoretical modeling, Professor Karl Ludwig (Physics) in the area of materials structure and Professor Kevin Smith (Physics) in the area of electronic structure. *Moustakas*



5.3 Centers and Interdisciplinary Activities

Center for Computational Science

http://satchmo.bu.edu

The CCS at Boston University was chartered in 1989 as an interdisciplinary focal point for computational science research and education. In collaboration with the Office of Information Technology's Scientific Computing and Visualization Group (SCV), CCS has made leading edge computational resources available to researchers and students on a university wide basis since the installation of its first massively parallel supercomputer in 1988. The recent installation of the SGI/Cray Origin2000 represents the fourth generation parallel supercomputing technology at the University. Facilities also include an SGI Power Challenge Array, advanced graphics workstations, virtual reality stations and very high speed networking.

The University's support of computational research has been extended to institutions throughout New England by means of the NSF funded MARINER (*http://mariner.bu.edu/*) project, a collaboration between CCS and SCV. MARINER offers education and training programs, access to state-of-the-art computing facilities and opportunities for pilot projects, Internet connectivity and industrial partnerships.

The Center is a cooperative venture in which associated members come from a variety of disciplines in the academic and industrial communities to develop and take advantage of leading-edge computer and communications technologies. Under the auspices of MARINER, CCS takes its place as a leader in developing computational applications in collaboration with regional schools and companies.

Building on MARINER, the University is extending its programs on a national scale as a partner in the National Computational Science Alliance, one of two national Partnerships for Advanced Computational Infrastructure supported by the NSF.

Center for Space Physics

http://www.bu.edu/csp/

The Center for Space Physics provides a focus for research and graduate training in space physics. It is a multidisciplinary center within the Graduate School of Arts and Sciences that includes faculty from the College of Engineering and the College of Arts and Sciences.

The mission of the Center is to promote and foster space physics research and to provide a central base for that research and for the teaching of space physics, especially at the graduate level. The Center seeks to fulfill this mission by creating an intellectual atmosphere conducive to research and to the exchange and exploration of new ideas. The Center organizes a seminar series in space physics as well as internal research discussion groups, and often hosts visits of scholars from the United States and abroad. Although the Center itself offers no degree program, graduate education is a major component of Center activities. Graduate students from programs in Astronomy, Applied Physics, and Engineering conduct their thesis research at the Center. The Center provides a formal link between research groups in the Colleges of Engineering and Arts and Sciences, allowing them to co-locate research students and post-doctoral associates to allow greater interaction to everyone's benefit. The Center also provides administrative support for research projects, particularly in the areas of grant management and proposal development.

Photonics Center

http://www.bu.edu/photonics

To help industry bridge the gap between basic research and practical application, Boston University launched the Photonics Center in 1994 with $29 million in seed funding from the federal government. The Center is now forging true business partnerships in which companies draw on the University's exceptional expertise and resources in engineering, science, medicine, and management to build actual product prototypes and spawn a growing stream of new companies.

The Photonics Center at Boston University is a bold new model for university-industry collaboration. It has been established to work directly with investors and industrial partners to turn emerging concepts in photonics technology into commercial products. The Center is staffed and equipped to help industry partners reduce the technical and financial risk involved in developing new ideas, refining them in the laboratory, building working prototypes, and starting up companies. To date the Center has forged joint ventures with nearly a dozen companies to develop new products in data storage, environmental monitoring, opto-electronics, and biotechnology.

In 1997, the University completed the nine-story, 235,000 square-foot Photonics Building to house this ambitious initiative. The $80 million facility includes a full complement of state-of-the-art laboratories as well as meeting rooms, lecture halls, and an entire floor devoted to incubator space for start-up companies that complements its existing incubator at 1106 Commonwealth Avenue. Faculty affiliated with the Center have in-depth expertise in all aspects of photonics technology, including the core areas of opto-electronics, photonic materials, data storage, imaging systems, medical applications, and sensors.

Resources available to industry partners, government, faculty, and students through the Photonics Center support development and testing of ideas and products. These resources include several research and development laboratories: Scanning Infrared Near-Field Microscopy Laboratory, Optoelectronic Device Characterization Laboratory, Femtosecond Laser Facility, Photochemical Processes Laboratory, Photonic Systems Engineering Laboratory, Liquid Crystal Display Laboratory, Quantum Imaging Laboratory, Precision Optics Laboratory, Optoelectronic Materials Laboratory, Precison Measurement Laboratory, Optoelectronic Processing Facility, Laser Measurement and Fiber Optic Sensors Laboratory, Magnetic and Optical Devices Laboratory, Near-Field Scanning Optical Microscopy Laboratory, Picosecond Spectroscopy Laboratory, and the Advanced Electronic Materials and Devices Processing Research Laboratory.

Center for Subsurface Sensing and Imaging Systems (CenSSIS)

http://www.censsis.neu.edu/

The Center for Subsurface Sensing and Imaging Systems (CenSSIS) is a National Science Foundation Engineering Research Center (ERC) established in 2000. It seeks to revolutionize the ability to detect and image objects that lie underground or underwater, or are embedded within cells, inside the human body, or within manmade structures. CenSSIS is a collaborative effort of 4 academic institutions: Northeastern University, Boston University, Rensselaer Polytechnic Institute, and the University of Puerto Rico at Mayagüez; and 4 strategic affiliates: Massachusetts General Hospital, Brigham and Women's Hospital, Lawrence Livermore National Laboratory, and the Woods Hole Oceanographic Institution. Together, the CenSSIS partnership works with industrial partners who provide their insight into research challenges.

The Center's primary focus is on detecting, locating, and identifying objects obscured beneath the covering media, such as underground plumes, tumors under the skin or developmental defects in an embryo. Utilizing electromagnetic, photonic, or acoustic probes, CenSSIS will engage biomedical and environmental problems, developing techniques for sensing subsurface conditions. Projects integrate new methods of subsurface sensing and modeling, physics-based signal processing and image-understanding algorithms, and image and data information management methods. Research topics being addressed include: humanitarian de-mining, multilayer hyperspectral oceanography, 3-D subretinal visualization, nonlinear ultrasound medical imaging, subcellular biological imaging, electrical impedance tomography, acoustic diffraction tomography, and multi-sensor civil infrastructure assessment. Overall, the CenSSIS program is a vehicle enabling substantial leverage of industrial investments because of the substantial level of funding available for basic research. In addition to research, the Center has established programs for education, industry collaboration, and technology transfer.

Center for Information Systems Engineering (CISE)

http://www.bu.edu/systems

The Center for Information and Systems Engineering (CISE) provides an interdepartmental home for faculty and students interested in research in information and control systems theory and its relevance to various application domains encompassing the analysis, design, and management of complex systems that have come to prominence as a result of the information, communication, and computation revolution.

Information and systems engineering research at BostonUniversity is strong and accomplished, but it is spread across departments, colleges and schools within the University. Approved by the Trustees in 2002, with administrative support added in Fall 2002, CISE has been raising the visibility of that strength and is beginning to foster greater interactions among researchers. As of June 2003, CISE has grown from 13 to 19 affiliated faculty from the Departments of Manufacturing Engineering, Aerospace & Mechanical Engineering, and Electrical & Computer Engineering in the College of Engineering; the Department of Mathematics & Statistics in the College of Arts and Sciences; and the Department of Operations Management in the School of Management.

Electrical and Computer EngineeringDepartment faculty affiliated with CISE are Professors Alanyali, Baillieul, Carruthers, Cassandras, Castañón, Karl, Saligrama, Starobinski and Trachtenberg. The application interests of their CISE related research include Automation, Robotics and Control; Communications, Networking and Information Systems; Production and Service Systems and Supply Chain Management; and Signal Processing and Pattern Recognition.

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Minsky, Y and **A Trachtenberg**. "Scalable set reconciliation." *40th Annual Allerton Conference on Communication, Control, and Computing*. Monticello IL. October 2002.

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Ünlü, MS, MK Emsley, OI Dosunmu, and Y Leblebici. "High-speed Si Resonant Cavity Enhanced Photodetectors and Arrays." Canadian Semiconductor Technology Conference. Ottawa, CA. August 18-22, 2003.

Ünlü, **MS**, SB Ippolito, Z Liu, **BB Goldberg**, and L Novotny. "Immersion Lens Microscopy of Photonic Nanostructures and Quantum Dots." *Materials Research Society Fall Meeting*. Boston, Massachusetts. December 5, 2002.

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Morse, TF, **AK Swan**, Y-T Liu, and **BB Goldberg**. "An Ultra-sensitive Whispering Gallery Biosensor." Provisional patent filed January 2003.

Morse, TF. "A New Technique for the Measurement of Polarization Mode Dispersion in Optical Components."

Morse, TF. "A Fiber Optic Temperature Sensor."

Morse, TF. "An Efficient 908 nm Double Clad Fiber Laser."

Morse, TF. "A New Design for High Power Double Clad Fiber Lasers."

Morse, TF. "A New Technique for the Fabrication of Low Loss Optical Fibers."

Morse, TF. "Aerosol Fabrication Techniques for Low Loss Optical Fiber."

Morse, TF. "Laser Cavity Design for Enhanced Output Using Multiple Pump Sources."

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Bellotti, E and **TD Moustakas.** "Design and Fabrication of GaN-based Static Induction Transistor." *Symposium on Static Induction Devices.* Tokyo, Japan. May 2002.

Bellotti, E. "Computational Electronics of Wide Band Gap Semiconductors." *Photonics West.* San Jose, California. January 2003.

Bigio, IJ. "Metodo optica para medir concentraciones de drogas en el tejido."
VII Encuentro Nacional de la Optica. Popayan, Colombia. September 2002.

Bigio, IJ. "Optical pharmacokinetics." *Bioengineering Colloquium.* Rice University, Texas. October 2002.

Bigio, IJ. "Monitoring of angiogenesis by the method of optical pharmacokinetics." *Physics Dept. Colloquium.* Lund University, Sweden.

Bigio, IJ. "Optical Biopsy: noninvasive detection of cancer with optical spectroscopy OSA Distinguished Speaker Lecture." *Ministry of Science and Education.* Bangkok, Thailand. June 2003.

Cassandras, CG. "Cooperative Control of Unmanned Air Vehicles." *Alphatech, Inc.* Burlington, Massachusetts. June 2002

Cassandras, CG. "Hybrid Systems, Complexity, and Networking." *NSF-European Union Workshop on Advanced Hybrid Systems Theory for the Control of Networked Systems.* Barcelona, Spain. July 2002.

Cassandras, CG. "From Discrete Event to Hybrid Systems." *6th Intl. Workshop on Discrete Event Systems.* October 2002.

Cassandras, CG. "Stochastic Fluid Models for Communication Networks." *17th Intl. Symposium on Computer and Information Sciences.* October 2002.

Cassandras, CG. "Optimal Control of Hybrid Systems and Some Applications to Manufacturing." Worcester Polytechnic Institute, Worcester, Massachusetts. November 2002.

Cassandras, CG. "Bargain Hunting in the No-Free-Lunch Mall of Complex Systems." *41st IEEE Conference on Decision and Control.* December 2002.

Cassandras, CG. "A Receding Horizon Approach for Solving Some Cooperative Control Problems." *41st IEEE Conference on Decision and Control.* December 2002.

Cassandras, CG. "Receding Horizon Optimization for Discrete Event and Hybrid Systems: The Cooperative Mission Control Problem." University of Colorado. May 2003.

Cassandras, CG. "Stochastic Fluid Models for Communication Networks." Colorado State University. May 2003.

Cassandras, CG. "When Computers Control: Joys and Perils of Automation." *NSF National Workshop for High School Teachers of Math and Science.* June 2003.

Cassandras, CG. "Properties of Receding Horizon Controllers for Some Hybrid Systems with Event Uncertainties."
2003 IFAC Conf. on Analysis and Design of Hybrid Systems. June 2003.

Cassandras, CG. "Five Lectures on Modeling and Control of Hybrid Systems."
Intl. Workshop on Hybrid Systems. June 2003.

Castañón, DA. "Distributed Algorithms for Dynamic Assignment." Ohio State University, Ohio. March 2003.

Castañón, DA. "Dynamic resource allocation under uncertainty." University of Florida. September 2002.

Castañón, DA. "Curve evolution techniques for segmentation and inverse problems." AFRL/Eglin. September 2002.

Hubbard, AE. "A Smart Acoustic Sensor." *2001 DARPA Acoustic Microsensors Review.* September 2002.

Karl, WC. "Object-Based Tomographic Reconstrution." *Workshop on Current Challenges in Multi-Scale Analysis.* Harvard-Smithsonian Center for Astrophysics, Cambridge, Massachusetts. January 15-16, 2003.

Karl, WC. "Tomographic Reconstruction of Dynamic Objects." *Workshop on Image Analysis and Understanding Data from Scientific Experiments.* Los Alamos, New Mexico. December 2-6, 2002.

Karl, WC. "Object-based Dynamic Tomography." *2003 IEEE AP-S International Symposium and USNC/CNC/URSI National Radio Science Meeting.* Columbus, Ohio. June 22-27, 2003.

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Kotiuga, PR. "Magnetic Helicity is Conserved in Ideal Magnetohydrodynamics, but What About the Real World?" *Graduate School of Applied Electromagnetism, Winter Seminar.* Tampere Finland. February 27-28, 2003.

Kotiuga, PR. "The Appearance of Helicity in Various Three-Dimensional Inverse Problems." Helsinki University of Technology, Helsinki, Finland. February 24, 2003.

Kotiuga, PR. "Weitzenbock Identities and their uses in Photonics." Institut Fresnel, Marseille France. July 24, 2002.

Levitin, LB. "Entropy and information in physics and complex systems." *Institute for the Study of Coherence and Emergence Workshop on Complexity and Philosophy.* Norwood, Massachusetts. July 2002.

Levitin, LB. "Paralogue distribution in bacterial genomes." Institute for Theoretical Biology, Humboldt University, Berlin, Germany. August 2002.

Levitin, LB. "Information and irreversibility of quantum measurement." *Simons Conference on Quantum and Reversible* Computing. Stony Brook, New York. May 2003.

Moustakas, TD. "III-Nitride Semiconductors and their applications to Optical and Electronic Device." *XVIII Panhellenic Symposium on Solid State Physics and Materials Science Heraklion.* Crete, Greece. September 15-18, 2002.

Moustakas, TD. "Ordering in Ternary Nitride Alloy." *13th International Conference on Ternary and Multinary Compounds*. Paris, France. October 14-18, 2002.

Saleh, BEA. "Stochastic Models of Noise in Photonic Devices." *ECE Colloquium Series*. Boston University, Boston, MA. September 2, 2002.

Saleh, BEA. "Dispersion-Cancelled Two-Photon Optical Coherence Tomography." Invited Lecture, *EECS/RLE Seminar Series on Optics and Quantum Electronics*. MIT. October 30, 2002.

Saleh, BEA. "A Unified Framework for Subsurface Sensing and Imaging." *Annual Retreat of the Center for Subsurface Sensing and Imaging Systems*. Lake George, NY. October 18, 2002

Saleh, BEA. "Quantum Optical Information Processing." Invited Lecture, *Distinguished Lecture Series*. Institute for Computing, Information, and Cognitive Systems (ICICS), University of British Columbia, Vancouver, BC, Canada. November 21, 2002.

Sergienko, AV. "Optical Entanglement and Single-Photon Detection." *Workshop on Single-Photon: Detectors, Applications, and Measurement Methods, NIST*. Gaithersburg, Maryland. March 31-April 1, 2003.

Sergienko, AV. "Quantum Metrology with Entangled Photons." *33rd Winter Colloquium on The Physics of Quantum Electronics*. Snowbird, Utah. January 5-9, 2003.

Sergienko, AV. "Secure Communication and Materials Characterization with Quantum States." *Seminar at Pirelli Research Labs*. Milan, Italy. September 2, 2002.

Sergienko, AV. "Quantum Information Processing and Quantum Metrology with Entangled States." *Theoretical Division seminar*. Los Alamos National Laboratory, Los Alamos, New Mexico. October 17, 2002.

Sergienko, AV. "Precise Optical Measurement and Secure Communication with Hyper-Entangled States." *Seminar at the Istituto Nazionale di Ottica Applicata*. Florence, Italy. October 23, 2002.

Sergienko, AV. "Entangled States for Quantum Information Processing and Optical Measurement."
Seminar at the Department of Physics, University of Toronto. Toronto, Canada. November 26, 2002.

Sergienko, AV. "Quantum Information Procesing and Optical Measurement with Hyper-entangled States." *Colloquium at the Institute of Optics, University of Rochester*. Rochester, New York. December 11, 2002.

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Sergienko, AV. "Quantum Information Processing and Precise Optical Measurement with Entangled Photons." *Colloquium*. University of California San Diego, La Jolla, California. February 21, 2003.

Sergienko, AV. "Quantum Optical Measurement with Entangled Photons." *Special Seminar*. Laboratory of Condensed Matter Physics, University of Nice Sophia Antipolis, Nice, France. March 3, 2003.

Sergienko, AV. "Quantum Computing, Quantum Communication, and Quantum Measurement with Entangled Photons." *Joint Colloquium Pirelli Research Laboratories and University of Milan*. Bicocca, Italy. March 12, 2003.

Sergienko, AV. "Quantum Entanglement and Surface Characterization." *QUEST 2002 Summer Workshop*. Santa Fe, New Mexico. August 4-9, 2002.

Sergienko, AV, G Di Giuseppe, M. Atature, **BEA Saleh**, and **MC Teich. "**Entangled-Photon State Engineering." *The 6th International Conference on Quantum Communication, Measurement and Computing*. MIT, Boston, Massachusetts. July 22- 26, 2002.

Sergienko, AV, G Di Giuseppe, GS Jaeger, M. Atatüre, MD Shaw, **BEA Saleh**, and **MC Teich**. "Hyperentangled-Photon Cryptography." *The International Symposium on Optical Science and Technology, SPIE 47th Annual Meeting*. Seattle, Washington. July 7-11, 2002.

Starobinski, D. "Robust Location Detection in Emergency Sensor Networks." *17th IEEE Annual Computer Communications Workshop (CCW)*. Santa Fe, New Mexico. October 2002.

Teich, MC. "Heart Rate Variability: Discriminating Healthy Patients from Those with Cardiac Dysfunction." *IEEE Providence Section*. Providence, Rhode Island. October 2002.

Teich, MC. "Quantum Optical Coherence Tomography." Beckman Laser Institute, University of California, Irvine, California. May 2003.

Teich, MC. "Neuronal Variability and Information Transmission in Biological Vision." *National Institute of Mental Health (NIMH) Workshop on Neuronal Variability and Noise: Challenges and Promises*. Rockville, Maryland. September 2002.

Toffoli, T. "A man and his computer: An issue of adaptive fitness and personal statisfaction." Kobe, Japan. October 2002.

Toffoli, T. "A Knowledge Home: Personal knowledge engineering for normal people." UniversitÈ de Montreal, Montreal, Canada. April 2003.

Toffoli, T. "Structural vs functional invertibility in computation." *Simons Conference on Quantum and Reversible Computation*. Stony Brook. May 2003.

Toffoli, T. "A pedestrian approach to spacetime crystallography." *Festschrift in honor of C H Bennett's 60th anniversary, IBM Research*. Yorktown Heights. May 2003.

Trachtenberg, A. "The set reconciliation problem or how to compare elephants by phone." *Illinois Institute of Technology, Department of Computer Science Seminar Series*. Illinios. October 2, 2002.

Trachtenberg, A. "Efficient reconciliation of distributed data: an information theoretic approach." *Harvard University, Electrical Engineering Seminar Series*. Cambridge, Massachusetts. January 31, 2003.

Ünlü, M.S. "Optical Microscopy Beyond the Diffraction Limit: Imaging Guided and Propagating Fields." *Massachusetts Institute of Technology Optics and Quantum Electronics Seminar Series*. Cambridge, Massachusetts. April 2003.

Ünlü, MS, SB Ippolito, Z Liu, **BB Goldberg**, and L Novotny. "High Spatial Resolution Subsurface Microscopy." *3rd Annual Semiconductor Failure Analysis and Reliability Workshop*. Austin, TX. October 17, 2002.

Moiseev, L, **AK Swan**, **MS Ünlü**, **BB Goldberg**, and C Cantor. "Self-Interference Fluorescence Microscopy." *New England Society of Microscopy*. Gordon College, MA. December 6th, 2002.

Ünlü, MS. "Nanotechnology Research at Boston University." *International Meeting on Education and R&D Management*. Sabo-Kaikan, Tokyo, Japan. July 23-24, 2003.

Venkatesh, S. "Intelligent Sensing and Relay Platforms." *ONR Program Review*. August 2002.

Technical Reports & Other Publications

Ruane, M. "Imaging." *Photon News*. 5-7. New England Board of Higher Education, Issue 3, Spring 2003.

Montpetit, M-J and **D Starobinski**. "Small and Home networks." 1-5. *Journal of Computer Networks*. May 2003.

5.5 Grants, Contracts, and Gifts

The table on the next three pages delineates the new grants awarded over the 2003 fiscal year. The funding level for new grants, where an ECE faculty member is the Principal Investigator (PI) is approximately $6,037k. ECE faculty members were also Co-PIs on grants with PIs from other departments, as noted in the table. Their share of the funding for new grants awarded is approximately $911k. The total of new grants is therefore approximately $6,948k. In addition, ECE faculty have received gifts and other awards totaling $71k.

New Grants with ECE Principal Investigators

Recipient	Title of Award	Source	Begin Date	End Date	Amount
Bellotti, Enrico	PBT Processing and Characterization	BAE Systems, Inc.	09/01/02	03/31/03	$9,000.00
Bellotti, Enrico	Young Investor Program: Single-Photon 3D Image Sensors	DOD/Navy	03/15/03	04/30/06	$67,073.00
Bellotti, Enrico	Photonics Technology Development and Insertion/Task 18: Computational Support for ARL Program (Photonics Center Award)	DOD/Navy	03/01/03	02/29/04	$40,155.00
Bigio, Irving	NovaSol Project (Subcontract via Los Alamos National Laboratory)	Department of Energy	10/21/02	07/16/03	$50,684.00
Bystrom, Maja	CAREER: Research and Education in Video Coding and Wireless Communications	NSF	09/01/02	07/31/04	$102,329.00
Bystrom Maja	CAREER: Research and Education in Video Coding and Wireless Communications (REU Supplement)	NSF	09/01/03	07/31/04	$5,600.00
Castañón, David **Karl**, W. Clement	Adaptive Feedback Algorithms for Sensor Management and Processing (Subcontract via AlphaTech, Inc.)	DOD/Air Force	08/14/02	12/31/02	$71,402
Castañón, David	Center for Subsurface Sensing and Imaging Systems (CenSSIS) -- Research Thrust 2 (Subcontract via Northeastern University)	NSF	09/01/02	08/31/03	$185,722.00
Castañón, David	Cooperative Control in Adversarial Environments	DOD/Air Force	12/01/02	11/30/03	$170,731.00
Eddy, Charles	Development of an Anisotropic Etch for InP	BAE System, Inc.	05/01/02	08/31/02	$16,915.00
Herbordt, Martin	CAREER: Integrating Architecture-level Simulation with Industrial CAD Tools	NSF	05/01/02	04/30/03	$40,914.00
Hubbard, Allyn	A Biomimetic Smart Acoustic Sensor (in conjunction with Hearing Research Center)	DOD/Navy	06/08/00	12/31/02	$115,000.00
Karl, W. Clement	Anatomic Morphologic Analysis of MRI Brain Images (in conjunction with Center for Computational Science) (subcontract via Massachusetts General Hospital)	HHS/NIH/NINDS	09/30/02	08/31/03	$80,966.00
Karl, W. Clement	Foundations of Automatic Target Recognition (in conjunction with Center for Computational Science)	DOD/Air Force	09/01/03	08/31/04	$75,001.00
Konrad, Janusz	Joint Space-Time Analysis and Characterization of Image Sequences	NSF	07/01/02	06/30/03	$100,270.00
Konrad, Janusz	Automultiscopic 3-D Visual Communication System Based on Joint Reconstruction/ Multiplexing of Views	NSF	09/01/02	08/31/05	$100,000.00
Konrad, Janusz **Karl**, W. Clement	US-France Cooperative Research: Segmentation and Reconstruction of Scenes with Dynamic Objects	NSF	05/01/03	04/30/06	$24,480

Recipient	Title of Award	Source	Begin Date	End Date	Amount
Konrad, Janusz	Joint Space-Time Analysis and Characterization of Image Sequences	NSF	07/01/03	06/30/04	$105,522.00
Morse, Theodore	ONR HBCU Future Engineering Faculty Fellowship (R. Wynne)	DOD	07/01/01	12/31/02	$22,122.00
Morse, Theodore	Photonics Technology Development and Insertion/Task 1: Fiber Laser Technology (Photonics Center Award)	DOD	09/01/01	02/28/03	$142,244.00
Morse, Theodore	ONR HBCU Future Engineering Faculty Fellowship (R. Wynne) (subcontract via North Carolina Agricultural and Technical State University)	DOD/Navy	07/01/01	05/31/03	$23,241.00
Morse, Theodore	Optical Fiber Fabrication (subcontract via Optoelectronics Industry Development Association)	Department of Commerce/ NIST	11/26/02	01/31/30	$25,000.00
Morse, Theodore	Research in Fiber Lasers	DOD/Air Force	11/01/02	10/31/03	$150,000.00
Morse, Theodore	Research in Fiber Lasers	DOD/Air Force	11/01/02	10/31/03	$30,000.00
Morse, Theodore	Photonics Technology Development and Insertion/Task 1: Fiber Laser Technology (Photonics Center Award)	DOD/Army	03/01/03	02/29/04	$98,395.00
Morse, Theodore	ONR HBCU Future Engineering Faculty Fellowship (R. Wynne) (subcontract via North Carolina Agricultural and Technical State University)	DOD/Navy	06/01/03	08/31/03	$9,170.00
Morse, Theodore	ONR HBCU Future Engineering Faculty Fellowship (R. Wynne) (subcontract via North Carolina Agricultural and Technical State University)	DOD/Navy	06/01/03	08/31/03	$999.00
Moustakas, Theodore	GaN Substrates for Superior GaN-based Devices (Subcontract via Boston Microsystems, Inc.)	DOD	06/01/02	10/22/02	$23,300.00
Moustakas, Theodore	UV Resonant Cavity Light-Emitting Diodes Grown by MBE on Non-Polar GaN Substrates (Subcontract via Crystal Photonics, Inc.)	DOD	06/28/02	09/30/03	$120,680.00
Moustakas, Theodore	Cluster Ion Beam Epitaxy of III-Nitrades	DOD/Navy	10/01/02	09/30/05	$121,871.00
Moustakas, Theodore	Electronic Cooler (subcontract via Astralux, Inc.)	DOD/Army	12/01/02	11/30/03	$70,000.00
Moustakas, Theodore	UV Resonant Cavity Light-Emitting Diodes Grown by MBE on Non-Polar GaN Substrates (Subcontract via Crystal Photonics, Inc.)	DOD	06/28/02	09/30/03	$167,932.00
Moustakas, Theodore	UV Resonant Cavity Light-Emitting Diodes Grown by MBE on Non-Polar GaN Substrates (Subcontract via Crystal Photonics, Inc.)	DOD/DARPA/Air Force	06/28/02	06/28/04	$173,388.00
Moustakas, Theodore	Photonics Technology Development and Insertion/Task 6: Gallim Nitride Vertical Cavity Surface-Emitting Lasers)GaN VCSEL) Technology (Photonics Center Award)	DOD/Army	03/31/03	02/29/04	$119,849.00
Moustakas, Theodore	Harsh Environment Fluid Viscosity-Density Sensor (subcontract via Boston MicroSystems, Inc.)	NSF	04/01/03	01/31/05	$150,000.00
Oliver, William	Machine Learning (O. Dain)	MIT/Lincoln Laboratory	09/01/02	12/31/02	$11,709.00
Oliver, William Banja, Thomas	Astronomical Instrumentation Project (M. Diaz) (Subcontract via MIT/Haystack Observatory)	NSF	09/01/02	08/31/04	$56,700
Ruane, Michael	Center for Subsurface Sensing and Imaging Systems (CenSSIS) -- Research Thrust 2 (Subcontract via Northeastern University)	NSF	09/01/02	08/31/03	$59,537.00

Recipient	Title of Award	Source	Begin Date	End Date	Amount
Saleh, Bahaa	Scanning Acoustic Microscope for Classification of Vulnerable Plaque-Research Thrust 1-Acoustics	Northeastern University/ CenSSIS	01/01/02	07/31/03	$5,000.00
Saleh, Bahaa	Center for Subsurface Sensing and Imaging Systems (CenSSIS) -- Research Thrust 2 (Subcontract via Northeastern University)	NSF	09/01/02	08/31/03	$135,816.00
Saligrama, Venkatesh	Intelligent Sensor and Relay Platforms (InSAR) (Young Investor Program)	DOD/Navy	05/01/02	04/30/05	$30,000.00
Saligrama, Venkatesh	Intelligent Sensor and Relay Platforms (InSAR) (Young Investor Program)	DOD/Navy	05/01/02	04/30/05	$34,948.00
Sergienko, Alexander **Saleh**, Bahaa **Teich**, Malvin	Quantum Network (subcontract via BBNT Solutions LLC)	DOD/DARPA	08/01/01	12/30/03	$519,999
Schubert, Fred	UV Spectrum Light Emitting Diodes with Omnidirectional Reflectors for High Extraction Efficiency	DOD	08/01/02	01/31/03	$75,000.00
Starobinski, David	CAREER: Quality of Service Engineering with Multiple Time-Scale Traffic	NSF	08/01/02	07/31/07	$338,000.00
Starobinski, David	CAREER: Quality of Service Engineering with Multiple Time-Scale Traffic (REU Supplement)	NSF	05/01/03	07/31/07	$6,000.00
Swan, Anna **Goldberg**, Bennett **Ünlü**, M. Selim **Karl**, W. Clement	Nanometer Resolution with Spectral Self-Interference Fluorescence Microscopy (additional co-PI: C. Cantor)	NSF	01/01/03	04/30/03	$29,936
Swan, Anna **Goldberg**, Bennett **Ünlü**, M. Selim **Karl**, W. Clement	Nanometer Resolution with Spectral Self-Interference Fluorescence Microscopy (additional co-PI.: C. Cantor)	NSF	05/01/03	04/30/04	$186,684
Ünlü, M. Selim **Goldberg**, Bennett Ekinci, Kamil Mohanty, Pritiraj **Swan**, Anna Murray, Todd	NIRT: Advanced Characterization Techniques in Optics for Nanostructures (ACTION) (additional co-pi.: L. Novotny)	NSF	10/01/02	09/30/03	$1,222,080
Trachtenberg, Ari **Starobinski**, David	A Scalable Middleware for Data Reconciliation in PDA's and Mobile Networks	NSF	06/01/03	05/31/06	$350,000
Trachtenberg, Ari	CAREER: Practical Data Syncronization - Minimizing Communication	NSF	02/01/02	01/31/05	$66,638.00
Ünlü, M. Selim	Photonics Technology Development and Insertion/Task 2: Optical Communication and Polarization Sensing (Photonics Center Award)	DOD/Army	03/01/03	02/29/04	$98,894.00
Subtotal	**Grants with ECE PIs**				**$6,036,901**

New Grants with ECE co-PIs

Recipient	Title of Award	Source	Begin Date	End Date	Amount
Rebbi, Claudio Coker, David Caramanis, Michael **Giles**, Roscoe	IGERT: Mulitidisciplinary Approach to the Integration of High-Performance Computing in Science Education (additional co-p.i.: S. Grossberg) ($518,532)	NSF	12/15/02	11/30/03	$129,633.00
Giles, Roscoe	ITR/EWF: New Approaches to Human Capital Development Through Information Technology Research (subcontract via Portland State University) ($98,003)	NSF	09/15/02	08/31/03	$98,003.00
Goldberg, Bennett **Ruane**, Michael Garik, Peter Phillips, Constance	GK-12: Project STAMP - Science Technology and Mathematics Partnerships (additional co-p.i.: Donald DeRosa) ($476,159)	NSF	06/01/03	05/31/04	$119,039.75
Goldberg, Bennett **Ruane**, Michael Garik, Peter Phillips, Constance	GK-12: Project STAMP - Science Technology and Mathematics Partnerships (additional co-p.i.: Donald DeRosa) ($54,000)	NSF	06/01/03	05/31/04	$13,500.00
Mountain, David **Hubbard**, Allyn	Active Filtering in the Cochlea (in conjunction with Hearing Research Center) ($448,561)	HHS/NIH/NIDCD	09/01/02	08/31/03	$224,280.50
Mountain, David **Hubbard**, Allyn	Models of Whale Auditory Function (in conjunction with Hearing Research Center) ($180,000)	HHS/NIH/NIDCD	09/01/00	09/30/03	$90,000.00
DeLuca, Carlo **Nawab,** S. Hamid	Harnessing Motoneuron Activity: From Lab to Clinic ($622,485)	HHS/NIH/NICHD	06/01/02	05/31/03	$124,497
DeLuca, Carlo **Nawab**, S Hamid	Harnessing Motoneuron Activity: From Lab to Clinic ($562,596)	HHS/NIH/NICHD	06/01/03	05/31/04	$112,519
Subtotal	**Grants with ECE co-PIs**				**$911,472.25**
Grand Total					**$6,948,373.25**

Gifts and Other Awards

Recipient	Source	Amount
Humphrey, Floyd	Seagate Technologies	$50,000
Humphrey, Floyd	Massachusetts Institute of Technology	$9,644
Morse, Theodore	3M Company	$10,000
Ruane, Michael	Madison Technology International	$1,000
Teich, Malvin	Photonics Center Technology Day Award	$500
Total Gifts and Awards		**$71,144**

Continuing Grants and Contracts

Recipient	Title of Award	Source	Begin Date	End Date
Bellotti, Enrico	Investigation of the Breakdown Mechanisms in HEMT's (subcontract via University of Michigan/BAE Systems, Inc.)	DOD/Army	10/01/01	12/31/02
Bellotti, Enrico **Moustakas**, Theodore	GaN-Based Permeable Base Transistors (PBT) Fabrication and Evaluation (subcontract via BAE Systems, Inc.)	DOD/Army	01/30/02	12/31/02
Carruthers, Jeffrey	CAREER: High Bit Rate Wireless Infrared Communciations	NSF	04/01/99	03/31/03
Carruthers, Jeffrey	CAREER: High Bit Rate Wireless Infrared Communciations	NSF	04/01/99	03/31/03
Giles, Roscoe	ITR/EWF: New Approaches to Human Capital Development Through Information Technology Research (subcontract via Portland State University)	NSF	09/15/01	09/14/02
Giles, Roscoe Rebbi, Claudio Porter, John Bresshnahan, Glenn	PACI: Education, Outreach and Training (EOT) (subcontract via University of Illinois)	NSF	10/01/01	09/30/02
Little, Thomas	Rapid Task-Based Self-Organization in Distributed Ad-hoc Spaces	NSF	09/01/00	05/31/04
Morse, Theodore	Photonics Technology Development and Insertion/Task 1: Fiber Laser Technology (in conjunction with Photonics Center)	DOD/Army	09/01/01	08/31/02
Moustakas, Theodore	Investigation of Atomic Long-Range Order in AiGaN Films	DOD/Navy	12/01/00	09/30/02
Moustakas, Theodore	Novel High Power, Wide Dynamic Range HBT for Use in Analog/Digital Converters (subcontract via Viatronix, Inc.)	DOD/DARPA	05/01/02	12/01/02
Moustakas, Theodore	Novel High Power Solid State Photoconductive Power Switch	DOD/Air Force	06/01/02	01/01/03
Oliver, William	Upper Atmosphere/Ionosphere Studies	NSF	08/01/01	07/31/02
Saleh, Bahaa **Teich**, Malvin **Sergienko**, Alexander	Modeling and Optimiztion of Ultrafast, Low-Noise Avalanching Photodiodes for Optical Communications (subcontract via University of New Mexico)	NSF	08/15/01	08/31/04
Sergienko, Alexander	CAREER: Quantum Cryptography with Entangled Photons	NSF	02/15/99	01/31/03
Swan, Anna	Photonics Technology Development and Insertion/Task 15: Integrated Optic Telecommunication Devices-Characterization and Fabrication (in conjunction with Photonics Center)	DOD/Army	03/01/02	02/28/03
Teich, Malvin **Saleh**, Bahaa	Functional Imaging of Synapses by Entangled-Photon Microscopy	The David and Lucille Packard Foundation	08/01/99	08/31/04
Teich, Malvin **Saleh**, Bahaa	XYX on a Chip: Development and Fabrication of Three-Dimensional Microdevices (subcontract via Boston College)	NSF	09/01/01	08/31/04
Toffoli, Thomas	Programmable Matter Methods (in conjunction with Center for Computational Science)	DOE	09/01/01	08/31/03
Ünlü, Selim **Goldberg**, Bennett Lutchen, Kenneth	Development and Study of Hyper-Polarized Noble Gas System for Magnetic Resonance Imaging (in conjunction with Photonics Center) (subcontract via Brigham & Women's Hospital)	NSF	09/01/01	08/31/03
Ünlü, Selim **Goldberg**, Bennett	Spectral Self-Interference Microscopy	Corning, Inc.	01/01/02	09/30/02
Ünlü, Selim	U.S. Switzerland Cooperative Research: Monolothic High-speed Photoreceivers, Wavelength, and Polarization Sensors	NSF	01/01/02	04/30/05

six: Outlook

The last decade has witnessed the maturation of the ECE department from a primarily undergraduate program to a more balanced department with high quality instruction, a substantial research program, and an increasingly distinguished faculty. Key statistics of enrollment, degrees awarded, faculty size, and grant funding in the last decade are exhibited in the following tables and charts.

6.1 Enrollment

Fall enrollments in the BS, MS, and PhD programs are listed in Table 6-1 and Chart 6-1. Important undergraduate trends in ECE have tended to mirror national patterns. These include the following:

- A demographic decline in undergraduate enrollment occurred in the mid-1990s, followed by an increase and subsequent stabilization resulting from college restriction on enrollment, which was implemented to attain a higher quality student body. Last year the BS enrollment dropped by 8%. It is not yet clear whether this represents a pattern. *(See Chart 6-1.)*

Table 6-1: Enrollments Fall 1992-Fall 2002

	'92	'93	'94	'95	'96	'97	'98	'99	'00	'01	'02
BS	329	328	344	361	399	398	410	407	406	405	373
MS	201	171	135	103	68	70	83	80	67	54	63
Ph.D.	49	50	55	64	78	83	80	72	83	68	94
Total	**579**	**549**	**534**	**528**	**545**	**551**	**573**	**559**	**556**	**527**	**530**

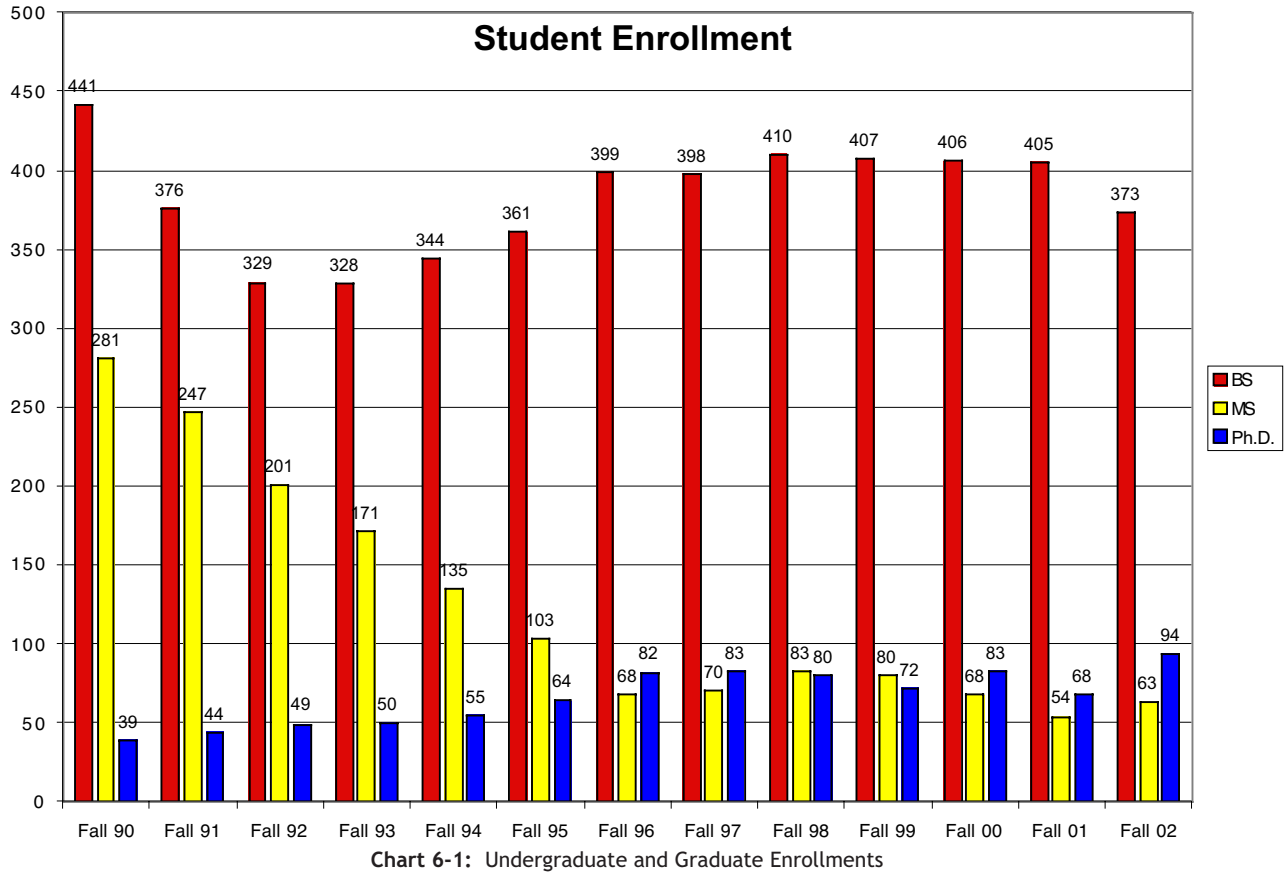

Chart 6-1: Undergraduate and Graduate Enrollments

- While the enrollment in the EE program has remained stable since the late 1990s, the large increase in CSE enrollment in the 1990s has been followed by a decline. CSE enrollment is now 57% of our total undergraduate enrollment.

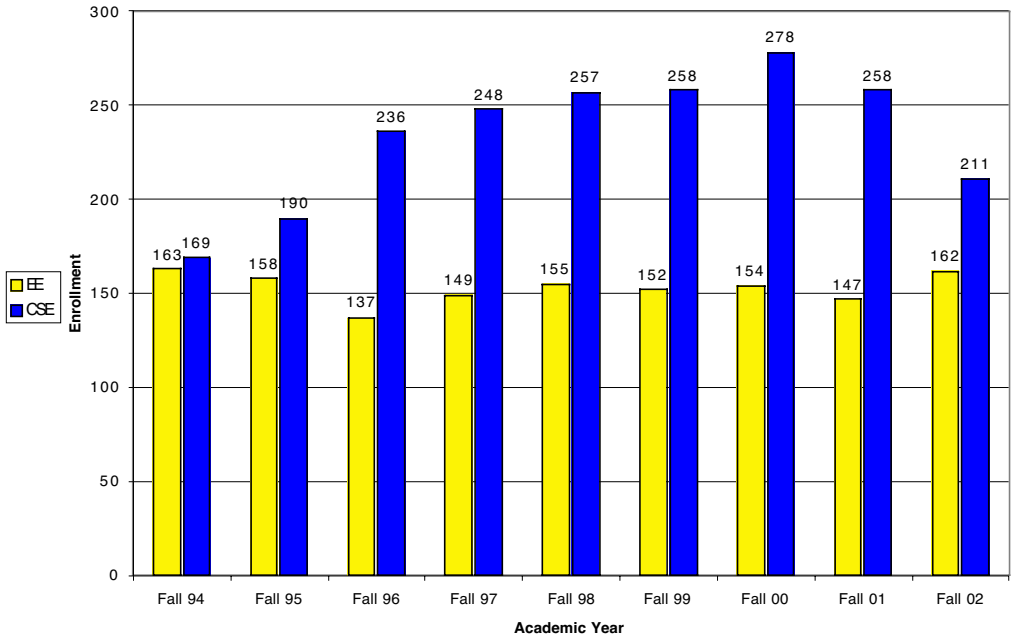

Chart 6-2: Enrollments in the EE and CSE Undergraduate Programs

At the graduate level, the emphasis has shifted from professional MS-oriented students to Ph.D. students:

- MS degree enrollments have been steady over the past five years, but remain much lower when compared to the early 1990s period, due to the demise of the Corporate Classroom program.
- PhD enrollment has risen, along with the number of applications. This year, we have reached an all-time high number of 94 PhD students.
- Graduate teaching fellowship resources have remained fixed, while RA support grew with grant funding.

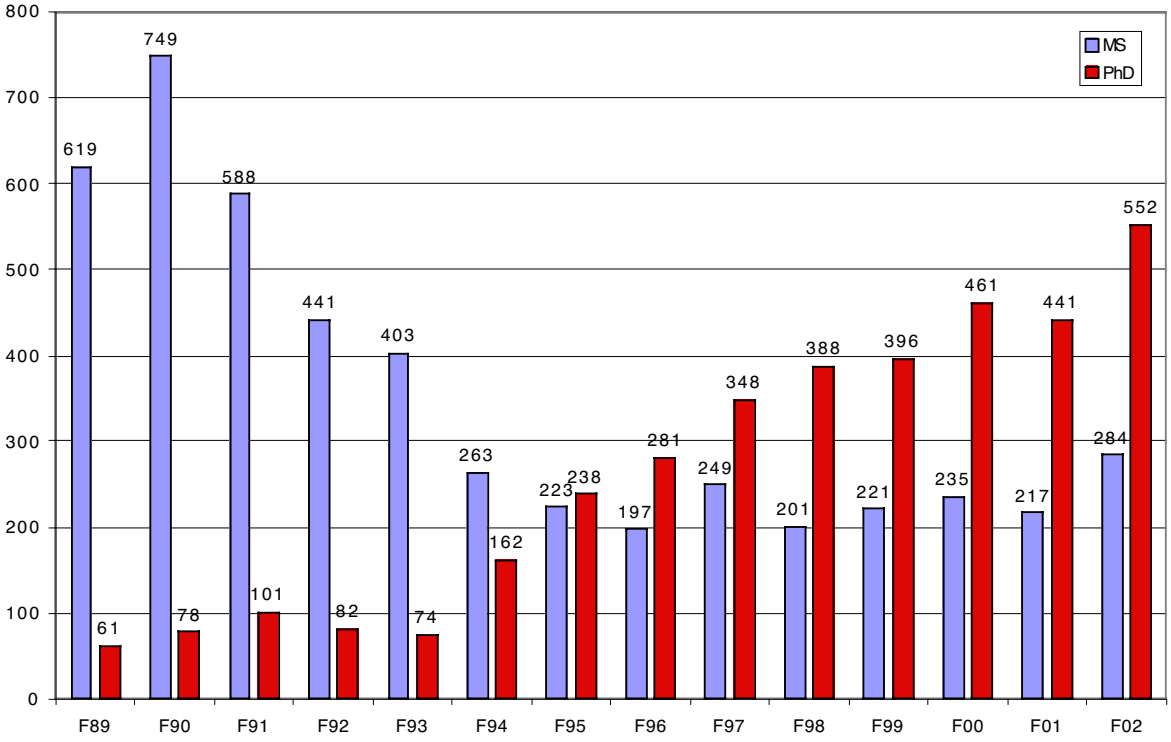

Chart 6-3: Graduate Student Applications

6.2 Degrees Awarded

Data on the degrees granted by the department in the last ten years are shown in Table 6-2 and Charts 6-4 to 6-6. The number of Ph.D. degrees awarded has increased from an average of 6 per year in 1992-96 to an average of 9 per year in 1997-2003.

Table 6-2: Degrees Awarded 1993-2003

	'93	'94	'95	'96	'97	'98	'99	'00	'01	'02	'03
BS	88	78	85	90	88	96	98	99	102	101	106
MS	109	91	92	70	52	28	43	38	45	41	35
Ph.D.	4	6	10	4	10	15	4	10	7	9	7
Total	**201**	**175**	**187**	**164**	**150**	**139**	**145**	**147**	**154**	**151**	**148**

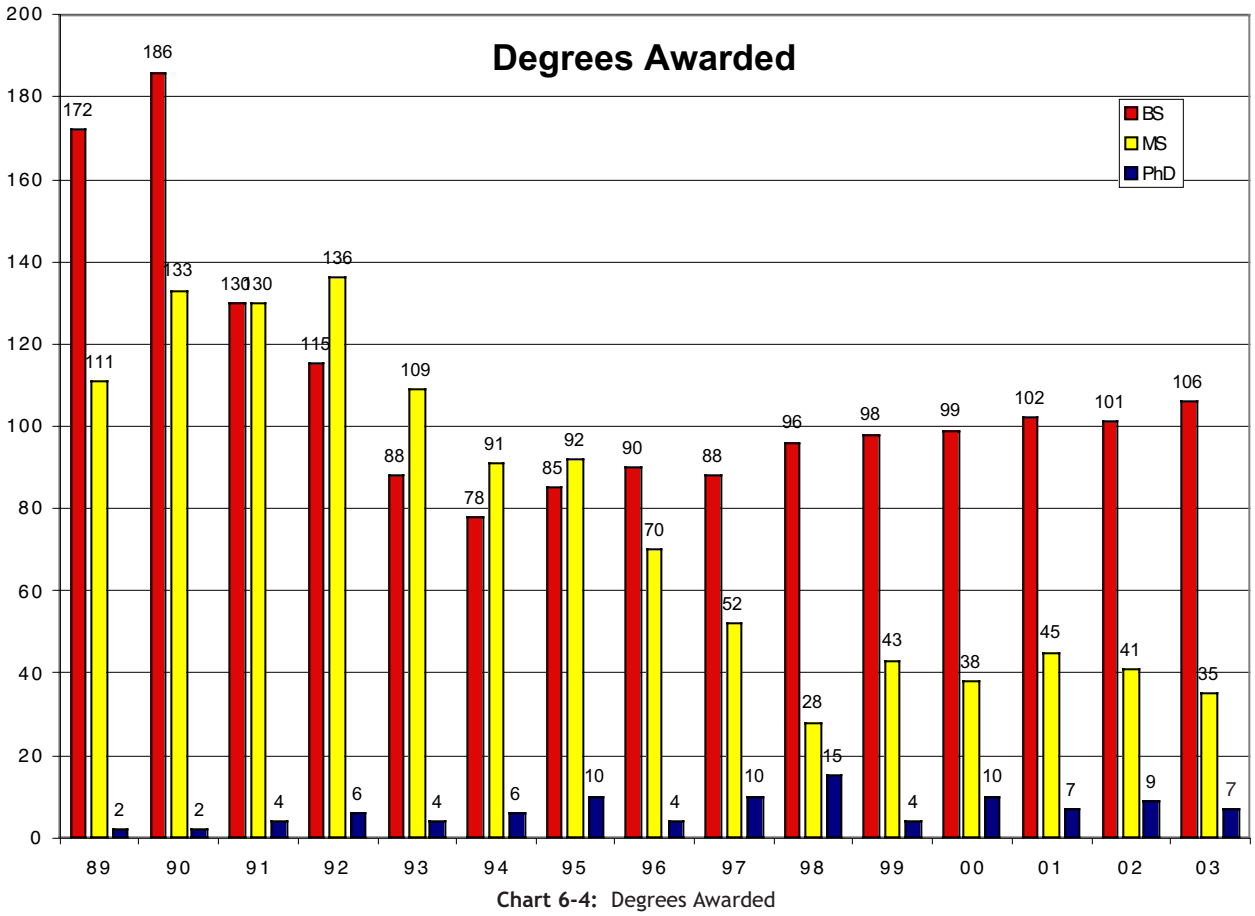

Chart 6-4: Degrees Awarded

6.3 Research Funding

Research funding has grown significantly over the past ten years. With aggressive effort, total new research funding surpassed $6.0M this year over last year's $5.2M.

- Funding per faculty totaled approximately $160k.
- Annual average over the last eight years (1996-02) is $5.2M., compared to $2.4M over the previous six years (1990-95).

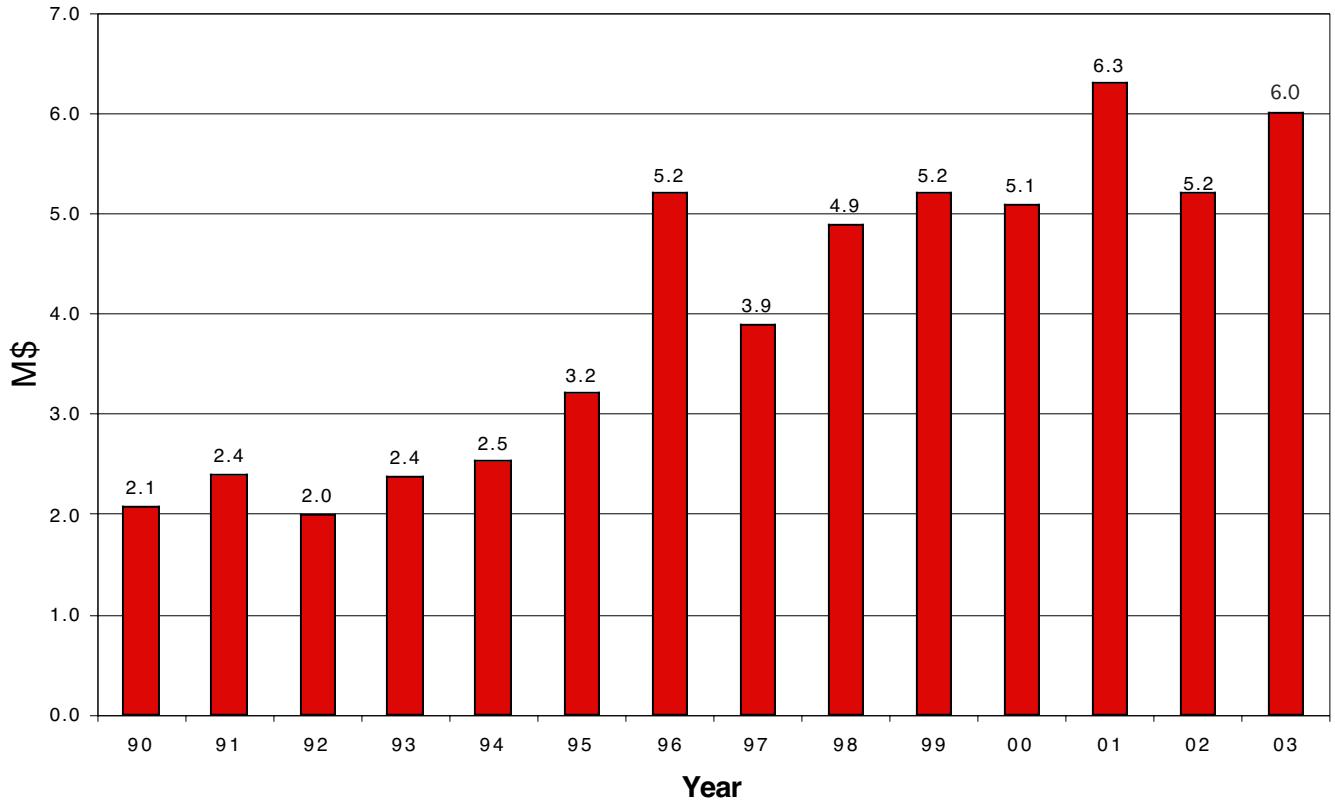

Chart 6-7: New Research Grants and Contracts These figures include only grants and contracts for which the Principal Investigators (PI) were ECE faculty. The share of grants for which ECE faculty were Co-PIs totaled approximately $911k in 2001/02, so that the total funding is approximately $6.9M.

6.4 Faculty and Staff

Faculty hiring has largely replaced departures, with small net growth over the last ten years:

- Department growth has has remained at about the same level over the last five years.
- 13 of the current faculty joined the department in the last five years.
- New hires have been directed both to strategic research thrusts and to address shifting enrollments.

Staff development has lagged behind the faculty and programmatic changes:

- Scientific staff (post docs, visitors) has increased with associated space and administrative demands.
- Technical lab staff positions have remained at 6.
- Administrative staff has grown much slower than the faculty/scientific staff head count and research volume.

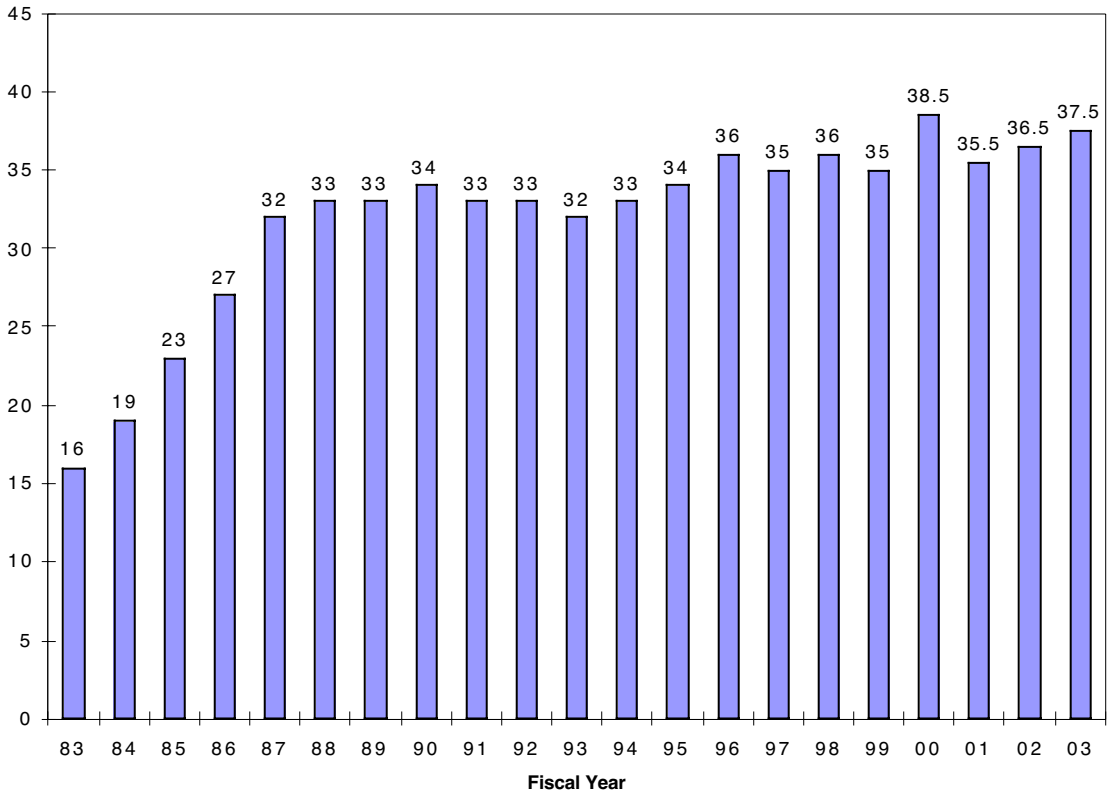

Chart 6-8: Faculty Growth and Turnover Since 1983 Affiliate faculty and research faculty with no teaching responsibilities are not included in this chart.

6.5 Outlook

ECE is a multidisciplinary department, with a strong systems perspective. Faculty have been trained in electrical engineering, computer engineering, physics, mathematics, material science, computer science and information systems. The Department encompasses three main areas of research and instruction: **electrophysics** (which includes photonics, solid state materials and devices, and electromagnetics), **information systems & sciences** (which includes signal and image processing, and control and communication systems), and **computer systems engineering** (which includes hardware, software applications, and computer and communication networks). These areas overlap and are mutually supportive. We have strong collegial ties to important Boston University centers, most notably the Photonics Center, the Center for Space Physics, the Center for Computational Science, the Center for Subsurface Sensing and Imaging Systems, and the Center for Cognitive and Neural Systems. We also have strong links with several other departments at Boston University. *(See Chart on page 6-7.)* Many faculty have strong extramural ties in larger centers, multi-university initiatives, and industry collaboratives.

Our strategy has been to focus on a few important areas of excellence that will create outstanding programs of research and innovation while contributing to a strong undergraduate learning experience and cutting edge graduate research. Plans for faculty growth have been motivated by the need to strengthen existing research areas to become more competitive at a national level, develop new expertise in areas of ECE to keep up with the rapidly-changing face of our profession and to play a leading role in shaping future technological advances, and respond to shifting and growing student enrollments at both the undergraduate and graduate levels. We also aim at exploiting the synergies between our existing research areas as well as links with other departments and centers at Boston University. We expect a strong rebound in high tech over the next five years, and plan to invest wisely now to benefit from these coming opportunities. The continued excellence of our faculty and students will lead to the increased prominence desired for Boston University's ECE Department.

Electrophysics

Electrophysics encompasses several strong and emerging areas of electrical engineering, including photonics, solid-state materials and devices, and nanotechnology. The electrophysics faculty have strong campus collaborations in the Photonics Center and the Center for Space Physics, and play key roles in the NSF Engineering Research Center for Subsurface Sensing and Imaging Systems (CenSSIS) (see page 5-19).

When BU established the Photonics Center, it made a strategic commitment to become a national center of excellence in photonics. World-class research facilities have been developed and a number of senior and junior ECE faculty have been added and have become core partners in the Photonics Center. The photonics faculty have infused a large number of new courses into the curriculum, have led the creation of the new MS in Photonics degree program, and are working to increase distance learning offerings for the courses in photonics. The instructional program, facilities, and courses in photonics were supported by external fellowships from the Department of Education and curriculum development funds from industry and the National Science Foundation. Our plan is to maintain the momentum and to continue to strengthen this program with new faculty, also enriching the scientific base of the Photonics Center and its technical vitality.

Research in photonics and solid state includes photonic and semiconductor materials and devices, computational electronics, quantum optics and its applications to information and communication systems, fiber optics, magneto-optics and optical storage, biophotonics, microscopy, and sensing and imaging systems. The 2000 award of Boston University's first Engineering Research Center, the Center for Subsurface Sensing and Imaging Systems (CenSISS), was a significant and widely publicized accomplishment. We have a timely opportunity to reshape the direction of electrophysics due to the recent departure of a number of faculty members in this area. This allows us to shape new research strengths in evolving areas of national need, while maintaining the traditional areas vital to the success of our educational mission, especially the new MS in Photonics. New hires in electrophysics will be carefully coordinated to establish a credible group of collaborating faculty that will enable us to respond fully to new national priorities. We will exploit university-wide initiatives and synergies in the area of micro- and nano-structures while maintaining the strong interest in photonic systems.

At the instructional level, we intend to continue our efforts to bring outstanding laboratory instruction to every undergraduate electrophysics course. This effort began with our move to new laboratories in the Photonics Center and coincided with changes in national accreditation standards that now emphasize laboratory and open-ended investigations as effective learning strategies.

Information Systems and Sciences

The ECE Department has a strong group in information systems and sciences with significant research in digital signal processing, image and video processing, multimedia communication, optimization and control, distributed processing, and mobile and wireless communication. This group has established an excellent reputation and enjoys strong graduate student interest. Members of the group are active in the NSF Engineering Research Center for Subsurface Sensing and Imaging Systems (CenSSIS) (see page 5-19), the Center for Information Systems and Engineering (CISE), and the Center for Space Physics.

We have had some recent departures of faculty in this area, and we are endeavoring to replace them in order to maintain our momentum and preserve our critical mass. We are also seeking opportunities for growth in areas including wavelets and filterbanks, multiresolution and adaptive representation and processing, signal and image compression and coding, distributed sensing and control, collaborative communication and signal processing. Applications relating to medical imaging and space-physics remote sensing are of particular interest since they exploit synergies with existing BU centers.

Computer Systems Engineering

Computer systems engineering has a special significance as a vital technology for the 21st century with very broad applications. This can be seen, for example, in the three national priorities outlined by the NSF -- Nanotechnology, Information Technology, and Bioinformatics. Their confluence lies directly within computer and systems engineering. Some opportunities include: combining nanotechnology with computing technology on a chip, development of computer systems for bioinformatics and computational biology, application of knowledge engineering to information technology and bioinformatics, and development of embedded systems for communications.

We have strengths within the ECE Department in computer systems and architecture, VLSI systems, testing and fault-tolerent computing, coding and cryptography, high-performance computing, computer and communication networks, and wireless cellular networks.

VLSI electronics continues to be an area of fundamental importance since VLSI circuits constitute the principal hardware for computers and embedded systems. Maintaining a strong instructional program in this area is essential for both our degree programs. Application of VLSI electronics to biological sensors is an area of great potential, and interests both the ECE and the Biomedical Engineering Departments.

Telecommunications and computer networking have dramatically changed our society and are expected to continue to have a significant economic impact and to drive much of the electronics and computer technology. The student demand for telecommunication and networking courses has been high and the Department has recently enhanced the curriculum at both the undergraduate and graduate levels. ECE research in this area has recently increased. The Computer Science Department has also targeted computer networks as a strong research thrust, and the Department of Manufacturing Engineering has a strong systems group with a related interest in discrete event systems. Our combined effort has created a strong BU program in this important area.

Research in high-performance computing is strong and is linked with the Center for Computational Science and the Scientific Computing and Visualization Center. Another link offering particularly strong synergistic possibilities with the high-performance computing group is that with the Center for Space Physics, a BU research center with strong links to ECE.

Our plans for faculty growth in computer systems engineering are dictated primarily by the large undergraduate instructional needs and by the growing demands of graduate students for research sponsorship. The addition of more faculty is essential to meet increased teaching needs, to reduce the current burden on research active faculty, and to give this research area the critical mass necessary to gain a higher national recognition and competitiveness for research funds. With targeted hires in areas such as embedded systems, hardware/software codesign, and VLSI, we will position ourselves to be among the leaders in these critical technologies, both in driving their development and in preparing students.