BOSTON UNIVERSITY

Department of Electrical and Computer Engineering

2005 - 2006
Annual Report

July 1, 2005 - June 30, 2006

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 2005-2006 academic year. Instructional activities are reported for Fall 2005, Spring 2006, and Summer 2006 semesters. Publications and scholarly activities, as well as budget information, are reported for the 2006 fiscal year (July 1, 2005 to June 30, 2006). 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 web site, *http://www.bu.edu/ece*.

1.1 Faculty

The ECE Department continued its vigorous effort to recruit new faculty members with outstanding research credentials in selected thrust areas. Two new junior faculty were appointed at the Assistant Professor (tenure-track) rank this year. **Masoud Sharif,** who finished an award-winning PhD thesis at Caltech, joins a strong ECE research group in wireless networks (see sidebar) and is expected to play an important role in the Center for Information Systems Engineering (CISE). **Luca Dal Negro** comes to us from M.I.T., where he was engaged in outstanding research in photonic-crystal nanophotonics (see sidebar).

Hatice Altug is another outstanding junior scientist in nanophotonics who will join the ECE tenure-track faculty in January 2007. She has done ground-breaking research in photonic-crystal nanocavity laser arrays at Stanford University and her research has been recently highlighted in Nature and other photonics publications. These are important additions to our photonics research team, which is becoming one of the strongest in the world.

Further, this year **Anna Swan** joined the tenure-track faculty at the rank of Associate Professor. As a previous member of the ECE research faculty, Swan has pursued excellent research in microscopy, biosensing, and carbon-nanotube photonics (see sidebar).

Three ECE faculty members were granted tenure and promoted to the rank of Associate Professor: **Enrico Bellotti, David Starobinski,** and **Ari Trachtenberg.** All three have received NSF CAREER awards. Bellotti is recognized for his excellent contributions to modeling and numerical simulation of semiconductor electronic and photonic devices. Starobinski has made significant contributions to performance analysis of packet networks, with applications to wireless networks. Trachtenberg has made important contributions to networks and coding theory and has pioneered new directions in data synchronization. He has also received the 2002-2003 ECE Excellence in Teaching Award.

Sabbatical leaves this year included **W. Clem Karl** and **Theodore Morse** in Fall 2005 and Spring 2006, **Thomas Skinner** in Fall 2005, and **Mike Ruane** and **Jeffrey Carruthers** in Spring 2006.

Luca Dal Negro joined the ECE Department as Assistant Professor (tenure-track) on January 1, 2006. He received his Ph.D. in Semiconductor Physics from the University of Trento, Italy in 2003. Prior to joining the ECE Department, he was a post-doctoral fellow at M.I.T. His research interests include optical amplification phenomena and laser physics; optical spectroscopy of semiconductor nanostructures; photonic crystals, Anderson light localization and aperiodic dielectrics; and nanophotonics and plasmonics.

Masoud Sharif joined the ECE Department as Assistant Professor (tenure-track) on January 1, 2006. He received his Ph.D. in Electrical Engineering from California Institute of Technology in 2005, where he won the 2006 Wilts Prize for the best PhD thesis in Electrical Engineering. His research interests include wireless multiuser networks and communications and information theory.

Anna Swan was promoted from Research Assistant Professor to Associate Professor (tenure-track), effective September 1, 2005. She received her Ph.D. in Physics from Boston University in 1993. Before joining the ECE Department as a Research Assistant Professor in 1999, she worked in the solid state division of Oak Ridge National Laboratory. Her research interests include optical properties of carbon-nanotubes; strain studies using Raman Spectroscopy; development of high-resolution fluorescence microscopy; bio-sensing; and educational outreach.

Faculty Awards and Honors

David Castañón received the IEEE Control Systems Society Distinguished Member Award.

Prakash Ishwar received an NSF Career award in support of his research entitled "Information-Scaling Laws, 'Bit-conservation' Principles, and Robust Coding Architectures in Sensor Networks."

Janusz Konrad received the EURASIP Image Communication Journal Best Paper Award for 2004-2005 for his paper with his recent ECE PhD graduate Nikola Bozinovic entitled "Motion analysis in 3D DCT domain and its application to video coding," *Signal Processing: Image Communications,* Vol. 20, pp. 510-528, July 2005. The paper was also among the top 25 most downloaded papers from *Signal Processing: Image Communication.*

Hamid Nawab was elected a Fellow of the American Institute of Medical and Biological Engineering.

Wei Qin received the 2006 ECE Award for Excellence in Teaching.

Roberto Paiella won a 2006 SPRInG grant from the Office of the Provost for research in "Development of Practical Sources of Terahertz Radiation by Use of Nitride Semiconductor Quantum Structures."

Joshua Semeter received an NSF CAREER Award in support of his research entitled "Magnetosphere-Ionosphere Coupling through Multi-Sensor Data Fusion."

Masoud Sharif was awarded the Caltech 2006 Wilts Prize for the best doctoral thesis at Caltech. The prize is awarded every year to one EE graduate student for outstanding independent research in electrical engineering leading to a PhD.

College of Engineering Faculty Service Award

Professor Selim Ünlü, Associate Chair for ECE Graduate Studies, was the winner of the 2006 Faculty Service Award. The College of Engineering Executive Board chooses a faculty member who has made outstanding contributions to the College through involvement in programs, committees, and organizations within the College and University.

1.2 Undergraduate Program

This year we continued improving our EE and CSE programs with two new courses introduced to replace previous requirements in both programs. Probability for Electrical & Computer Engineers (ENG SC381) was formally approved by the College of Engineering faculty in Fall 2005 and was taught for the first time in Spring 2006 by Professor David Castañón. Introduction to Engineering Computation (ENG EK127) was proposed and approved by the faculty to replace the older course ENG EK126. The major change involved teaching the entire course using MATLAB rather than C++. This was done in response to feedback from our students and faculty that the older course failed to sufficiently prepare our students for the extensive use of MATLAB later in the curriculum. The teaching of C++ will be postponed until the data structures course for the CSE program. In another instance of continual program improvement, in AY 2005-2006 several ECE courses implemented the cellular phone as a running theme to help the students see connections between those courses. The objective was to obtain better learning outcomes along the "integrated view" dimension.

Enrollment in the BS programs has been steady in recent years. A total of 273 students enrolled in the Electrical Engineering (EE) and Computer Systems Engineering (CSE) programs, with CSE enrollment now dropping to about 36% of the total undergraduate enrollment. The number of EE and CSE BS degrees awarded this year were 65 and 29, respectively. (See details in Section 3.1 and enrollment history in Section 6.2.)

Efforts to enhance the undergraduate laboratories are successfully ongoing, with new equipment, maintenance, and upgrades this year at a total cost of $211k. In both classrooms and laboratories, emphasis is placed on design, laboratory practice, and applications. Successful ideas that were initiated in previous years, such as the Teaching Workshop, the ECE Senior Project Day, ECE Advising Day, and the ECE Teaching Excellence Award, continued this year. (See Section 3 for more information.)

Undergraduate Student Awards

The senior design team of **Joseph D'Errico, Andrew Hagedorn, Yaniv Ophir,** and **Vyas Venkataraman** received honorable mention as one of 10 groups that competed in the CSIDC 2006 world finals in Washington, DC on July 2. Other competing teams hailed from China, India, Poland, Romania, Jordan, and the U.S. Sponsored by the IEEE and Microsoft, the competition aims to advance excellence in computer science and computer engineering education by encouraging student teams to design and implement computer-based solutions to real-world problems.

The group also won the GE Imagination Award 2006 for their design of trash cans that can communicate with each other (and to a central point) when they need to be emptied (displaying both full and overflowing status). The GE Award is given to the team whose project best exemplifies imagination and creativity.

Students **Simon Au, Tina Chu, Eddie Lau,** and **Richard Yu** were selected by Senior Project faculty as recipients of the 2005 P.T. Hsu Award for the best overall ECE senior design project.

Shihchin (Matt) Chiu receiving the ECE Graduate Teaching Fellow of the Year Award from Selim Ünlü, Associate Chair for Graduate Studies.

1.3 Graduate Program

In 2005-2006, new student recruiting efforts were rewarded with success. Five PhD students were awarded Dean's Research Fellows (DRF) and began matriculation in ECE in Fall 2005. Four of these students will be continuing their degree programs and are making excellent progress in their programs. Eighteen graduate students began matriculation in Fall 2005 with Graduate Teaching Fellowships (GTF). Fourteen of these eighteen GTFs have been offered Research Assistantships for the Fall 2006 semester. For the Fall 2006 semester, we have recruited four new DRFs, 11 new GTFs, and one Photonics Fellow.

The BU Photonics Center has started a new program funding photonics graduate students in the sciences and engineering. The program grew out of the belief that greater interdisciplinary research and education in photonics will require strong support of doctoral students. The awards are divided into two types: full-year Junior Assistantships and two-semester Senior Assistantships. One of the three Photonics Center Junior Research Assistantships was awarded to David Harrah starting as an ECE student in September 2006. Continuing ECE PhD students Ayca Yalcin, Anthony Vamivakas and

Joshua Abell were recipients of Senior Student Awards. The selection for these Awards is merit based, and students were evaluated based on criteria that included academic record, scores on standardized tests, recommendation letters, publications, conference presentations, participation in the Photonics Center community, and recommendation of the graduate committee of the affiliated BU department. This cohort of students, including six others from BME, Physics, MFG, and Chemistry, will contribute to building an interdisciplinary Photonics Community.

Graduate Student Awards

ECE graduate students made an excellent showing in the 2006 Science and Engineering Day. The "College Of Engineering Award Dean's Award" was received by **George Atia** for his poster "On Outage and trade-off in half duplex relay channels" (Advisor: Venkatesh Saligrama). The "CISE Award" was received by **Shuchin Aeron** for his poster, "Energy Efficient policies for distributed target tracking in multi-hop sensor networks" (Advisor: Venkatesh Saligrama). The "Photonics Berman Future of Light Award" was received by **Tao Xu** for her poster "Fundamental Physical, Chemical, and Material Phenomena." (Advisor: Theodore Moustakas) In its second year, the "Electrical and Computer Engineering Award" was shared by two students: **Brynmor Davis** for his poster "Using Multi-Element Detectors to Utilize Out-of-Focus Light and Synthesize Optimal Apertures in Confocal Microscopy" (Advisor: W. Clem Karl) and **I. Emre Ozkumur** for his poster "Label-free biological microarray imaging." (Advisor: Selim Ünlü)

Graduate student **Shihchin (Matt) Chiu** received the 2005/2006 ECE Graduate Teaching Fellow of the Year Award.

1.4 Research

New research funding this year totaled about $7M in awards for research, of which $5.2M were awarded to ECE Principal Investigators (PI) and $1.8M were awarded to ECE faculty members working as Co-PI on projects outside of the Department. Of the PI awards, 23 were for new research projects, while 21 awards were for continuing projects. (*See Section 5.5 for details on research funding.*)

During this year, research funding has supported 108 research assistant students who have had the opportunity to expand their knowledge from the classroom into cutting edge research.

This year, Theodore Moustakas received more than $784k for his research projects involving work with the Department of Energy for the development of solid state lighting; a three-year grant from NASA to develop a deep UV laser for identification of

biological substances during exploration of Mars ($125k); and a continuation of his project Blue/UV LEDs for white lighting.

Selim Ünlü's new and continuing projects received more than $500k, with his work on high-throughput, label-free, promoter sequence discovery awarded $231k. Thomas Little, Murat Alanyali and Venkatesh Saligrama received $500k to continue their research project in internetworking of sensor systems. Alexander Sergienko, Bahaa Saleh and Malvin Teich continued their project "Ultrafast Quantum Optics," which received funds of $300k this year.

Several large research grants were received this year in support of inter-departmental collaborative research. The NSF Center for Subsurface Sensing and Imaging Systems (CenSSIS) continued its sixth year with Research Thrust 1 led by Bahaa Saleh and funded at $126k, Research Thrust 2 led by David Castañón and funded at $295k; and the education program led by Michael Ruane and funded at $60k.

Allyn Hubbard continued his research for Robot Enhanced Detection Outpost with Laser (REDOWL), a tactical sensory system based on human hearing that can detect and locate snipers on the first shot fired at personnel or vehicles, bringing more than $670k to the Department.

Three ECE professors received $306k in CAREER awards this year: Prakash Ishwar ($152k) for his project "Information-Scaling Laws, "Bit-Conversation" Principles and Robust Coding Architectures in Sensor Networks"; Joshua Semeter ($83k) for his project "Magnetosphere-Ionosphere Coupling Through Multi-Sensor Data Fusion"; and Ari Trachtenberg ($71k) for his project "Practical Data Synchronization – Minimizing Communication".

This year, the ECE faculty, academic staff, and graduate students published 53 research papers in archival journals, authored, co-authored or edited 11 books or book chapters, and made 115 conference contributions (papers, abstracts, and presentations). They have also filed 16 patents or patent disclosures. (See Section 5.4 for a complete listing of faculty publications.) The Department continued its weekly Research Spotlight Seminar series this year and nine ECE faculty presented highlights of their research.

1.5 Special Events

ECE Day 2005

Initiated in 1997, ECE Day is a forum for student teams to present their senior design projects. Held at the end of the Spring semester, ECE Day 2006 included 23 presentations attended by students, faculty, alumni, and industry representatives. (For more information on ECE Day 2006 see Section 3.4.)

ECE Retreat

The ECE Department held its annual Faculty Retreat on May 12, 2006 at the Boston University Corporate Education Center in Tyngsboro, MA. This year's principal themes were undergraduate curriculum, enhancing the stature and visibility of the department, and the merit review process. New initiatives for the undergraduate curriculum included the creation of more flexible tracks to allow students to study a broader range of subjects, refreshing the core classes, and more emphasis on application than on theory.

NSF Workshop: Future Directions in Systems Research for Networked Sensing

Venkatesh Saligrama organized the workshop with a grant from the NSF Division of Electrical and Communications Systems. Held on May 25–26, 2006 in the Photonics Building, the workshop brought together renowned scholars in the field of distributed sensing and control and drew over 140 academic and industry leaders from across North America. The workshop included a panel of industry and government experts.

Attendees hailed from research institutions including University of California at Berkeley, University of Illinois at Urbana-Champaign, McGill University, Université Catholique de Louvain, Massachusetts Institute of Technology, Harvard University, Princeton University, and Yale University.

Government leaders from the Office of Naval Research, the Army Research Office, Oak Ridge National Laboratory, and Los Alamos National Laboratory highlighted the impact of sensor networking on issues of national importance.

Advanced Computational Electromagnetics Workshop (ACE '06)

Robert Kotiuga organized the workshop with a grant from the NSF. Held on May 4-6, 2006 at Boston University, the workshop addressed the themes of emerging applications requiring 3D finite element analysis and non-scalar interpolation; essential and evolving techniques from algebraic topology and geometric analysis; and geometric inverse problems.

Attendees included engineers, numerical analysts, software developers, and mathematicians who, when viewed in the context of the workshop themes, have made remarkable and lasting contributions in their respective fields.

two: *Faculty & Staff*

2.1 Faculty

Murat Alanyali, *Assistant Professor*
- Ph.D., University of Illinois, Urbana- Champaign 1996
- Communication networks; performance analysis and optimization; stochastic systems
- 2003 NSF CAREER Award
- 2004 Legacy Gift Award, College of Engineering
- Associate Editor, *IEEE Control Systems Society Conference Editorial Board*

Enrico Bellotti, *Assistant Professor*
- Ph.D., Georgia Institute of Technology, 1999
- Computational electronics; semiconductor materials and device simulations; power electronics; parallel computing
- 2005 NSF CAREER Award
- 2003 ONR Young Investigator Award

Irving Bigio, *Professor*
- Ph.D., University of Michigan, 1974
- Medical application of optics, lasers, and spectroscopy; biophotonics; nonlinear optics; applied spectroscopy; laser physics
- Fellow - Optical Society of America, American Society for Lasers In Medicine and Surgery, American Institute for Medical & Biological Engineering
- Los Alamos Inventor Awards, 1994, 1996, 1999

Richard Brower, *Professor*
- Ph.D., University of California, 1969
- Molecular dynamics simulation for biomolecules; lattics methods for QCD and statistical mechanics; quantum field theory of strings and particles
- A.P. Sloan Research Fellow, SLAC and M.I.T., 1974-1976
- Past Managing Editor, *International Journal of Computational Physics C*

Maja Bystrom, *Associate Professor*
- Ph.D., Rensselaer Polytechnic Institute, 1997
- Source and channel coding; multi-media communications; image processing
- 1999 NSF CAREER Award
- 2005 ECE Award for Excellence in Teaching
- 2001 Fulbright Award
- Associate Editor, *Signal Processing Letters*

David Campbell, *Professor & Provost*
- 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, American Association for the Advancement of Science
- Editor-in-Chief, *Chaos*; Editor, *Physics Report*s

Jeffrey Carruthers, *Associate Professor*
- Ph.D., University of California, Berkeley, 1997
- Wireless infrared communications; broadband communications; mobile and wireless networks
- 1999 NSF CAREER Award
- Senior Member, IEEE
- 2001 ECE Award for Excellence in Teaching
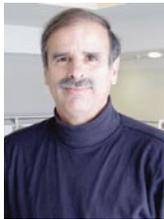
David Castañón, *Professor*
- Ph.D., Massachusetts Institute of Technology, 1976
- Stochastic control; estimation optimization; image understanding and parallel computation
- Associate Director, Center for Subsurface Sensing and Imaging Systems; Co-Director, BU Center for Information and Systems Engineering (CenSSIS)
- IEEE Control Systems Society Distinguished Member Award.
- Associate Editor, *Computational Optimization and Applications;* Past Associate Editor, *IEEE Transactions on Automatic Control*

Luca Dal Negro, *Assistant Professor*
- Ph.D., University of Trento, 2003
- Optical amplification phenomena and laser physics; optical spectroscopy of semiconductor nanostructures; photonic crystals, anderson light localization and aperiodic dielectrics; nanophotonics and plasmonics.

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
- Cited as one of the "50 Most Important Blacks in Research Science in 2004" by The Career Communications Group (CCG)
- A. Nico Haberman Award, CRA
- 1996 College of Engineering Award for Excellence in Teaching

Martin Herbordt, *Associate Professor*
- Ph.D., University of Massachusetts, 1994
- Computer architecture; electronic design automation; communication switch design; computer vision architecture; bioinformatics
- 1997 NSF CAREER Award
- 2004 Legacy Award, College of Engineering

Mark Horenstein, *Professor & Associate Dean for Graduate Studies*
- Ph.D., Massachusetts Institute of Technology, 1978
- Applied electromagnetics; electrostatics; microelectromechanical systems
- President, Electrostatics Society of America
- Editor-in-Chief, *Journal of Electrostatics*

Allyn Hubbard, *Professor*
- Ph.D., University of Wisconsin-Madison, 1977
- VLSI design using analog and digital techniques in CMOS; neural net chips, smart sensor chips, and chips with biological applications; models of the peripheral auditory system
- 2002 College of Engineering Award for Excellence in Teaching

Prakash Ishwar, *Assistant Professor*
- Ph.D., University of Illinois Urbana-Champaign, 2002
- Distributed and collaborative signal processing; multi-terminal information theory; statistical modeling and inference; image and video coding and processing; multiresolution signal processing and optimization with applications to sensor networks; multimedia-over-wireless security.
- 2006 NSF CAREER Award

W. Clem Karl, *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
- 2000 ECE Award for Excellence in Teaching
- Past Associate Editor, T*omography & MRI, IEEE Transactions on Image Processing*; Past Assistant Editor*, Systems Control Newsletter*

Mark Karpovsky, *Professor*
- Ph.D., Leningrad Electrotechnical Institute, 1967
- Design of secure cryptographic devices and smart cards; routing in interconnection networks; design and protection of cryptographic devices; fault-tolerant computing; error correcting codes; testing and diagnosis of computer hardware
- Fellow and Senior Member, IEEE
- Past Associate Editor, *Tomography and MRI, IEEE Transactions on Image Proceesing*

Thomas Kincaid, *Professor*
- Ph.D., Massachusetts Institute of Technology, 1965
- Signal and image processing; neurodynamics; non-destructive testing
- Chair, Electrical & Computer Systems Engineering, 1983-1994
- Associate Dean for Undergraduate Programs, 1995-1998
- Leap Advisor, 1998-2005

Ronald Knepper, *Professor*
- Ph.D., Carnegie Mellon University, 1969
- VLSI integrated circuit technology; SiGe BICMOS device and circuit modeling; silicon CMOS & bipolar devices; numerical device simulation; RF/analog IC design
- Fellow, IEEE
- 1989 IBM Outstanding Innovation Award; 1988 IBM Division Award; 1983 IBM Outstanding Technical Achievement Award
- Past Editor, *Solid State Electronics*

Janusz Konrad, *Associate Professor*
- Ph.D., McGill University, 1989
- Multimedia communications; image and video processing; stereoscopic and 3-D imaging; digital signal processing
- Senior Member, IEEE
- 2001 IEEE Signal Processing Magazine Award
- Associate Technical Editor, *IEEE Communications Magazine*; Past Associate Editor, *IEEE Signal Processing Letters*; Past Associate Editor, *IEEE Transactions on Image Processing*

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; micromagnetics; nanoscale magnetics; geometric inverse problems; Topological aspects of magnetic scalar potentials; helicity functionals; analysis of high performance interconnects
- Member, Electromagnetics Academy

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

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

Thomas Little, *Professor*
- Ph.D., Syracuse University, 1991
- Mobile Ad Hoc Networks (MANETs); multimedia computing; computer networking; software engineering; embedded sensor networks
- 1995 NSF CAREER Award
- Editorial Board Member, *ACM/Springer Multimedia Systems, Journal of Multimedia Tools and Applications*

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

Theodore Moustakas, *Professor*
- Ph.D., Columbia University, 1974
- Growth by MBE, MOCVD, HVPE and Gas-Cluster Ion Beam Deposition (GCIB); growth, fabrication and characterization 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); III-Nitride semiconductors (materials growth and device fabrication)
- Fellow, American Physical Society, Electrochemical Society
- 1998 ECE Award for Excellence in Teaching

S. Hamid Nawab, *Professor & Associate Chair for Undergraduate Studies*
- Ph.D., Massachusetts Institute of Technology, 1982
- Information and data extraction; algorithms/architectures with application to the analysis of brain to muscle communications via EMG signals from surface and needle electrodes
- 2005 College of Engineering Service Award
- 1998 College of Engineering Award for Excellence in Teaching
- 1993 Metcalf Award for Excellence in Teaching
- Fellow - American Institute for Medical & Biological Engineering

William Oliver, *Associate Professor*
- Ph.D., University of Illinois, 1973
- Radar studies of the upper atmosphere and ionosphere; modeling and simulation; global change in the upper atmosphere
- Associate Director, BU Center for Space Physics

Roberto Paiella, *Assistant Professor*
- Ph.D., California Institute of Technology, 1998
- Optical technologies for information processing; photonic devices based on semiconductor quantum structures, including group-III nitride quantum wells; nanoscale photonic devices and circuits; ultrafast optics
- Vice Chair, IEEE Laser and Electro-Optics Society (LEOS), New England Chapter

Wei Qin, *Assistant Professor*
- Ph.D., Princeton University, 2004
- Tools, methods and architectures for embedded systems; synthesis and verification of programmable processors; design languages for electronic systems
- 2006 ECE Award for Excellence in Teaching

Tatyana Roziner, *Associate Professor*
- Ph.D., Moscow Scientific Research Institute, 1975
- Digital design; testing and diagnostics of computer hardware; fault-tolerant computing
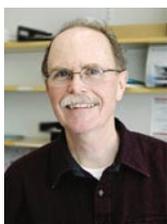
Michael Ruane, *Professor*
- Ph.D., Massachusetts Institute of Technology, 1980
- Resonant cavity imaging system; micro-magnetics modeling; optical systems; AFRL Loss Cone Imager DSX Satellite
- Senior Member, IEEE
- 2004 ASEE New England Section Outstanding Teacher Award
- 1999 ECE Award for Excellence in Teaching
- 1991 College of Engineering Faculty Service Award

Bahaa E.A. Saleh, *Professor & Chair*
- Ph.D., Johns Hopkins University, 1971
- Quantum optics; nonlinear optics; image processing
- Fellow, IEEE, Optical Society of America, John Simon Guggenheim Foundation
- 2004 BACUS Award
- 1999 OSA Beller Award
- Deputy Director, Center for Subsurface Imaging and Imaging Systems (CenSSIS)
- Past Editor-in-Chief, *Journal of the Optical Society of America A: Optics, Image Science and Vision*

Venkatesh Saligrama, *Associate Professor*
- Ph.D., Massachusetts Institute of Technology, 1997
- Information and control theory; statistical signal processing; applications to sensor networks
- 2005 NSF CAREER Award
- 2003 ONR Presidential Early Career Award
- 2002 ONR Young Investigator Award

Joshua Semeter, *Assistant Professor*
- Ph.D., Boston University, 1997
- Ionospheric and space plasma physics; spectroscopy of atmospheric airglow and the aurora borealis; image processing; radar systems and radar signal processing
- 2004 SRI Presidential Achievement Award
- 2000 Prize Lecture, NSF Cedar Workshop
- Associate Editor, *Journal of Geophysical Research*
- 2006 NSF CAREER Award

Alexander Sergienko, *Professor*
- Ph.D., Moscow State University, 1987
- Correlation spectroscopy, field optical microscopy and spectroscopy of semiconductor materials and devices; quantum communications; remote laser sensing; laser physics; nonlinear optics; quantum optics, including quantum radiometry and metrology
- 1999 NSF CAREER Award
- Fellow, Optical Society of America
- 2001 ECE Award for Excellence in Teaching

Masoud Sharif, *Assistant Professor*
- Ph.D., California Institute of Technology, 2005
- Wireless multiuser networks, and communications and information theory
- 2006 Wilts Prize for the best PhD thesis in Electrical Engineering at Caltech

Thomas Skinner, *Associate Professor*
- Ph.D., Boston University, 1982
- Microprocessors; computer networks; operating systems; distributed systems
- 2003 Microsoft Most Valuable Professional Award
- 1997 College of Engineering Award for Excellence in Teaching

David Starobinski, *Assistant Professor*
- Ph.D., Technion, Israel Institute of Technology, 1999
- Wireless and sensor networks; QOS and traffic engineering; networks performance evaluation
- 2004 Department of Energy Early Career Award
- 2002 NSF CAREER Award

Anna Swan, *Associate Professor*
- Ph.D., Boston University, 1993
- Development of nanoscale optical self-interference microscopy; optical properties of carbon nanotubes

Alexander Taubin, *Associate Professor*
- Ph.D., Electrotechnical University of St. Petersburg, 1981
- Asynchronous circuit, logic design; computer architecture; CAD; attack resistant hardware
- Senior Member, IEEE

Malvin Teich, *Professor*
- Ph.D., Cornell University, 1966
- Quantum optics and imaging; photonics; fractal stochastic processes; information transmission in biological sensory systems
- Fellow, IEEE, American Physical Society, Acoustical Society of America, American Association for the Advancement of Science, John Simon Guggenheim Foundation, Optical Society of America
- 1997 IEEE Morris E. Leeds Award, 1992 Palacky University Memorial Gold Medal, 1969 IEEE Browder J. Thompson Memorial Prize
- Editorial Advisor, Photonics and Physical Electronics, *Physics Today*

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
- Senior Member, IEEE
- Member, Editorial Board *Complex Systems*; *The Interjournal (on-line)*

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
- 2002 NSF CAREER Award
- 2003 ECE Award for Excellence in Teaching
- Senior Member, IEEE

Selim Ünlü, *Professor & Associate Chair for Graduate Studies*
- Ph.D., University of Illinois, Urbana-Champaign, 1992
- Near-field optical microscopy and spectroscopy of semiconductor materials and devices; design, processing, characterization and simulation of semiconductor optoelectronic devices; nanoscale imaging of biological samples, biosensors
- 2005 IEEE Lasers and Electro-Optics Society (LEOS) Distinguished Lecturer
- 1996 NSF CAREER Award
- 1996 ONR Young Investigator Award
- 2002 ECE Award for Excellence in Teaching
- Senior Member, IEEE
- Associate Editor, *IEEE Journal of Quantum Electronics*
- 2006 College of Engineering Service Award

Research Faculty

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
- 1998 Magnetics Society Achievement Award
- Millenium Medal

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

Affiliated Faculty

John Baillieul, *Professor, Chairman, Dept. of Aerospace and Mechanical Engineering*
- Ph.D., Harvard University, 1975
- Robotics; control of mechanical systems; mathematical system theory
- IEEE Fellow
- Elected 40th President of IEEE
- Distinguished Member, IEEE Control Systems Society
- Director, Boston University Center for Control and Dynamics of Smart Structures
- Past Editor-in-Chief, *IEEE Transactions on Automatic Control*
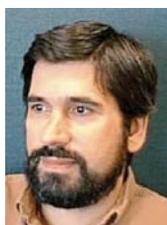
Christos Cassandras, *Professor*
- Ph.D., Harvard University, 1982
- Analysis and control of discrete event dynamic systems; stochastic control and optimization; dynamic control of computer and communication networks
- IEEE Fellow, 1991 Lilly Fellow
- IEEE Control Systems Society Board of Governors
- Editor-in-Chief, *IEEE Transactions on Autonomic Control*

Supriya Chakrabarti, *Professor*
- Ph.D., University of California, Berkeley, 1982
- Space experimentation; ultraviolet spectroscopy
- Director, Center for Space Physics

Solomon Eisenberg, *Professor, Dean Ad Interm, & Associate Dean for Undergraduate Programs*
- Sc.D., Massachusetts Institute of Technology, 1983
- Electrically mediated phenomena in tissues and biopolymers
- 1987 NSF Presidential Young Investigator
- 1990 Metcalf Award for Excellence in Teaching

Theodore Fritz, *Professor*
- 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 Dept. 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 Dept. of Astronomy and the Center for Space Physics)
- Ph.D., Boston University, 1971
- Low-light level optical instrumentation; signal processing in space physics; planetary atmospheres; GPS satellite communications; space plasmas in the solar system
- Fellow, American Geophysical Union

Peter O'Connor, *Research Assistant Professor*
- Ph.D., Cornell University, 1995
- Mass spectrometry instrumentation and applications
- Assistant Director, Mass Spectrometry Resource, Boston University School of Medicine

Eric Schwartz, *Professor*
- Ph.D., Columbia University, 1973
- Computational neural science; machine vision; neural anatomy; neural modeling

William Skocpol, *Professor*
(primary appointment with the Dept. of Physics)
- Ph.D., Harvard University, 1974
- Nanofabrication; device processing; transport experiments in materials

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; microprocessors; distributed digital networks
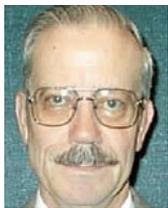
Richard Vidale, *Professor Emeritus*
- Ph.D., University of Wisconsin-Madison, 1964
- Modeling and simulation, software engineering

Moe Wasserman, *Professor Emeritus*
- Ph.D., University of Michigan, 1955
- Semiconductor processing, electronic circuits

Leopold B. Felsen, ECE Affiliated Professor, passed away on Sept. 24, 2005 at the age of 81.

Dr. Felsen joined the College of Engineering faculty in 1994, where he made significant contributions to the field of electromagnetics. His discoveries underlie the technology in every cell phone and Radiation and Scattering of Waves, the 1972 book he co-authored, is a standard text in the field. His pioneering work found application in other fields, such as optics and geophysics, which previously were thought to be unrelated.

Dr. Felsen earned his BS, MS and PhD in electrical engineering at the Polytechnic University of New York. The author of more than 300 research papers, Dr. Felsen was a member of the National Academy of Engineering and a life fellow of the Institute of Electrical and Electronics Engineers, which awarded him its Heinrich Hertz Medal for his theories advancing the study of electromagnetic waves. In 2003, he won the IEEE Electromagnetics Award. Dr. Felsen is survived by his son and daughter.

Fellows of Technical Societies

IEEE

John Bailleul	Ronald Knepper
Christos Cassandras	Lev Levitin
Floyd Humphrey	Bahaa Saleh
Mark Karpovsky	Malvin Teich

American Physical Society (APS)

David Campbell	Malvin Teich
Theodore Moustakas	

Optical Society of America (OSA)

Irving Bigio	Alexander Sergienko
Bahaa Saleh	Malvin Teich

Electrochemical Society (ECS)

Theodore Moustakas

American Institute for Medical & Biological Engineering (AIMBE)

Irving Bigio	Hamid Nawab

American Geophysical Union (AGU)

Michael Mendillo

Fellows of Technical Societies

American Society for Lasers in Medicine & Surgery

Irving Bigio

Acoustical Society of America

Malvin Teich

NSF PYI/CAREER Awards

Murat Alanyali	Thomas Little
Enrico Bellotti	Venkatesh Saligrama
Maja Bystrom	Joshua Semeter
Jeffrey Carruthers	Alexander Sergienko
Solomon Eisenberg	David Starobinski
Bennett Goldberg	Ari Trachtenberg
Martin Herbordt	Selim Ünlü
Prakash Ishwar	

ONR Young Investigators

Enrico Bellotti	Selim Ünlü
Venkatesh Saligrama	

PECASE Award

Venkatesh Saligrama

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. The following is a list of people who have helped the Department meet its teaching needs over the past year.

John Brackett, *SC518 (Spring 2006)*
• PhD, Purdue University, 1963

Babak Kia Montazan, SC464 (Spring 2006) & SC757 (Summer 2005 & 2006)
• MS, Boston University, 1996

Gerd Keiser, SC563 (Spring 2006)
• Ph.D., Northeastern University, 1973

Alan Pisano, SC463/464 (Fall 2005) & SC402 (Spring 2006)
• PhD, Northeastern University, 1974

Vladimir Kleptsyn, *SC578 (Fall 2005)*
• PhD, Moscow Lomonosov's Institute of Fine Chemical Technology, 1983

2.3 Research Staff

Name	Title	Advisor
Basilio Sanchez, Gilberto*	Visiting Scholar	Theodore Morse
Bertazzi, Francesco*	Research Assistant	Enrico Bellotti
Bhattacharyya, Anirban	Research Associate	Theodore Moustakas
Blixt, Maarten*	Senior Research Associate	Joshua Semeter
Bonato, Cristian	Research Assistant	Alexander Sergienko
Cabalu, Jasper	Research Assistant	Theodore Moustakas
Cohen, Reuven	Research Associate	David Starobinski
Friel, Ian*	Research Associate	Theodore Moustakas
Ippolito, Stephen*	Research Associate	Selim Ünlü
Jaspan, Martin	Senior Research Associate	Alexander Sergienko
Kotov, Valeri	Research Assistant Professor	David Campbell
Li, Xiaojun*	Research Assistant	Theodore Morse
Nasr, Magued	Research Associate	Malvin Teich/Bahaa Saleh
Nikiforov, Alexey	Research Associate	Theodore Moustakas
Qin, Xiangping	Research Associate	David Starobinski
Redjdal, Makhlouf	Research Associate	Floyd Humphrey
Shubochkin, Roman	Research Associate	Theodore Morse
Tsai, Shan Wen*	Research Assistant	David Campbell
Van Court, Thomas D	Research Associate	Martin Herbordt
Wong, Wai Yan	Research Assistant	Malvin Teich

* Completed appointment during 2005/2006

2.4 Administrative and Technical Staff

Administrative Staff

Marchioni, Carly	*Academic Programs Administrator*
Perez, Alfredo	*Grants Administrator*
Ryan, Gordon	*Senior Staff Coordinator*
Nabiel, Hemayat	*Assistant Director*
Santore, Catherine	*Communications Manager*
Rennie, Wayne	*Department Director*
McLaughlin, Mark	*Financial Administrator*

Technical Staff

Albro, Jeffrey*/open	*Systems Analyst/Administrator I*
Caine, Aaron	*Manager, Technology and Systems*
Berkovitch, Dan	*Systems Analyst/Administrator I*
France, Ryan	*MBE Laboratory Manager*
Kleptsyn, Vladimir	*Electronics/Circuits Laboratory Manager*
Open	*Laboratory Researcher*

* Resigned during 2005/2006

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 student 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 (Assoc. Chair, Grad) Nawab (Assoc. Chair, Undergrad) Little (CSE) Castañón (ISS) Ruane (Electro-Phys.) Sergienko (Electro-Phys.) Rennie (Director)	**Ünlü (Chair)** **Oliver (Assoc. Chair)** Alanyali Bellotti Bigio Ishwar Qin Sharif Taubin Trachtenberg	**Nawab (Chair)** Bystrom Carruthers Fahim Paiella Roziner Ruane Semeter Starobinski	**Saleh (Chair)** Herbordt Karpovsky Rennie (ex-officio) Saligrama Swan Teich	**Saleh (Chair)** Brower Castañón Hubbard Levitin Moustakas Rennie (ex-officio) Teich

Publicity, Special Events and Seminars	Industrial and Alumni Relations	Information Technology Committee	EK100 Advisors	Senior Design Advisors
Saleh (Chair) Konrad Kotiuga (RSS)* Paiella Qin Rennie Ryan Saligrama Santore Toffoli	**Saleh (Chair)** Horenstein Hubbard Knepper Oliver Pisano Rennie Skinner	**Little (Chair)** Bellotti Caine Giles Herbordt Hubbard Konrad Rennie Toffoli	Brower Bystrom Lee Little Oliver Paiella Ruane Starobinski Trachtenberg	Bystrom Carruthers Giles Horenstein Konrad Kotiuga Morse Pisano Qin Toffoli Ünlü

* *Research Spotlight Seminar*

2.6 Department Organizational Chart

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                                    ┌──────────┐
                                    │  Chair   │
                                    └──────────┘
                                         │
                        ┌────────────────┴──────────────────┐
                        │                              ┌──────────┐
                 ┌──────────────┐                      │ Director │
                 │   Faculty    │                      └──────────┘
                 │┌────────────┐│                            │
                 ││  Tenured   ││                      ┌──────────┐
                 ││  Faculty   ││                      │  Staff   │
                 │└────────────┘│                      └──────────┘
                 └──────────────┘
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Planning Committee

Area Coordinator	Area Coordinator	Area Coordinator	Associate Chair	Associate Chair
Electro-Physics	**Information Systems & Sciences**	**Computer Engineering**	**Graduate Committee**	**Undergraduate Committee**
- Solid-State Materials and Devices - Photonics - Electromagnetics - Space Physics	- Signal and Image Processing - Information & Decision Systems - Multimedia Processing - Communications Networks	- Computer Networks - Reliable Computing - High-Performance Computing - Software Engineering	- Admissions - Petitions - Awards - Exams - Curriculum - GTF's	- Curriculum - Labs - ABET - Awards - GTF's

Search Committee	**APT Committee**	**Publicity and Special Events**	**Industrial and Alumni Relations**	**Information Technology**
- Recruitment of New Faculty	- Appointment - Promotion - Tenure	- Annual Report - Brochures - Web Page	- Industrial Advisory Council - Co-Op Program	- IT Support for instructional and research labs and faculty and staff

2.7 ECE Representation in the College of Engineering and the University

College of Engineering Committee	Faculty
APT Committee	Karl, Little, Ünlü
Graduate Committee	Bigio, Horenstein, Ünlü
Scholarship Exam Committee	Ünlü
Undergraduate Committee	Carruthers, Nawab
Math Exam Committee	Bystrom, Kotiuga, Levitin
Student Conduct Committee	Levitin
Professional Practice Advisory Group	Knepper
COE Leap Advisor	Kincaid, Oliver

University Committee	Faculty
Faculty Council	Giles (Chair), Ünlü, Ruane
Faculty Council Compensation Committee	Ruane (Chair)
Patent Policy Committee	Moustakas, Ünlü
Student Conduct Committee	Ünlü
Research Activities & Libraries Committee	Ünlü
Laser Safety Committee	Ruane
Board of Student Council	Ünlü
Leadership Council Board of Trustees	Giles
Presidents Council on BU and the Global Future	Ünlü
Provost Faculty Advising Committee on Photonics	Bigio, Ünlü
Research Compliance Board	Ünlü

Advisory Group	Faculty
IEEE	Semeter
Minority Engineers' Society (MES)	Giles
Student Association of Graduate Engineers (SAGE)	Oliver
Society of Hispanic Professional Engineers (SHPE)	Castañón
Tau Beta Pi	Starobinski
Alpha Pi Omega	Ruane
Engineering House	Nawab

| Other Representation	Faculty
University Board of Trustees	Giles (member)
Center for Computational Science	Giles (Deputy Director)
Inauguration Honorary Advisory Committee	Giles (Co-Chair)

three: *Undergraduate Programs*

3.1 Academic Programs

The ECE Department continues to pride itself on developing a strong laboratory curriculum to accompany our classroom teaching for undergraduates. We continue to have excellent teaching labs with up-to-date equipment. Undergraduates are encouraged to become involved with research and development efforts in faculty labs through UROP (Undergraduate Research Opportunity Program), work study, or student employment. Engineering is an applied science, and we believe it is important to start applying what is learned in the classroom as soon as possible.

We continued improving our undergraduate programs this year. This process includes student surveys, student feedback forums, faculty review of courses and outcomes, and implementation of curriculum changes aimed at improving program outcomes.

The capstone design project provides our graduating seniors with real engineering experience and the student projects have continued to be outstanding, with several projects receiving awards. (See page 6 for more details).
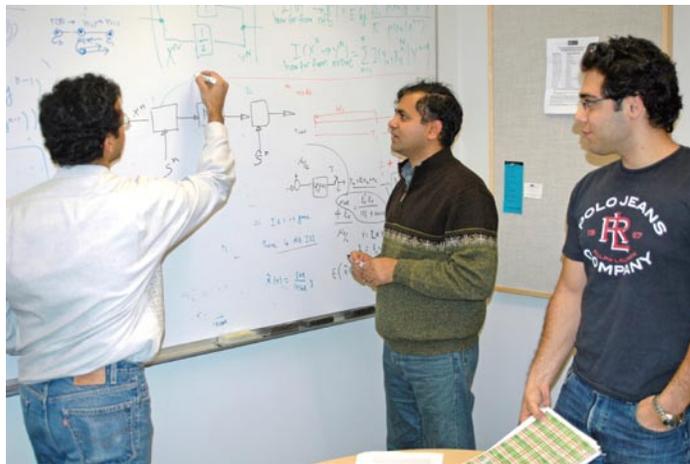
Professors Prakash Ishwar and Venkatesh Saligrama discuss distributed source coding for sensor networks with graduate student Ehsan Afkhami.

Enrollment and Degrees Awarded

Fall 2005 Enrollment

	Electrical	Computer Systems	Total
Freshmen*	26	20	46
Sophomores*	27	29	56
Juniors	50	16	66
Seniors	72	33	105
Total	**175**	**98**	**273**

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

Degrees Awarded

Electrical Engineering	65
Computer Systems Engineering	29
Total	**94**

Honors Students

Summa Cum Laude	11
Magna Cum Laude	14
Cum Laude	13
Total	**38**

ECE Advising Day

Continuing a tradition initiated in 1998, each semester an ECE Advising Day was held prior to the beginning of the web-based registration period. This year we held a student feedback forum (co-sponsored by the BU chapter of the IEEE) each semester to give ECE students (mostly juniors and seniors) the opportunity to voice their concerns and suggestions for improvements in our undergraduate programs. The main highlights of their feedback were:

• More experience with MATLAB desired in the freshman year.

• A course in technical writing/communication recommended.

• Dissatisfaction expressed with Introductory Physics and Chemistry courses.

• More faculty involvement desired in Senior Project courses.

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, and ethics.

ECE Teaching Award 2005/2006

Professor Wei Qin, right, was the winner of the 2006 ECE Award for Excellence in Teaching. He received the award for outstanding teaching evaluations from his students for the first course he taught at Boston University and even better teaching evaluations the second time he taught the same course; as noted by his students, his lectures were always well prepared and organized; and his extensive availability outside the classroom and the genuine care he shows for the learning process.

The ECE Department instituted this award during the 1997-98 academic year 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 $1,000 prize to be used towards instructional activities. A committee of ECE professors and students evaluated the nominees, using teaching statements, classroom material and student comments, and sitting in on classes. The 2006 ECE Teaching Award Committee, chaired by Professor Nawab, recommended this award.

3.2 Instructional Laboratories

Expenditures for Instructional Laboratories 2005-2006

Facility	Equipment	Approximate Cost
Microprocessor Lab and Software Engineering Lab	Lab kits, workstation upgrades, software licenses, maintenance, etc.	$21,653
VLSI Lab and Signals/ Networks Lab	Software licenses, maintenance, etc.	$86,457
Electronics Lab	Oscilloscopes, lab kits, electronics kits, maintenance, etc.	$63,348
Senior Design Lab	Workstations, software licenses, etc.	$2,252
Other	General infrastructure upgrades, supplies, licenses, etc.	$37,299
Total		**$211,009**

Instructional Laboratories

Control Systems Laboratory

This laboratory houses four 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

The VLSI Instructional Laboratory of the Department of Electrical and Computer Engineering (ECE) is involved in almost all aspects of digital design. We have a wide range of CAD tools available for student use, including Cadence, Synopsys, and the NCSU Design Toolkit. *Herbordt, Hubbard, Kincaid, Knepper, Roziner, Taubin*

Electronics Laboratory

The Electronics Laboratory has 30 stations, each equipped with a PC, GPIB-controlled Agilent test instruments and National Instruments ELVIS development stations linked by LabVIEW. Sixteen stations have new LeCroy digital scopes. New Agilent MSO mixed signal oscilloscopes are being added in summer 2006. This facility supports introductory ECE cours-

es in circuits and electronics with modern industry-standard equipment and software. The lab also supports more advanced experiments in signals and systems, communications, electromagnetics, and photonics. Senior design and project students use the lab on an open basis, and freshman EK131/132 modules are held here. A small parts window sells common discrete components. OrCAD software including PSpice supports circuit simulations, schematic capture and PCB layout. *Nawab, Carruthers, Fahim, Horenstein, Knepper, Kotiuga, Lee, Oliver, Roziner, Ruane, Sergienko*

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, Brower*

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, ENVI and LabVIEW. The HTTTL supports freshman

EK131/132 modules in imaging and subsurface imaging, senior design capstone projects in imaging, and experiments in senior level electives related to imaging. The lab also hosts summer research through UROP, REU, RET and High School Honors programs. Some undergrads are supported during the academic year to work on improving stations in the HTTTL. *Ruane*

IMSIP Instructional Laboratory

This laboratory serves graduate instructional needs of the department in the areas of multidimensional signal processing (including image and video processing), statistical signal processing, pattern recognition, as well as earth and space sciences. The laboratory provides advanced computational resources and associated software packages. Fast, dual processor workstations connected through a gigabit network form a computational backbone while high-capacity monochrome and color printers serve the hardcopy needs. State-of-the-art processing and optimization software is available. This laboratory was developed with funds from the National Science Foundation, and is currently being upgraded with departmental funds. *Karl, Konrad, Nawab, Oliver*

Microprocessor and PC Laboratory

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

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 interface (SCI), and distributed shared memory; network of workstations (NOW), case studies of high performance scalable networks, and cluster computing. *Karpovsky*

Photonics Laboratory

The Photonics Instructional Laboratory supports introductory and intermediate level courses in the MS in Photonics program. Four stations each have a vibration isolated optical table, HeNe and semiconductor lasers, fiber components and systems, electronic test equipment, and GPIB-connected PCs for LabVIEW 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, Bigio, Morse, Paiella, Saleh, Teich, Ünlü*

RF Measurements Lab

The RF Measurements Lab provides an opportunity to train students in advanced radio frequency experimental techniques. The lab contains up-to-date high frequency equipment for testing RF printed circuit boards, MMICs, and other high frequency components in the frequency range 100 MHz to 26 GHz. The lab is used for both undergraduate and graduate instruction for courses SC580 and SC582, as well as for research in coupled electrical substrate noise effects in RF/mixed-signal IC technology. Included in the RF Measurements Lab are recent Agilent high frequency tools: a 26-GHz vector network analyzer, 26-GHz spectrum analyzer, high frequency oscilloscope, and RF signal generator. Students use the equipment to learn the basics of S-parameter measurements, as well as characterization of RF mixers, VCOs, amplifiers, and other components. *Knepper*

Senior Project Laboratory

This lab supports our senior design teams, serving real-world customers such as NASA, Analog Devices, Boston public schools, social service agencies, artists, and small businesses, as well as 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 crosscompilers for DSP and micro-controller development. Software from MSDNAA is available for all teams. *Ruane, Knepper, Pisano*

Signals and Networks (SIGNET) Laboratory

This laboratory provides instructional facilities for courses in the areas of signal processing and communication networks. This laboratory houses numerous workstations for digital signal processing, image processing, and various real-time applications covering the complete audio frequency spectrum. Equipment includes Linux-based workstations, 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), SC415 (Communication Systems), SC416 (Intro to Digital Signal Processing), SC 512 (Digital Signal Processing), and some ECE modules in EK130 (Introduction to Engineering). On the communications side, experiments involving data communication links, local-area networks, and wide-area

networks are supported. 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. *Bystrom, Carruthers, Kincaid, Konrad, 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 and embedded computerbased 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. *Skinner, Brackett, Herbordt, Taubin, Toffoli, Trachtenberg*

3.3 Undergraduate Courses

Course Number	Title	Fall 05	Spring 06	Summer 06
EK131/EK132	Intro to Engineering	Lee Trachtenberg Kincaid Ruane	Lee Konrad Toffoli	
EK307	Electric Circuit Theory	Fahim Fahim	Fahim Roziner Semeter Fahim	Redjdal
EK440	Intro to Electronic Systems		Horenstein	
EK317	Circuit Theory I	Oliver		
EK318	Circuit Theory II		Kotiuga	
SC311	Intro to Logic Design	Roziner Roziner	Roziner Roziner	Freedman, David
SC312	Computer Organization	Taubin Qin	Herbordt	
SC330	Applied Algorithms	Brower	Trachtenberg	
SC381	Probability Theory in ECE		Castanon	
SC401	Signals and Systems	Kincaid	Bystrom	Nawab
SC402	Control Systems		Pisano	
SC410	Intro to Electronics	Horenstein Lee Lee Knepper Kotiuga	Lee	Kleptsyn
SC412	Analog Electronics		Sergienko	
SC415	Communication Systems	Carruthers		
SC416	Intro to Digital Signal Processing	Nawab	Nawab	
SC440	Intro to Operating Systems	Skinner	Skinner	
SC441	Intro to Computer Networks	Starobinski	Alanyali	
SC447	Software Design		Skinner	
SC450	Microprocessors	Giles	Giles Toffoli	
SC455	Electromagnetic Systems I	Semeter	Lee	
SC456	Electromagnetic Systems II		Kotiuga	
SC463	Senior Design Project I	Ruane Pisano	Little	
SC464	Senior Design Project II	Ruane	Knepper Montazam	
SC471	Physics of Semiconductor Devices	Moustakas	Swan	
SC500	Special Topics in ECE	Little	Ishwar Saleh	
SC501	Dynamic Systems Theory	Dupont		
SC505	Stochastic Processes	Saligrama	Saligrama	
SC513	Computer Architecture	Herbordt		
SC514	Simulation	Vakili		
SC515	Digital Communication	Ishwar		
SC516	Digital Signal Processing	Bystrom		
SC518	Software Project Management		Brackett	
SC520	Image Processing and Communication	Konrad		
SC524	Optimization Theory and Methods	Paschalidis		
SC533	Intro to Discrete Mathematics	Levitin		
SC534	Discrete Stochastic Models		Levitin	
SC535	Intro to Embedded Systems		Qin	
SC541	Computer Communication Networks	Alanyali	Starobinski	
SC551	Advanced Digital Design	Taubin		
SC560	Intro to Photonics	Teich	Teich	
SC561	Error-Control Codes	Karpovsky		
SC563	Fiber-Optic Communication Systems		Keiser	
SC566	The Atmosphere and Space Environment		Oliver	
SC570	Lasers		Unlu	
SC571	VLSI Principles and Applications	Hubbard	Hubbard	
SC575	Semiconductor Devices	Bellotti		
SC577	Solid State Devices		Paiella	
SC578	Fabrication Technology for Integrated Systems	Klepstyn		
SC579	Microelectronic Device Manufacturing		Cole	
SC580	Modern Active Circuit Design	Knepper		
SC582	RF/Analog IC Design Fundamentals		Knepper	
SC599	Advanced Laboratory Topics in ECE	Paiella		

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 real-life customers, who are drawn from industry, small businesses, community groups, and faculty and staff. Students learn design methods, project management, team dynamics, communication skills, and legal and ethical standards for design. A substantial first-deliverable milestone and oral presentation complete the first semester.

The second semester is spent in the Senior Project Laboratory. 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. The year culminates in student project presentations on ECE Day to faculty, industry representatives, and fellow students. On May 1, 2006, 21 teams and two BS Honors Thesis students presented their projects in two parallel sessions. Best presentation awards for each session were presented at luncheon for faculty, customers and seniors.

2006 P.T. Hsu Award

For their successful, working FPGA-based engine control module that went beyond the original customer specifications and their admirable team dynamics, Simon Au, Tina Chu, Eddie Lau, and Richard Yu of Team Designex received the 2006 P.T. Hsu Award.

Since 1982, ECE has honored Professor P.T. Hsu by acknowledging the best overall ECE capstone design project with the P.T. Hsu Award. A faculty committee considers degree of success, difficulty, scope, creativity, cost, project communications, and team effectiveness.

2006 GE Imagination Award

The SmarTrash team of Joseph D'Errico, Andrew Hagedorn, Yaniv Ophir, and Vyas Venkataraman won the 2006 GE Imagination Award for designing trash cans that can communicate with each other and to a central point when they need to be emptied (displaying both full and overflowing status). In its inaugural year, the GE Award is given to the team whose project best exemplifies imagination and creativity. The SmarTrash project's creativity also garnered the team an invitation to attend a park services trade show in New York City and won them honorable mention at the CSIDC 2006 world finals.

Notable Senior Projects 2005-2006

Team 10 SmarTrash members: Yaniv Ophir, Joseph D'Errico, Andrew Hagedorn, and Vyas Venkataraman. Winners of 2006 GE Imagination Award and honorable mention at the CSIDC 2006 world finals.

SmarTrash for Cleaner Parks

Trash is big money and trash collection from public parks is a serious budget drain. The SmarTrash team addressed this issue by designing a trash can that can sense when it's full and communicate this information to a central network, enabling targeted trips to only those trash cans which are full.

The cans sense when they are full by using two types of infrared sensors. Infrared light emitting diodes and phototransistors examine a plane at the top of the trashcan, and an infrared distance sensor looks down into the trashcan from the lid.

The trash cans are networked together with Crossbow MICA2 motes, which enables multiple sensors distributed over a large area to wirelessly transmit data to a central server. The data is forwarded from trash can to trash can until it reaches the main server and the motes figure out how to form the most efficient network by themselves.

"Each trash can acts as a node in the network. The trash cans themselves form the network, so you don't need any external hardware," said Ophir. The motes can perform multihopping, which allows a mote out of range of the server to pass its information from mote to mote until it is within range. The network can also heal itself by bypassing motes that are damaged to find alternative routes.

The server displays trash can status via a Google Maps-based web interface. Each status has an icon; green for empty, yellow for almost full, red for full, and an exclamation point for maintenance. To view the status of cans throughout the park, the user refreshes the map, which triggers the motes to send the latest information to the server.

"We reported a 99.3% ability to report the data back with one failed attempt," said D'Errico.

FPGA-Based Engine Control Module

Project customer Andrew Watchorn of National Instruments wanted to show the company's LabVIEW FPGA development platform at trade shows by designing an Engine Control Modules (ECM) to control the steering, throttle, cruise control, gear shifting, speedometer, head lights, break lights, and turn signals of a fuel-powered, radio-controlled (RC) car.

A PlayStation controller wheel replaced the standard RC controller for a more realistic driving experience. The students created the software so that the FPGA translates the PlayStation controller signal into a signal that the RC car accepts. The team also created the user interface for the computer to monitor the car functions controlled by the ECM.

"Our system is adjustable and we can fine-tune it regarding how much it turns and other things," said Eddie Lau. The software they designed could be adapted for use on any RC car, a good thing since the car used in their project crashed head-on into a brick wall shortly before ECE Day.
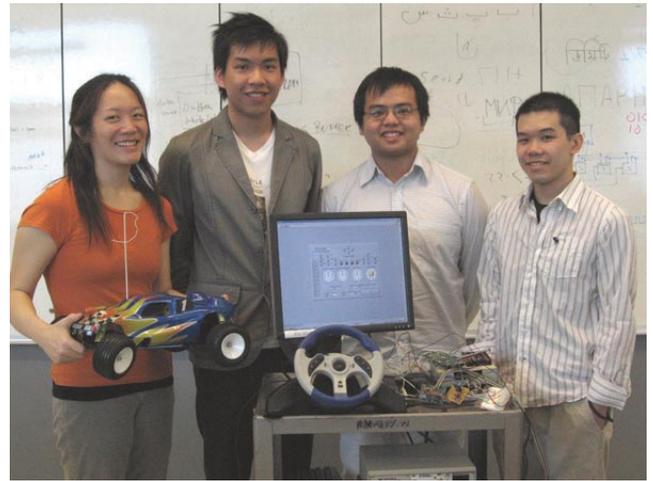

Team 15 Designex members: Tina Chu, Simon Au, Eddie Lau, and Richard Yu. Winners of 2006 P.T. Hsu Award.

eMouse for Felines

The mouse is encased in black fiberglass, with proximity sensors in the front and back, which keep the eMouse from bumping into walls or furniture and from running over hapless cats. The sensors create a 12-inch acoustic bubble around the mouse, which gives the toy reaction time to change direction. If the mouse does not sense any obstacles, it will move around the room semi-randomly.

The mouse has a dual-motor control system for precise turning and a radio frequency device for remote detection. The remote control makes the mouse more user friendly with an on/off switch and a locator noise.

This senior project, ordered by customer Professor Maja Bystrom, required that the mechanical mouse weigh less than a pound, and run on hardwood and tile floors for at least two hours on rechargeable lithium ion batteries.
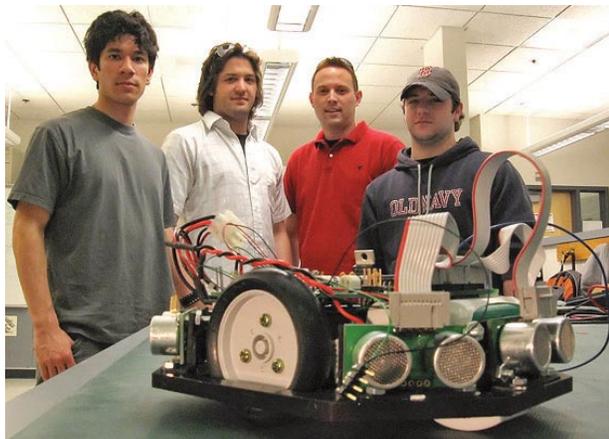
Team 13 Mousetronics members: Jonathan Tang, Michael Waecker, Jason Adams, and Aaron Wyand. Winners of the ECE Day Best Presentation Award.

Wireless Diving Board Displacement Sensor

DiveIT developed a system that provides divers with performance feedback by plotting the displacement of a diving board. Their customer, Professor Bennett Goldberg, required the system to be wireless, easy to install without affecting board dynamics, and able to display information on a laptop. The team waterproofed a Wireless Inertial Sensor (WIS), which can be attached to a diving board with a velcro strap. The user interface provides a displacement versus time graph, which can be saved to compare it with future dives.

Professor Babak Kia presents ECE Day Best Presentation awards to Team 4 DiveIT members Fernando Trindade, Eric Blanchard, Jeffrey Borrelli, and Chris Maloof.

3.5 Student Activities

The ECE Department supports two active undergraduate students groups, an IEEE Student Section and the Eta Kappa Nu honor society. These groups 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 2005-2006 are detailed below.

IEEE Meetings with Guest Speakers

Computer Algorithms and Airline Pricing Talk

Todd Williams, a senior computer scientist at ITA Software, spoke on the structure of the airline industry, how tickets are priced and sold, and some of the reasoning behind the complexity in airline price structures. The talk introduced some recent projects at ITA, both deployed and in development, to show how the company continues to tackle challenging problems and revolutionize the travel industry.

Heather Schmidt, BAE Systems, on Career Development

Heather Schmidt, a College of Engineering graduate, spoke on career development and utilizing career resources. In addition, she talked about what it is like to work for a defense contractor and about BAE Systems and their Engineering Leadership Program.

Elliot Ranger, Draper Lab, on low-powered electronics in robotic projects.

Educational and Other Activities
• Q&A - Inside Info about Classes
• Halo Tournament

Eta Kappa Nu Honor Society

The Kappa Sigma Chapter of Eta Kappa Nu (HKN), the National Society of Electrical and Computer Engineering, was established at Boston University in 2003. As a newly established chapter, HKN is expanding its mission to help students achieve their academic goals with its ECE tutoring program in which the members of HKN volunteer their time to help undergraduates in their coursework. Group activities also included an introduction dinner for new members; a talk about the financial comparisons of entering the work force versus entering graduate school; and a BAE recruiting event where members could discuss opportunities with the company.

3.6 Continual Program Improvement

Improvement cycles for our undergraduate programs continued during AY 2005/06. The highlights this year were:

• Responding to prior feedback from ECE undergraduates that the probability and statistics material is not well integrated into our curriculum, a new course, Probability for Electrical & Computer Engineers (SC381), was introduced as a requirement in both of our programs and taught for the first time in Spring 2006 by Professor David Castañón. This course is designed to introduce students to basic probability concepts while pointing out their relevance to EE and CSE applications (e.g. packet-switched networks, optical systems, and signal detection in noise). The course has circuit theory and logic design as pre-requisites in order to ensure that students can understand how probability is relevant in ECE applications.

• In response to student and faculty feedback about insufficient MATLAB preparation in the freshman year, a new Introduction to Engineering Computation (ENG EK 127) was introduced. This course relies solely on MATLAB to teach programming concepts and their application to engineering problems. For CSE majors, the teaching of C++ is postponed till the data structures course.

• Student surveys were conducted to collect and analyze data on student perceptions of how well our programs are achieving their outcomes.

• Student feedback forums were held in the Fall and Spring semesters for ECE students to express their concerns and suggestion for improvements in the EE and CSE programs.

• Several ECE courses used the cellular phone as a common theme, with an objective to enhance the ability of our students to attain an integrated view of the curriculum.

four: *Graduate Programs*

4.1 Course and Program Development

The ECE Department continues to refine the graduate curriculum, with several new courses developed and offered during 2005-2006. In addition, several courses that were developed as special topics in 2004-2005 were approved to become part of the regular curriculum and were assigned course numbers.

In Fall 2005, four new courses were offered: SC500/MN500 Networking the Physical World by Professor Little; SC599 Photonics Lab I by Professor Paiella; BE700/SC700 Advanced Optical Microscopy and Biological Imaging by Professor Mertz; and SC700 Personal Knowledge Engineering Project by Professor Toffoli.

Three more new courses were offered in Spring 2006: SC500 Statistical Theory of Communication by Professor Ishwar; SC500 Introduction to Subsurface Imaging by Professor Saleh; and SC700 Nanophotonics by Professor Dal Negro.

During the year, several courses that were originally developed as special topics (SC500, SC599 and SC700) were given course numbers and entered into the course inventory:

- SC512 Enterprise Client-Server Software Systems Design (Phase in date: Fall 06)
- SC535 Intro to Embedded Systems (Phase in date: Spring 06)
- SC544 Networking the Physical World (Phase in date: Fall 06)
- SC569 Intro to Subsurface Imaging (Phase in date: Fall 06)
- SC591 Photonics Lab I (Phase in date: Fall 06)
- SC707 Radar Remote Sensing (Phase in date: Spring 07)

In Spring 2006, SC577 Solid State Devices was revised to better integrate it into the curriculum, resulting in a new course, SC574 Physics of Semiconductor Materials with a phase in date of Fall 2006. The change in number, as well as updated course content and title, was made to better reflect the course sequence, as SC575 Semiconductor Devices is the next logical course students should take.

In addition to adding courses to the curriculum, an overhaul of the current course inventory was made. After looking at the entire course inventory for ECE, including cross-listed courses, the obsolete courses were made inactive in the course inventory. Obsolete courses were also removed from the MS program planning sheet.

4.2 Graduate Student Recruitment

Five PhD students were awarded Dean's Research Fellows (DRF) and began matriculation in Fall 2005. Four of these students will be continuing their degree programs and are making excellent progress. Eighteen graduate students began matriculation in Fall 2005 with Graduate Teaching Fellowships (GTF) and 14 of these students were offered Research Assistantships for the Fall 2006 semester. We have also recruited four new DRFs, 11 new GTFs, and one Photonics Fellow for the Fall 2006 semester.

We received 613 applications for the Fall 2006 semester, up from 557 in Fall 2005. There was a total of 324 admits, with 265 MS admits (116 of these applied for the post-BS PhD program), 39 post-BS PhD admits, and 20 post-MS PhD admits. This is in comparison to Fall 2005, which had a total of 310 admits, with 246 MS admits (105 of these applied for the post-BS PhD), 38 post-BS PhD admits, and 26 post-MS PhD admits.

As can be seen from these numbers, the admissions process continues to be much more selective in respect to PhD students than it has been in the past. Our requirement that PhD applicants have a clear path to continued financial aid has resulted in a large decrease in the number of PhD admits. In Fall 2004, there were a total of 274 PhD admits, compared with a total of 64 in Fall 2005 and 59 in Fall 2006. In Fall 2005, 26 students began their PhD program in ECE, which is in accordance with the estimate that was made after the revisions to the admission process in 2004-2005 (about 20-30 PhD students begin matriculating each year).

For the second year in a row, ECE held two open house events instead of one. This allowed for more non-local applicants to be invited. The events were held on back-to-back weekends with a similar agenda to those of the last two years. Between

Professor Murat Alanyali and graduate student Ashraf Al Daoud discussing control mechanisms for data networks.

both weekends, a total of 28 applicants were in attendance, 16 of whom were non-local attendees. An extra effort was made to invite those applicants being seriously considered for some kind of funding. In the end, 23 of the 28 attendees received an offer of aid.

4.3 PhD Graduate Student Progress

The number of PhD graduates per year is an important measure of the strength of the graduate programs. Last year we saw the results of the procedural improvements implemented by the Graduate Committee to keep the progress of the PhD students on track. Our requirement that students must pass the PhD prospectus within two years of PhD candidacy was intended to guide the students to identify dissertation topics, focus on their research, and reach their degrees in a timely manner. The chart below shows the number of PhD students achieving candidacy, completing prospectus defense, and graduating over the last four academic years. While the number of new PhD candidates is steady at around 20 per year, those completing their prospectus have increased rapidly,

reaching the steady value of about 20 per year. This year, after a predicted time-lag, the number of PhD graduates reached 15 students. We expect that the departmental goal of 20 PhD graduates per year is easily attainable within the next several years.

4.4 Colloquia and Seminars

The ECE Colloquium Series and the Research Spotlight Series (RSS) continued for another successful year. Prominent speakers from both inside and outside the University gave research talks on current issues. Graduate students continued to attend and contribute to both the Colloquium Series and RSS.

A list of speakers for the academic year for these two seminar series, as well as other relevant seminars, is given on pages 4-14 through 4-16.
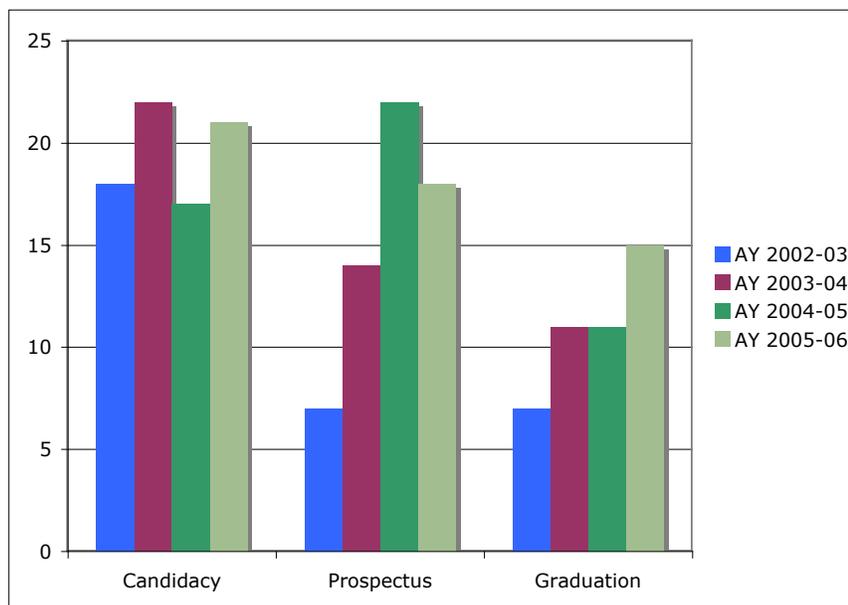
4.5 New Matriculants

New Students Entering 2005-2006

		Male	Female	FT	PT	GTF	RA	Fellow	DRF
MS	US	18	4	19	3	0	0	0	1
	Intl.	14	5	18	1	2	0	0	0
Ph.D.	US	7	0	7	0	6	3	0	0
	Intl.	14	5	19	0	10	6	0	5
Total		**53**	**14**	**63**	**4**	**18**	**9**	**0**	**6**

Fall 2005 Mean GRE Scores

		Verbal	%	Quantitative	%	Analytical	%	Analytical Writing	%
MS	US	513	59	743	78	770	92	4.6	55
	Intl.	494	55	760	86	705	92	4.2	42
PhD	US	548	69	779	87	710	82	5.0	68
	Intl.	471	48	769	89	732	86	4.1	39
Mean		**507**	**74**	**763**	**85**	**729**	**88**	**4.5**	**51**

Spring 2006 Mean GRE Scores

		Verbal	%	Quantitative	%	Analytical	%	Analytical Writing	%
MS	US	498	57	725	75	590	75	4.0	44
	Intl.	510	56	771	85	----	---	4.0	43
PhD	US	438	41	745	80	----	---	4.0	39
	Intl.	325	13	760	81	----	---	4.0	42
Mean		**443**	**42**	**750**	**80**	**590**	**75**	**4.0**	**42**

4.6 MS Students

Student Name	Advisor	Research Area or Thesis Title
Al Masri, Marwan*	Taubin, Alexander	Computer Systems Engineering
Aldridge, John*	Ruane, Michael	Photonics
Alelis, Jonathan	Starobinski, David	Computer Systems Engineering
Atkinson, John*	Kincaid, Thomas	Photonics
Ayache, Maurice	Teich, Malvin	Electrical Engineering
Ayoade, Kolawole*	Alanyali, Murat	Computer Systems Engineering
Banguero, Edgar	Starobinski, David	Computer Systems Engineering
Browning, Cassandra	Trachtenberg, Ari	Computer Systems Engineering
Byrnes, John	Semeter, Joshua	Electrical Engineering
Cao, Huanwen*	Konrad, Janusz	Electrical Engineering
Capozzi, Stephen	Semeter, Joshua	Electrical Engineering
Carssow, Douglas*	Hubbard, Allyn	Electrical Engineering
Chaipipakorn, Panupong	Giles, Roscoe	Electrical Engineering
Chan, Chun-Wei*	Konrad, Janusz	Electrical Engineering
Colson, Jeremy	Ünlü, M Selim	Electrical Engineering
Conte, Matthew	Bellotti, Enrico	Electrical Engineering
Cunha, Michael*	Bellotti, Enrico	Electrical Engineering
Datta, Michael	Horenstein, Mark	Electrical Engineering
DiSabello, Douglas*	Herbordt, Martin	Fault Tolerant FPGA C0-Processing Toolkit
DiSimone, Christopher*	Saligrama, Venkatesh	Electrical Engineering
Dobson, Jennifer*	Bigio, Irving	The Limitations of Mie Theory for Light Scattering Measurements on Cells
Doros, Michael*	Little, Thomas	Computer Systems Engineering
D'Orsogna, Danilo*	Bellotti, Enrico	Electrical Engineering
Dorta-Quinones, Carlos	Hubbard, Allyn	Electrical Engineering
Dutta, Madhuparna*	Paiella, Roberto	Electrical Engineering
Eizenberg, Zvi	Konrad, Janusz	Electrical Engineering
El Jamous, Ziad	Konrad, Janusz	Electrical Engineering
El Katerji, Ahmad*	Giles, Roscoe C	Computer Systems Engineering
Fan, Chunxia	Alanyali, Murat	Electrical Engineering
France, Ryan*	Moustakas, Theodore	Metal Contacts to GaN and its Alloys With AlN
Garnier, Robert*	Taubin, Alexander	Position and Orientation Tracking with the Extended Kalman Filter using 3D LADAR Imagery
Gioux, Sylvain*	Bigio, Irving	Photonics
Gore, Siddarth	Castañón, David A	Computer Systems Engineering
Graham, Matthew	Hubbard, Allyn	Computer Systems Engineering
Guo, Song	Alanyali, Murat	Computer Systems Engineering
Han, Shih-Yen*	Oliver Jr, William	Electrical Engineering
Hashim, Zaileena*	Kincaid, Thomas	Electrical Engineering
Hemdan, Wael*	Knepper, Ronald	Active Substrate Noise Suppression Circuit in Advanced 0.18um SiGe BiCMOS Technology for High Performance RF/Mixed-Signal SOC Applications
Hsieh, Lung-Chang	Konrad, Janusz	Electrical Engineering
Hsu, Hong-Jen*	Trachtenberg, Ari	Electrical Engineering
Huang, Chiao-Chi*	Herbordt, Martin	Computer Systems Engineering
Ignjatovic, Milena*	Carruthers, Jeffrey	Electrical Engineering
Issa, Jerome*	Teich, Malvin	Electrical Engineering
Itkowitz, Brandon	Castañón, David	Electrical Engineering
Jain, Ashish*	Karl, William C	Crosstalk-aware Design of Anti-alias Filters for 3D Automultiscopic Displays
Joo, Eduardo	Taubin, Alexander	Computer Systems Engineering
Ke, Yuqing	Trachtenberg, Ari	Computer Systems Engineering
Kurata, Cathy*	Starobinski, David	Computer Systems Engineering
LaBossiere, Michael*	Qin, Wei	Computer Systems Engineering
Li, Meng	Bellotti, Enrico	Electrical Engineering
Li, Ning*	Morse, Theodore	Intra-Cavity Fiber Laser for Measurement and Sensing Applications
Li, Rui	Swan, Anna	Electrical Engineering
Lin, Tzu-Yung	Knepper, Ronald	Electrical Engineering

Student Name	Advisor	Research Area or Thesis Title
Liu, Jie*	Hubbard, Allyn	Computer Systems Engineering
Liu, Ming-Chieh	Trachtenberg, Ari	Computer Systems Engineering
Liu, Si Ming*	Alanyali, Murat	Electrical Engineering
Mahmood, Noveira	Bystrom, Maja	Electrical Engineering
McClure, Marc*	Skinner, Thomas	Computer Systems Engineering
Menekse, Cem	Starobinski, David	Computer Systems Engineering
Menn, Steven*	Ünlü, M Selim	Silicon Photodiodes for Wireless Opto-electrical Stimulation of Neural Tissue
Meydbray, Yevgeny*	Bellotti, Enrico	Novel Approach to Subsurface Imaging and Microlens Translation
Misic, Mead*	Ünlü, M Selim	Electrical Engineering
Mitchell, Brian*	Carruthers, Jeffrey	Electrical Engineering
Mitsch, Patrick*	Carruthers, Jeffrey	Computer Systems Engineering
Model, Joshua	Castañón, David	Electrical Engineering
Nasveschuk, Peter*	Bellotti, Enrico	Electrical Engineering
Nintanavongsa, Prusayon*	Levitin, Lev	Electrical Engineering
Owen, Russell*	Bellotti, Enrico	Joint Opening Effect Avalanche Photodiode: Dark Current and 1.55 μm Optical Beam Simulations in ISE TCAD
Patel, Mitul*	Karpovsky, Mark	Computer Systems Engineering
Petrova, Mariya*	Nawab, Syed Hamid	Electrical Engineering
Powers, Matthew*	Carruthers, Jeffrey	Computer Systems Engineering
Quesnel, Justin*	Ünlü, M Selim	Electrical Engineering
Raghunath, Savitha	Little, Thomas	Computer Systems Engineering
Rahman, Rashedur*	Castañón David	Electrical Engineering
Ramakrishnan, Karthik	Trachtenberg, Ari	Computer Systems Engineering
Reese, Gilbert	Carruthers, Jeffrey	Computer Systems Engineering
Rinard, Katherine	Taubin, Alexander	Computer Systems Engineering
Rodehorst, Michael	Castañón, David	Electrical Engineering
Rodi, Stephen	Brackett, John	Computer Systems Engineering (BS/MS)
Romaniuk, Alex	Konrad, Janusz	Electrical Engineering
Rosales Garcia, Andrea	Morse, Theodore	Photonics
Rosson, Richard	Oliver Jr, William	Electrical Engineering
Said, Mohamad*	Nawab, Syed Hamid	Computer Systems Engineering
Sexton, Patrick	Herbordt, Martin	Computer Systems Engineering
Shagam, Michael	Paiella, Roberto	Electrical Engineering
Shah, Kartik	Taubin, Alexander	Electrical Engineering
Sheth, Sameep	Starobinski, David	Computer Systems Engineering
Singh, Angad	Trachtenberg, Ari	Computer Systems Engineering
Siraj-Eddin, Yaser	Ishwar, Prakash	Electrical Engineering
Spasov, Dejan*	Trachtenberg, Ari	Computer Systems Engineering
Srinuanchai, Worrawat*	Bystrom, Maja	Computer Systems Engineering
Steele, Joshua*	Teich, Malvin	Electrical Engineering
Subramanian, Krishnakumar*	Castañón, David	Techniques for Detection of Text in Photo Images and Video Frames
Succari, Tala	Alanyali, Murat	Computer Systems Engineering
Thammanomai, Apisate	Qin, Wei	Computer Systems Engineering
Thulin, Lukas*	Levitin, Lev	Photonics
Tin Maung, Latt*	Hubbard, Allyn	Computer Systems Engineering
Voss, David	Fahim, Azza	Electrical Engineering
Wang, Chun-Kai*	Levitin, Lev	Computer Systems Engineering
Wang, Yang*	Bellotti, Enrico	Electrical Engineering
Wang, Zhen	Roziner, Tatyana	Computer Systems Engineering
Ward, Nicole*	Kincaid, Thomas	Electrical Engineering
Westfried, Jerome*	Carruthers, Jeffrey	Computer Systems Engineering
Wong, Wai Yan*	Ünlü, M Selim	Photonics
Yap, Holson Adi*	Taubin, Alexander	Computer Systems Engineering
Zhalehdoust-Sani, Yashar	Ruane, Michael	Electrical Engineering
Zhang, Chen	Starobinski, David	Computer Systems Engineering

Degree receieved in 2005/2006

4.7 PhD Students

Student Name	Advisor	Research Area or Thesis Title
Abell, Joshua	Moustakas, Theodore	Electrical Engineering
Aeron, Shuchin	Saligrama, Venkatesh	Electrical Engineering
Agarwal, Ashish	Little, Thomas	Computer Engineering
Agarwal, Sachin*	Trachtenberg, Ari	Efficient Reconciliation of Unstructured and Structured Data Over Networks
Al Daoud, Ashraf	Alanyali, Murat	Computer Engineering
Almeida, Nuno	Bellotti, Enrico	Electrical Engineering
Atia, George	Saligrama, Venkatesh	Electrical Engineering
Bach, Edward	Toffoli, Tommaso	Computer Engineering
Bergstein, David	Ünlü, M Selim	Electrical Engineering
Beriont, Walter	Levitin, Lev	Computer Engineering
Borogovac, Tarik	Carruthers, Jeffrey	Systems Engineering
Bozinovic, Nenad	Ünlü, M Selim	Electrical Engineering
Bozinovic, Nikola*	Konrad, Janusz	Advanced Motion Modeling for 3D Video Coding
Butler, Thomas	Saligrama, Venkatesh	Electrical Engineering
Byrnes, John	Semeter, Joshua	Electrical Engineering
Cabalu, Jasper*	Moustakas, Theodore	Development of Fan-Based Ultraviolet and Visible Light-Emitting Diodes using Hydride Vapor-Phase Epitaxy and Molecular Beam Epitaxy
Campbell, Bryan	Ruane, Michael	Computer Engineering
Carssow, Douglas	Hubbard, Allyn	Electrical Engineering
Chandrasekaran, Ramya	Moustakas, Theodore	Electrical Engineering
Chang, Shey-Sheen	Nawab, Syed Hamid	Electrical Engineering
Chen, Tai-Chou	Moustakas, Theodore	Electrical Engineering
Chiu, Shihchin	Herbordt, Martin	Computer Engineering
Chivas, Robert	Morse. Theodore	Electrical Engineering
Coleiny, Golshan	Morse, Theodore	Electrical Engineering
Coles, Michael	Qin, Wei	Computer Engineering
Cui, Yanhong	Horenstein, Mark	Electrical Engineering
Cunha, Michael	Bellotti, Enrico	Electrical Engineering
Cvetkovski, Andrej	Bystrom, Maja	Electrical Engineering
Dai, Haitao	Knepper, Ronald	Electrical Engineering
Dashouk, Maxim	Saligrama, Venkatesh	Electrical Engineering
Davis, Brynmor*	Karl, William C	Analysis of Multi-Channel Microscopy: Spectral Self-Interference, Multi-Detector Confocal and 4PI Systems
Debitetto, Paul	Karl, William C	Systems Engineering
Diaz Quezada, Marcos	Semeter, Joshua	Electrical Engineering
Doros, Michael	Little, Thomas	Computer Engineering
D'Orsogna, Danilo	Oliver, William	Electrical Engineering
Driscoll, Kristina	Paiella, Roberto	Electrical Engineering
Dupuis, Julia	Ünlü, M Selim	Electrical Engineering
Egorov, Roman	Levitin, Lev	Computer Engineering
El Katerji, Ahmad	Toffoli, Tommaso	Computer Engineering
Ermis, Erhan	Saligrama, Venkatesh	Electrical Engineering
Fazlollahi, Niloofar	Starobinski, David	Electrical Engineering
Fercho, Todd#	Konrad, Janusz	Electrical Engineering
Freedman, David	Hubbard, Allyn	Electrical Engineering
Gao, Zhengsu	Qin, Wei	Systems Engineering
Georgescu, Ramona	Bigio, Irving	Electrical Engineering
Goode, Darryl	Teich, Malvin C	Electrical Engineering
Gopinath, Ashwin	Oliver Jr, William	Electrical Engineering
Griffis, Karin	Bystrom, Maja	Systems Engineering
Gu, Yongfeng	Herbordt, Martin	Computer Engineering
Gunna, Sulakshana	Bellotti, Enrico	Computer Engineering
He, Zhihua	Bystrom, Maja	Electrical Engineering
Huang, Chien Chih	Knepper, Ronald	Electrical Engineering
Hunt, Stephen	Oliver Jr, William	Electrical Engineering
Ince, Serdar	Konrad, Janusz	Electrical Engineering

Student Name	Advisor	Research Area or Thesis Title
Jastrzebski, Piotr*	Lee, Min-Chang	Trans-Hemispheric Propogation of VLF Signals in the Presence of Ionospheric Heating
Jenkins, Karen	Castañón, David	Electrical Engineering
Jeong, Jonghoon	Levitin, Lev	Electrical Engineering
Jones, Lawrence*	Levitin, Lev	Multi-Timescale Traffic Model for Broadband Internet Access Engineering
Kang, Wei	Ishwar, Prakash	Computer Engineering
Karl, Christian#	Hubbard, Allyn	Analog Circuits for Auditory Sound Source Localization Using Current Mode Techniques
Kaur, Parminder	O'connor, Peter	Computer Engineering
Ke, Wang*	Little, Thomas	Adaptive Attribute Based Routing for Clustered Wireless Sensor Networks
Keene, Sam	Carruthers, Jeffrey	Electrical Engineering
Kim, Duk Joong	Hubbard, Allyn	Electrical Engineering
Kim, Soojin	Bellotti, Enrico	Electrical Engineering
Koklu, Fatih	Ünlü, M Selim	Electrical Engineering
Kulikowski, Konrad	Karpovsky, Mark	Computer Engineering
Kumar, Rohit	Konrad, Janusz	Electrical Engineering
Kunapareddy, Nagapratima	Bigio, Irving J	Electrical Engineering
Laifenfeld, Moshe	Trachtenberg, Ari	Electrical Engineering
Li, Wei	Moustakas, Theodore	Electrical Engineering
Li, Yan	Paiella, Roberto	Electrical Engineering
Litvin, Andrey*	Karl, William C	Statistical Shape and Appearance Models for Segmentation and Classification
Liu, Chenhui*	Levitin, Lev	Design and Analysis of Novel Fixed Structure Stochastic Learning Automata in Non-Stationary Environments
Lu, Shan	Hubbard, Allyn	Computer Engineering
Ma, Nan	Semeter, Joshua	Electrical Engineering
Martin, Benjamin	Castañón, David	Electrical Engineering
Mathur, Raman	Karpovsky, Mark	Electrical Engineering
Miao, Lei*	Cassandras, Christos	Energy-Latency Trade-Offs in Wireless Sensor Networks
Mustafa, Mehmet*	Karpovsky, Mark	Turn Prohibition Based Algorithms for Unicast Wormhole Routing in Multiprocessors and Computer Networks
Mutlu, Huseyin	Starobinski, David	Electrical Engineering
Nourzad, Marianne	Hubbard, Allyn	Computer Engineering
Ntaikos, Dimitrios	Carruthers, Jeffrey	Electrical Engineering
Orten, Burkay	Saligrama, Venkatesh	Electrical Engineering
Ozkumur, Ismail	Ünlü, M Selim	Electrical Engineering
Parker, Charles	Sergienko, Alexander	Electrical Engineering
Pavlovich, Julia	Karl, William C	Electrical Engineering
Petrova, Mariya	Nawab, Syed Hamid	Electrical Engineering
Polimeni, Jonathan	Schwartz, Eric	Electrical Engineering
Ristivojevic, Mirko*	Konrad, Janusz	Space-Time Image Sequence Analysis: Object Tunnels and Occlusion Volumes
Rodriguez, Eladio	Castañón, David	Electrical Engineering
Rykalova, Yelena	Levitin, Lev	Computer Engineering
Saleh, Mohammed	Saleh, Bahaa	Electrical Engineering
Savas, Onur	Alanyali, Murat	Electrical Engineering
Shagam, Michael	Paiella, Roberto	Electrical Engineering
Sharma, Abhishek	Alanyali, Murat	Computer Engineering
Smirnov, Alexander	Taubin, Alexander	Computer Engineering
Spasov, Dejan	Trachtenberg, Ari	Electrical Engineering
Stern, Alvin	Moustakas, Theodore	Electrical Engineering
Stewart, Jason	Bifano, Thomas	Electrical Engineering
Stojanovic, Ivana	Ishwar, Prakash	Electrical Engineering
Sukhwani, Bharat	Herbordt, Martin	Electrical Engineering
Vamivakas, Anthony	Ünlü, M Selim	Electrical Engineering
Van Court, Thomas*	Herbordt, Martin	LAMP: Tools for Creating Application-Specific FPGA Co-processors
Wang, Meijun	Trachtenberg, Ari	Electrical Engineering

Student Name	Advisor	Research Area or Thesis Title
Wang, Yang	Bellotti, Enrico	Electrical Engineering
Wang, Ye	Ishwar, Prakash	Electrical Engineering
Williams, Adrian	Moustakas, Theodore	Electrical Engineering
Wotiz, Robert*	Nawab, Syed Hamid	Joint Signal and Symbol Processing for a Bio-Sensing Application
Wu, Tao	Starobinski, David	Electrical Engineering
Xiao, Weiyao	Starobinski, David	Electrical Engineering
Xu, Tao	Moustakas, Theodore	Electrical Engineering
Yalcin, Ayca	Ünlü, M Selim	Electrical Engineering
Yarnall, Timothy	Teich, Malvin	Electrical Engineering
Zettergren, Matthew#	Oliver Jr, William	Electrical Engineering
Zhai, Qingtai	Fritz, Theodore	Electrical Engineering
Zhao, Manqi	Ishwar, Prakash	Electrical Engineering

#Received MS as part of PhD
*Received PhD in 2005/2006

4.8 Degrees Awarded

MS Degrees Awarded	
Electrical Engineering	35
Computer Systems Engineering	23
Photonics	6
TOTAL	64

PhD Degrees Awarded	
Electrical Engineering	10
Computer Systems Engineering	5
Systems	0
TOTAL	15

PhD Dissertations

Student Name	Dissertation Advisor	Dissertation Title
Agarwal, Sachin	Trachtenberg, Ari	Efficient Reconciliation of Unstructured and Structured Data Over Networks
Bozinovic, Nikola	Konrad, Janusz	Advanced Motion Modeling for 3D Video Coding
Cabalu, Jasper	Moustakas, Theodore	Development of Fan-Based Ultraviolet and Visible Light-Emitting Diodes using Hydride Vapor-Phase Epitaxy and Molecular Beam Epitaxy
Davis, Brynmor	Karl, William C	Analysis of Multi-Channel Microscopy: Spectral Self-Interference, Multi-Detector Confocal and 4PI Systems
Jastrzebski, Piotr	Lee, Min-Chang	Trans-Hemispheric Propagation of VLF Signals in the Presence of Ionospheric Heating
Jones, Lawrence	Levitin, Lev	Multi-Timescale Traffic Model for Broadband Internet Access Engineering
Karl, Christian	Hubbard, Allyn	Analog Circuits for Auditory Sound Source Localization Using Current Mode Techniques
Ke, Wang	Little, Thomas	Adaptive Attribute Based Routing for Clustered Wireless Sensor Networks
Litvin, Andrey	Karl, William C	Statistical Shape and Appearance Models For Segmentation and Classification
Liu, Chenhui	Levitin, Lev	Design and Analysis of Novel Fixed Structure Stochastic Learning Automata in Non-Stationary Environments
Miao, Lei	Cassandras, Christos	Energy-Latency Trade-Offs in Wireless Sensor Networks
Mustafa, Mehmet	Karpovsky, Mark	Turn Prohibition Based Algorithms for Unicast Wormhole Routing in Multiprocessors and Comuter Networks
Ristivojevic, Mirko	Konrad, Janusz	Space-Time Image Sequence Analysis: Object Tunnels and Occlusion Volumes
Van Court, Thomas	Herbordt, Martin	LAMP: Tools for Creating Application-Specific FPGA Coprocessors
Wotiz, Robert	Nawab, Syed Hamid	Joint Signal and Symbol Processing for a Bio-Sensing Application

4.9 Graduate Teaching Fellows

Student Name	Course
Fall 2005	
Bozinovic, Nenad	SC471
Butler, Thomas	SC463/464
Chiu, Shihchin	SC571
Cunha, Michael	SC560
Dashouk, Maxim	SC416
Freedman, David	SC410
Gao, Zhengsu	SC330
Gopinath, Ashwin	SC410
Kang, Wei	SC410
Kumar, Rohit	SC401
Ma, Nan	SC455
Mutlu, Huseyin	SC311
Orten, Burkay	SC401
Parker, Charles	SC463/464
Petrova, Mariya	EK307
Raghunath, Savitha	SC410
Rosasles Garcia, Andrea	SC410
Stojanovic, Ivana	EK307
Wang, Meijun	SC441
Wang, Ye	SC463/464
Zhao, Manqi	SC311

Student Name	Course
Summer 2005	
Butler, Thomas	SC401
Chivas, Robert	SC410
Jain, Anish	SC311
Petrova, Mariya	EK307

Student Name	Course
Spring 2006	
Chiu, Shihchin	SC571
Bozinovic, Nenad	SC471
Butler, Thomas	SC463/464
Cvetkovski, Andrej	SC440/447
Cunha, Michael	Photonics Lab
Dashouk, Maxim	SC416
Freedman, David	EK440
Gao, Zhengsu	SC402
Gopinath, Ashwin	SC450
Gore, Siddarth	SC535
Kang, Wei	SC410
Kumar, Rohit	EK307
Ma, Nan	EK307
Mutlu, Huseyin	SC311
Orten, Burkay	SC463/464
Parker, Charles	SC463/464
Petrova, Mariya	EK307
Rahman, Rashedur	SC412
Raghunath, Savitha	SC312
Rosales Garcia, Andrea	EK307
Stojanovic, Ivana	EK307
Wang, Meijun	SC441
Zhao, Manqi	EK307

4.10 Research Assistants

Student Name	Advisor	Student Name	Advisor
Abell, Joshua	Moustakas, Ted	Ermis, Erhan	Saligrama, Venkatesh
Aeron, Shuchin	Saligrama, Venkatesh	Fazlollahi, Niloofar	Starobinski, David
Agarwal, Ashish	Little, Thomas	Farny, Caleb [AME]	Roy, Ron
Agarwal, Sachin	Trachtenberg, Ari	Fettig, Rabi [AME]	Cleveland, Robin
Ahn, Sunmin [BME]	Swan, Anna/Ünlü, Selim	France, Ryan	Moustakas, Ted
		Freedman, David	Hubbard, Allyn
Al Daoud, Ashraf	Alanyali, Murat	Gao, Zhengsu	Little, Thomas
Almeida, Nuno	Bellotti, Enrico	Georgescu, Ramona	Bigio, Irving
Atia, George	Saligrama, Venkatesh	Gioux, Sylvain	Ünlü, Selim
Atkinson, John	Chakrabarti, Supriya	Goode, Darryl	Saleh, Bahaa/Teich, Malvin
Ayache, Maurice	Swan, Anna		
Balogun, Oluwaseyi [AME]	Ünlü, Selim/Murray, Todd	Gopinath, Ashwin	Dal Negro, Luca
		Griffis, Karin	Bystrom, Maja
Banguero, Edgar	Oliver, William	Gu, Yongfeng	Herbordt, Martin
Basu, Subhendra	Qin, Wei	Gunna, Sulakshana	Bellotti, Enrico
Bergstein, David	Ünlü, Selim	Guo, Song	Little, Thomas
Bozinovic, Nenad	Mertz, Jerome	Guo, Dong [MFG]	Paschalidis, Ioannis
Bozinovic, Nikola	Konrad, Janusz	Hagedorn, Andrew	Trachtenberg, Ari
Browning, Cassandra	Hubbard, Allyn	He, Zhihua	Bystrom, Maja
Butler, Thomas	Castañón, David	Huang, Chien-Chih	Ekinci, Kamil
Byrnes, John	Semeter, Joshua	Ince, Serdar	Oddsson, Lars/Konrad, Janusz
Cabalu, Jasper	Moustakas, Ted		
Campbell, Bryan	Ruane, Michael	Jenkins, Karen	Castañón, David
Carssow, Douglas	Fritz, Theodore	Karabacak, Devrez [AME]	Ekinci, Kamil/Ünlü, Selim
Chandrasekaran, Ramya	Moustakas, Ted		
Chang, Shey-Sheen (Sam)	Gottlieb, Gerald/Roy, Serge	Kaur, Parminder	Costello, Catherine/O'Connor, Peter
Chen, Tai-Chao	Moustakas, Ted	Ke, Yuqing	Trachtenberg, Ari
Chivas, Robert	Morse, Ted/Dal Negro, Luca	Ke, Wang	Little, Thomas
		Kim, Soojin	Bellotti, Enrico
Coleiny, Golshan	Sergienko, Alexander	Kim, Duk Joong	Bifano, Thomas/Hubbard, Allyn
Coles, Michael	Qin, Wei/Goldberg, Bennett (GK-12)		
		Koklu, Fatih	Ünlü, Selim
Colson, Jeremy	Ünlü, Selim	Kulikowski, Konrad	Karpovsky, Mark
Cui, Yanhong	Horenstein, Mark	Kumar, Rohit	Castañón, David
Cunha, Michael	Bellotti, Enrico	Kunapareddy, Nagapratima	Bigio, Irving
Cvetkovski, Andrej	Saligrama, Venkatesh	Lai, Puxiang [AME]	Roy, Ron
Dai, Haitao	Knepper, Ronald	Laifenfeld, Moshe	Trachtenberg, Ari
Datta, Michael	Horenstein, Mark	Li, Meng	Bellotti, Enrico
Davis, Brynmor	Swan, Anna	Li, Wei	Moustakas, Ted
Diaz, Marcos	Semeter, Joshua	Li, Wei [MFG]	Cassandras, Christos
DiSabello, Douglas	Herbordt, Martin	Li, Yan	Paiella, Roberto
Dobson, Jennifer	Bigio, Irving	Liang, Zhuangli [BME]	Karl, W. Clem
Doros, Michael	Goldberg, Bennett (GK-12)	Litvin, Andrey	Karl, W. Clem
		Lu, Shan	Mountain, David/Hubbard, Allyn
D'Orsogna, Danilo	Oliver, William/Cook, Timothy	Ma, Nan	Ishwar, Prakash
		Ma, Xiang [AME]	Castañón, David
Draudt, Andrew [AME]	Cleveland, Robin	Mao, Jianfeng [MFG]	Cassandras, Christos
Driscoll, Kristina	Paiella, Roberto	Martin, Benjamin	Castañón, David
El Katerji, Ahmad	Mountain, David/Toffoli, Tommaso	Mathur, Raman	O'Connor, Peter/Costello, Catherine
Eraslan, Mesut	Ünlü, Selim	Menn, Steven	Ünlü, Selim

Research Assistants

Student Name	Advisor
Meydbray, Yevgeny	Ünlü, Selim
Miao, Lei	Cassandras, Christos
Model, Joshua	Herbordt, Martin
Mohan, Nishant [BME]	Teich, Malvin
Nourzad, Marianne	Hubbard, Allyn
Ntaikos, Dimitrios	Fritz, Theodore
Orten, Burkay	Karl, W. Clem
Ozkumur, I. Emre	Ünlü, Selim/Goldberg, Bennett
Parker, Charles	Fritz, Theodore
Pavlovich, Julia	Karl, W. Clem/Bystrom, Maja
Polimeni, Jonathan	Schwartz, Eric
Quesnel, Justin	Ünlü, Selim
Richards, Michael [BME]	Barbone, Paul
Rinard, Katherine	Spence, Harlan/Oliver, William
Ristivojevic, Mirko	Konrad, Janusz
Rivas Aroni, Carlos Enrique [AME]	Barbone, Paul
Rodehorst, Michael	Castañón, David
Rodriguez, Eladio	Castañón, David
Rosales Garcia, Andrea	Morse, Ted
Saleh, Mohammed	Saleh, Bahaa
Savas, Onur	Alanyali, Murat
Sexton, Patrick	Herbordt, Martin
Shagam, Michael	Ekinci,Kamil/Goldberg, Bennett (GK-12)
Smirnov, Alexandre	Karpovsky, Mark
Stern, Alvin	Moustakas, Ted
Stewart, Jason	Bifano, Thomas
Su, Ming	Karpovsky, Mark
Subramanian, Krishnakumar	Castañón, David
Sui, Lei [AME]	Roy, Ron
Sukhwani, Bharat	Herbordt, Martin
Thrall, Erica [BME]	Swan, Anna/Morgan, Elise
Vamivakas, Anthony	Ünlü, Selim
Van Court, Thomas	Herbordt, Martin
Venkataraman, Vyas	Taubin, Alexander
Voss, David	Fritz, Theodore
Walsh, Andrew [Physics]	Ünlü, Selim/Goldberg, Bennett
Wang, Ye	Ishwar, Prakash
Williams, Adrian	Moustakas, Ted
Wu, Arthur [BME]	Ünlü, Selim
Xiao, Weiyao	Starobinski, David
Xu,Tao	Moustakas, Ted
Yalcin, Ayca	Ünlü, Selim/Goldberg, Bennett
Yarnall, Timothy	Teich, Malvin

Student Name	Advisor
Yin, Yan [Physics]	Goldberg, Bennett
Zettergren, Matthew	Oliver, William/ Semeter, Joshua
Zhai, Qingtai	Fritz, Theodore
Zhao, Manqi	Saligrama, Venkatesh
Zhong, Minyi [MFG]	Cassandras, Christos
Zhou, Bo [Physics]	Swan, Anna
Zhuang, Shixin [MFG]	Cassandras, Christos

4.11 Graduate Courses

Course Number and Title		Fall 05	Spring 06	Summer 06
SC500	Special Topics in ECE	Little	Ishwar	
			Saleh	
SC501	Dynamic Systems Theory	Dupont		
SC505	Stochastic Processes	Saligrama	Saligrama	
SC513	Computer Architecture	Herbordt		
SC514	Simulation	Vakili		
SC515	Digital Communication	Ishwar		
SC516	Digital Signal Processing	Bystrom		
SC518	Software Project Management		Brackett	
SC520	Image Processing and Communication	Konrad		
SC524	Optimization Theory and Methods	Paschalidis		
SC533	Intro to Discrete Mathematics	Levitin		
SC534	Discrete Stochastic Models		Levitin	
SC535	Intro to Embedded Systems		Qin	
SC541	Computer Communication Networks	Alanyali	Starobinski	
SC551	Advanced Digital Design	Taubin		
SC560	Intro to Photonics	Teich	Teich	
SC561	Error-Control Codes	Karpovsky		
SC563	Fiber-Optic Communication Systems		Keiser	
SC566	The Atmosphere and Space Environment		Oliver	
SC570	Lasers		Ünlü	
SC571	VLSI Principles and Applications	Hubbard	Hubbard	
SC575	Semiconductor Devices	Bellotti		
SC577	Solid State Devices		Paiella	
SC578	Fabrication Technology for Integrated Systems	Klepstyn		
SC579	Microelectronic Device Manufacturing		Cole	
SC580	Modern Active Circuit Design	Knepper		
SC582	RF/Analog IC Design Fundamentals		Knepper	
SC599	Advanced Laboratory Topics in ECE	Paiella		
SC700	Advanced Special Topics in ECE	Mertz	Dal Negro	
		Toffoli		
SC702	Recursive Estimation and Optimal Filtering	Castanon		
SC710	Dynamic Programming and Stochastic Control		Hu	
SC713	Parallel Computer Architecture		Herbordt	
SC715	Wireless Communication		Sharif	
SC720	Digital Video Processing		Konrad	
SC725	Queueing Systems	Hu		
SC730	Informational-Theoretical Design of Algorithms		Levitin	
SC733	Discrete Event and Hybrid Systems		Cassandras	
SC744	Mobile Ad hoc Networking and Computing		Little	
SC749	Inteconnection Networks for Multicomputers	Karpovsky		
SC751	Design of Asynchronous Circuit and Systems		Taubin	
SC752	Theory of Computer Hardware Testing		Karpovsky	
SC757	Advanced Microprocessor Design			Montazam
SC761	Advanced Information Theory and Coding	Levitin		
SC762	Quantum Optics	Saleh		
SC765	Biomedical Optics and Biophotonics	Bigio		
SC771	Physics of Compound Semiconductor Devices		Bellotti	
SC850	Graduate Teaching Seminar	Nawab	Nawab	
SC892	Seminar: Electro-Physics	Moustakas	Moustakas	
		Ünlü	Ünlü	

4.12 Colloquia & Seminars

Date	Speaker	Title
September 19[a]	David Starobinski Electrical and Computer Engineering Boston University	On the Global Effects of Local Transmission Strategies in Wi-Fi Mesh Networks
September 23[b]	Gregg Jaeger Division of Natural Sciences Boston University	Quantum Information: An Overview
September 28[b]	Ari Trachtenberg Electrical and Computer Engineering Boston University	The Importance of Communicating Efficiently: A Networking Perspective
September 30[b]	Malvin Teich Electrical and Computer Engineering Boston University	Fractal-Based Point Processes
October 5[a]	Enrico Bellotti Electrical and Computer Engineering Boston University	Design and Simulation of Optoelectronics Devices from the UV to the Far IR
October 7[b]	Roscoe Giles Electrical and Computer Engineering Boston University	EPIC: Engaging People in Cyberinfrastructure
October 12[a]	Mahmut Kandemir, Computer Science and Engineering Pennsylvania State University	Software-Directed Energy Optimization for Embedded NoC Architectures
October 14[b]	William Oliver Electrical and Computer Engineering Boston University	Least-Distances Curve Fitting and Outlier Detection
October 17[a]	Tom Toffoli Electrical and Computer Engineering Boston University	The Quest for Efficient Computation
October 19[a]	Rishiyur Nikhil Bluespec, Inc.	Putting Advanced Programming Techniques to Practical Use: Taming CTO Chip Design Complexity
October 21[b]	Prakash Ishwar Electrical and Computer Engineering Boston University	Enabling Low-Power Video-Over-Wireless: Do We Need a Paradigm Shift Based on Distributed Coding?
October 28[b]	Min-Chang Lee Electrical and Computer Engineering Boston University	Whistler Wave Propagation and Interactions with Space Plasmas and Laboratory Simulation Experiments
November 4[b]	Robert Devaney Mathematics Boston University	Chaos in the Classroom: Exciting Students About Contemporary Mathematics
November 7[a]	Michael Gennert Computer Science Department Worcester Polytechnic Institute	Warning: Breathing May be Hazardous to Your Health Care - Tracking patient respiratory motion
November 14[a]	Ralf Koetter Electrical Engineering University of Illinois at Urbana-Champaign	Network Coding for the Non-multicast Case

Date	Speaker	Title
November 15[c]	Stark Draper Electrical Engineering & Computer Science University of California, Berkeley	Opportunistic Decoding: Maximizing rate and reliability in channels with feedback
November 16[a]	Yaakov Bar-Shalom Electrical and Computer Engineering University of Connecticut	The CRLB in the Presence of False Measurements with Application to Track Detection and Estimation for Low Observable Targets
November 18[b]	Theodore D. Moustakas Electrical and Computer Engineering Boston University	Physics of Textured III-Nitride Quantum Wells for Applications to LEDs
November 30[a]	Pierre Moulin Electrical and Computer Engineering University of Illinois at Urbana-Champaign	Steganography: Art or Science?
December 2[b]	Robert Kotiuga Electrical and Computer Engineering Boston University	Advanced Computational Electromagnetism (ACE '06) – Coming to a Lecture Hall Near You!
December 5[a]	Sir Michael Berry Physics department University of Bristol	Optical Vorticulture
December 9[b]	Thomas Little Electrical and Computer Engineering Boston University	Attribute-Based Routing in Sensor Networks
December 13[a]	Massimo Fischetti Electrical & Computer Engineering University of Massachusetts Amherst	Scaling MOSFETs to the limit: A physicist's perspective
January 20[b]	Frederick Beihold CST of America, Inc.	Fun with UWB Phased Array Antennas
January 30[a]	Devavrat Shah Electrical Engineering & Computer Science Massachusetts Institute of Technology	Capacity-Delay Scaling in Arbitrary Wireless Networks.
February 3[b]	Theodore Fritz Astronomy Boston University	The LCI project at BU
February 23[c]	Dror Baron Electrical Engineering & Computer Science Rice University	Distributed Compressed Sensing
February 24[b]	Meers Oppenheim Astronomy Boston University	Simulations of Space Plasma Physics Using Almost a Billion Particles
February 27[a]	Paul Scott Carney Electrical & Computer Engineering University of Illinois at Urbana-Champaign	3-D Optical Imaging Beyond OCT
March 03[b]	Sheryl Grace Aerospace & Mechanical Engineering Boston University	What is WISE?

Date	Speaker	Title
March 13[a]	Fiorenzo Omenetto Biomedical Engineering, Physics Tufts University	Guiding light through glass and holes (Nonlinear optics in conventional and photonic crystal fibers)
March 15[a]	George Cybenko Engineering Dartmouth College	Discrete Process Detection – Theory and Applications
March 16[c]	Olivier Leveque Laboratory of Information Theory Ecole Polytechnique Fédérale de Lausanne	Determinants of Random Cauchy Matrices and Capacity of Wireless Networks
March 20[a]	Ann Gordon-Ross Computer Science and Engineering University of California, Riverside	Dynamic Optimization of Highly-Configurable Caches for Reduced Energy Consumption
March 22[a]	Sherief Reda Computer Science and Engineering University of California, San Diego	From Nanometer VLSI Circuits to Gene Chips: New Approaches to Placement and Benchmarking
March 22[a]	Anant Sahai Electrical Engineering and Computer Science University of California Berkeley	Delay, Feedback, and the Price of Ignorance
March 27[a]	Martin Margala Electrical and Computer Engineering University of Rochester	Breaking the Barrier of Terahertz and Teraflops in Digital Circuits and Systems
March 30[a]	David Kaeli Electrical and Computer Engineering Northeastern University	Architectural Approaches to Improving Software Security
March 31[c]	Angel Lozano Lucent Technologies	The MIMO Layered Architecture: From Fundamentals to Standards.
April 3[a]	Hatice Altug Stanford University Electrical Engineerings	Photonic Crystal Devices for Nano- and Bio-photonics
April 6[a]	Azadeh Davoodi Electrical and Computer Engineering University of Maryland	Optimization Schemes for Variability-Driven VLSI Design Automation
April 13[d]	Mehmet Sarikaya Materials Science and Engineering University of Washington	GEPI – Genetically Engineered Polypeptides for Inorganics: Peptide-Based Molecular Tool Set
April 13[d]	Hür Köçer Electrical Engineering Yale University	Magnetic Liquids for Lab-on-a-Chip and Rapid Diagnostics Applications
April 24[a]	Jonathan Katz Computer Science University of Maryland	New Techniques for Authenticating Humans (and Other Resource-Constrained Devices)

[a] *ECE Colloquium Series*
[b] *Research Spotlight Seminar*
[c] *ISS/CISE Seminar*
[d] *CNN Seminar*

five: *Research*

5.1 Areas of Research

Electro-Physics

Coordinator: Michael Ruane

Solid-State Materials & Devices

- Bellotti
- Campbell
- Horenstein
- Humphrey
- Knepper
- Moustakas
- Skocpol

Photonics

- Bellotti
- Bigio
- Dal Negro
- Goldberg
- Levitin
- Luo
- Morse
- Moustakas
- Paiella
- Ruane
- Saleh
- Sergienko
- Swan
- Teich
- Ünlü

Electromagnetics

- Eisenberg
- Giles
- Humphrey
- Kotiuga
- Lee
- Semeter

Space Physics

- Chakrabarti
- Fritz
- Lee
- Mendillo
- Oliver
- Ruane
- Semeter

Information Systems & Sciences

Coordinator: W. Clem Karl

Signal & Image Processing

- Bystrom
- Carruthers
- Castañón
- Ishwar
- Karl
- Konrad
- Nawab
- Schwartz

Information & Decision Systems

- Baillieul
- Castañón
- Karl
- Saligrama
- Sharif

Multimedia Processing

- Bystrom
- Ishwar
- Konrad
- Little

Computer Engineering

Coordinator: Thomas Little

Software Applications

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

Hardware

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

Communications & Computer Networks

- Alanyali
- Carruthers
- Castañón
- Cassandros
- Ishwar
- Karpovsky
- Levitin
- Saligrama
- Sharif
- Starobinski
- Trachtenberg

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*

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 light as the transmission medium for high-datarate 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*

Computation Signal Processing Laboratory

This laboratory conducts research in computational signal processing (CSP) and its integration into application systems. Issues of interest include CSP

algorithms, knowledge-based systems, software architectures for CSP systems, software environments for the development of CSP systems, integration of numeric and symbolic processing, statistical signal processing, and multidimensional signal processing. This research is carried out in the context of auditory and biosignal applications. *Nawab*

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 focused 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*

Professor Joshua Semeter helps research assistant Marcos Diaz set up an antenna

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, Semeter*

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*

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 , high power optical fiber lasers, and a variety of optical fiber sensors. We are developing a new technique for combining multimode pump radiation into double clad fibers. The components of this facility consist of a fabrication laboratory with three glass lathes including a new stateof- 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 optical, magnetic and magneto-optical materials have been studied in the MODL using optical, electrical, and computational methods. A novel optical device, the Resonant Cavity Imaging Biosensor, for tag-free bio-sensing using resonant optical cavities and IR imaging has recently opened a new area of investigation for the MODL. The lab is building a mask-free optical synthesizer for bio-arrays. Collaborations with the Center for Space Physics are investigating miniature magnetometers based on Giant Magneto Impedance, and developing the motor controls for the Loss Cone Imager, which will fly on the USAF DSX satellite in 2009. *Ruane, Humphrey, Semeter*

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*

Optical Characterization and Nanophotonics

Nanophotonics addresses a broad spectrum of optics on the nanometer scale covering technology and basic science.
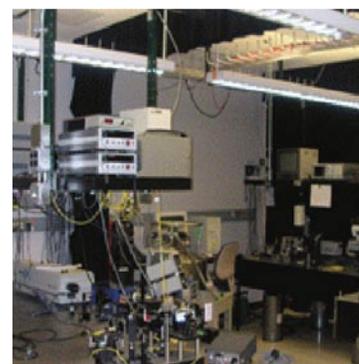
Compared to the behavior of isolated molecules or bulk materials; the behavior of nanostructures exhibit important physical properties not necessarily predictable from observations of either individual constituents or large ensembles. We develop and apply advanced optical characterization techniques to the study of solid-state and biological phenomena at the nanoscale. Current projects include development of high-resolution subsurface imaging techniques based on numerical aperture increasing lens (NAIL) for the study of semiconductor devices and circuits and spectroscopy of quantum dots; micro resonant Raman and emission spectroscopy of individual carbon nanotubes; biosensors based on microring resonators; and development of new nanoscale microscopy techniques utilizing interference of excitation as well as emission from fluorescent molecules. In

addition to microscopy, optical resonance is nearly ubiquitous in our research projects including development of resonant cavity enhanced photodetectors and imaging biosensors for DNA and protein arrays. *Goldberg, 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 crosschecking the results obtained in the field experiments. *Lee, Semeter*

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 (Blue, Green, and 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, Professor Kevin Smith (Physics) in the area of electronic structure, and Professor Roberto Paiella in the area of devices based on intersubband transitions. *Moustakas*

5.3 Centers and Interdisciplinary Activities

Center for Computational Science

http://satchmo.bu.edu

The Boston University Center for Computational Science (CCS) was founded in 1990 to coordinate and promote computationally based research, to foster computational science education and to provide for the expansion of computational resources and support.

CCS provides a forum for the multidisciplinary exchange of ideas among researchers, educators and students. Regularly scheduled seminars as well as workshops and symposia are offered to highlight advances in computational science. CCS has acted to develop and facilitate the formulation of projects in computationally based research and education, working with scientists from 20 different departments and centers.

CCS works in close collaboration with the Office of Information Technology, in particular with its Scientific Computing and Visualization Group (SCV) group, in the development of resources to support computational science. The high performance computing and visualization systems at Boston University currently include the IBM Blue Gene, IBM pSeries 690, an IBM pSeries 655, an Intel Pentium III Linux Cluster, our Deep Vision Display Wall, the Access Grid Conference Facility, the Laboratory for Virtual Environments and the Computer Graphics Laboratory.

CCS offers a Certificate in Computational Science to graduate students in engineering and science pursuing a Ph.D. through a multidisciplinary training program ACES (Advanced Computation in Engineering and Science).

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 Center carries out a wide variety of research in some of the following fields of space physics including: space plasma physics; magnetospheric physics; ionospheric physics; atmospheric physics; and planetary and cometary atmospheric studies.

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 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 $85 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, Precision 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 (NSF) Engineering Research Center (ERC), one of an elite group of only nineteen ERCs in the nation. 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: Boston University, Northeastern University, Rensselaer Polytechnic Institute, and the University of Puerto Rico at Mayagüez; and 4 strategic affiliates: Massachusetts General Hospital, Memorial Sloan-Kettering Cancer Center, 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.
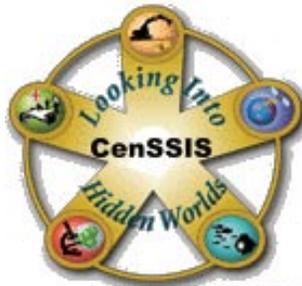
The Center's primary focus is on detecting, locating, and identifying objects obscured beneath the covering media, such as underground plumes, tumors under the skin or developmental defects in an embryo. Utilizing electromagnetic, photonic, or acoustic probes, CenSSIS will engage biomedical and environmental 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. An important outcome of this process is the education of students well-trained in these crucial fields for the future of public health and the preservation of the planet's physical resources.

Center for Information and 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 Boston University is strong and accomplished, but it is spread across departments, colleges and schools within the University. Approved by the Trustees in 2002, with management support added in Fall 2002, CISE has raised the visibility of that strength and fostered greater interactions among researchers.

The Center for Information and Systems Engineering fosters interdisciplinary collaboration and research in emerging applications and the use of methodologies such as Optimization methods, Information theory, Control theory, Applied probability and statistics, Simulation and modeling. Primary application interests are in the areas of automation, robotics, and control; communication, networking and information systems; production, service and supply chain systems; and signal processing and pattern recognition.

As of June 2005, CISE has grown from 13 to 26 affiliated faculty from the Departments of Manufacturing Engineering, Aerospace & Mechanical Engineering, and Electrical & Computer Engineering in the College of Engineering; the Department of Computer Science, and Mathematics & Statistics in the College of Arts and Sciences; and the Department of Operations Management in the School of Management. There are approximately 60 graduate students affiliated through these faculty. CISE maintains a searchable data base of academic 'systems' publications authored by the affiliated faculty and their students.

As of November 2004, CISE launched the Sensor Network Consortium (SNC) to facilitate interactions among the academic community and industry participants who support the growth of the sensor network industry through focused research and development activities. The SNC's goals are to develop, test and accelerate adoption of sensor network

related technologies in strategic applications areas; develop strategic partnerships to access federal and regional research funding; and educate graduate students and facilitate their involvement with industry. Industry participation includes a diverse group of companies, start-ups, system integrators and adopters of sensor network technology that currently includes Arch Rock Corporation, BP International, Ember Corporation, The Hartford, Honeywell, IBM, Millennial Net, Mitre Corporation, SAP, Siemens Building Technologies, Sun Microsystems, and Textron Systems.

Electrical and Computer Engineering Department faculty affiliated with CISE are Professors Alanyali, Baillieul, Carruthers, Cassandras, Castañón, Ishwar, Karl, Little, Saligrama, Sharif, 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. Professor David Castañón is currently serving as Co-Director along with Professor Yannis Paschalidis of the Department of Manufacturing Engineering. Several ECE faculty also serve on the CISE Management Committee.

Center for Remote Sensing
http://www.bu.edu/remotesensing

The Center was established in 1986 as a facility for scientific research in the fields of archaeology, geography and geology. The Center uses satellite images and other data from airborne and ground sensors to study the Earth and its resources, particularly groundwater. This includes the monitoring of environmental changes due to both natural processes and human activities. In 1997, the Center was selected by NASA as a "Center of Excellence in Remote Sensing."

Center for Nanoscience and Nanobiotechnology
http://nanoscience.bu.edu/

Boston University formed the Center for Nanoscience and Nanobiotechnology (CNN) to advance academic and technological research and development by extending discoveries in nanoscale materials and platforms toward applications that examine and seek to understand and manipulate biological systems. The Center serves as a hub for nanoscience researchers from the Charles River and Medical Campuses and builds interdisciplinary research and training.

The Center connects scientists and engineers from disparate disciplines with each other in seminars, meetings, joint visitors programs, interdisciplinary courses, industrial collaborations, and seeded projects.

CNN has three core functions: First, to develop interdisciplinary research and education in nanoscience and nanobiotechnology; second, to develop and run an industrial liaison program that partners researchers with external companies for mutual benefit; and third, to connect researchers to resources for technological commercialization. CNN and affiliated faculty are also involved in outreach activities, organizing hands-on activities, discussions, and panels on nanoscience for grade school students and local organizations and museums.

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S. B. Ippolito, **M. S. Ünlü,** B. B. Goldberg, T. M. Levin, and D. P. Vallett, "Laser signal injection microscopy of Si integrated circuits with a numerical aperture increasing lens," *Proceedings of IEEE Lasers and Electro-Optics Society 2005 Annual Meeting,* October 22-27, 2005.

M. S. Ünlü, "Applications of microresonators: from photodetectors to biological sensing and imaging (Keynote Presentation)," *European Optical Society Topical Meeting: Optical Microsystems,* September 15, 2005.

M. S. Ünlü, A. N. Vamivakas, S. B. Ippolito, and B. B. Goldberg, "Numerical aperture increasing lens microscopy for

quantum dot and integrated circuit imaging," *European Optical Society Topical Meeting: Optical Microsystems,* September 2005.

B. J. Davis, **M. S. Ünlü, A. K. Swan, B. B. Goldberg,** and **W. C. Karl,** "Using Multi-Element Detectors to Create Optimal Apertures in Confocal Microscopy," *The 18th Annual Meeting of the IEEE Lasers and Electro-Optics Society*, pp. 547-548, October 23-27, 2005.

Invited Lectures:

M. Alanyali, "A random walk model for distributed computation in energy-limited networks," Inauguration Workshop for the Center for Information Theory and its Applications, UCSD, February 6-10, 2006.

E. Bellotti, "Design and Simulation of Optoelectronics Devices From the UV to the Far IR," MIT Lincoln Laboratory, February 28, 2006.

I. J. Bigio, "Monitoring of angiogenesis by the method of optical pharmacokinetics," CenSSIS Conference, Northeastern University, October 2005.

I. J. Bigio, "Optical spectroscopy for the detection and treatment management of prostate cancer," Symposium on Novel Technologies for Prostate Cancer, November 2005.

I. J. Bigio, "Potential applications of elastic-scattering spectroscopy to pancreatic cancer," M.D. Anderson Cancer Center, Houston, December 2005.

I. J. Bigio, "Elastic scattering spectroscopy for the noninvasive detection of cancer," Department of Bioengineering, University of Illinois at Urbana-Champaign, January 2006.

I. J. Bigio, "Optical spectroscopy for noninvasive detection of cancer," Department of Biomedical Engineering, University of Arizona, February 2006.

I. J. Bigio, "Applications of optical spectroscopy in the detection and treatment of prostate cancer," NIH/AdMeTech Prostate Cancer Brain Trust workshop, Bethesda, MD, March 2006.

I. J. Bigio, "Optical Spectroscopy for Management of Cancer Treatment," OSA Conference on Biomedical Optics, Ft. Lauderdale, FL, March 2006.

I. J. Bigio, "Elastic scattering spectroscopy for noninvasive detection of cancer," Department of Biophysics and Biochemistry, University of Pennsylvania, March 2006.

I. J. Bigio, "Optical monitoring of drug concentrations in the brain," Department of Anesthesiology, Columbia University Medical School, April 2006.

I. J. Bigio, "Optical Biopsy: Noninvasive Detection of Early Cancer with Elastic Scattering Spectroscopy," Physics Department Colloquium*,* Boston University, April 2006.

I. J. Bigio, "Elastic scattering spectroscopy for noninvasive detection of early cancer and pre-cancer," Stanford University Medical School, June 2006.

I. J. Bigio, "Optical spectroscopy to monitor PDT pharmacokinetics and therapy," Progress and Clinical Translation of In-Vivo Imaging Symposium, Philadelphia, June 2006.

L. Dal Negro, "Light from Silicon-based Nanostructures," American Physical Society meeting, Baltimore, MD, March 13-17, 2006.

L. Dal Negro, J. H. Yi, J. Michel, L. C. Kimerling, S. Hamel, A. Williamson, and G. Galli, "Light Emission in Silicon-rich Nitride Nanostructures," Materials Research Society Spring Meeting, San Francisco, CA, April 17-21, 2006.

L. Dal Negro, "Light in Aperiodic Deterministic Structures," Advanced Computational Electrodynamics Workshop, Boston, MA, May 04-06, 2006.

L. Dal Negro, "Light emission from silicon nanostructrures," IEEE-LEOS Conference, Montreal, Canada, October 29-November 2, 2006.

S. Lu, D. C. Mountain, and **A. E. Hubbard,** "A multicompartmental cochlear model with piezoelectric outer hair cells," Acoustical Society of America, Providence, RI, June 2006.

S. Deligeorges, D. Mountain, and **A. Hubbard,** "A biomimetic robotic system for localizing gunfire," Acoustical Society of America, June 2006.

S. Deligeorges, A. Zosuls, D. Anderson1, T. Gore, C. Karl, D. Mountain, and **A. Hubbard,** "A Biomimetic Robotic System for Localizing Sound," International Conference on Congnitive and Neural Systems, May 2006.

M. Nourzad, C. Karl, S. Deligeorges, and **A. Hubbard,** "Hardware implementations of a biomimetic acoustic localizing system," International Conference on Congnitive and Neural Systems, May 2006.

S. Lu, D Mountain, and **A. Hubbard,** "A Multi-compartment Model of the Cochlea with Nonlinear Outer Hair Cell Force Generators," International Conference on Cognitive and Neural Systems, May, 2006.

L. B. Levitin, "Maximum rate of quantum computational dynamics," CREATE-NET Research Center, Trento, Italy, July 2005.

L. B. Levitin, "Foundations of information theory," Max Planck-Institute, Berlin, Germany, August 2005.

T. D. C. Little, "Challenges in Sensor Network Tasking," CISE SNC Member Meeting, Boston University, May 24, 2006.

T. D. Moustakas, "GaN LEDs for Solid State Lighting," Saint-Gobain Lighting Community Meeting, Boston, July 7, 2005.

T. D. Moustakas, "MBE and HVPE Growth of III-Nitrides," 16th American Conference on Crystal Growth and Epitaxy, Big Sky, MT, July 10-15, 2005.

T. D. Moustakas, J. S. Cabalu, R. Chandrasekaran, and S. Riyopoulus, "High efficiency LEDs based on textured GaN templates with wrinkled quantum wells," Optics East, Boston, October 25, 2005.

T. D. Moustakas, "Physics of Textured III-Nitride Quantum Wells for Applications to LEDs," International Semiconductor Device Research Symposium, Washington, DC, December 7-9, 2005.

T. D. Moustakas, "Low-cost Blue/UV LEDs with very high Photon Conversion and Extraction Efficiency for White Lighting," DOE Solid-State Lighting Program Planning Workshop Orlando, February 1-3, 2006.

T. D. Moustakas, "GaN-based Materials for Optoelectronics," Lehigh University, February 14, 2006.

T. D. Moustakas, "A New Model Describing the Plasma-Assisted MBE Growth of GaN Thin Films and its Alloys with AlN and InN," International Conference on Metallurgical Coatings and Thin Films, San Diego, May 1-5, 2006.

B. E. A. Saleh, "Classical and Quantum Optical Coherence Imaging and Quantum Two-Photon Imaging," Meeting of the European Optical Society, London, July 1, 2005.

B. E. A. Saleh, "Quantum Imaging," Physics Department, University of Kent, UK, July 4, 2005.

B. E. A. Saleh, "Vector-Beam Microscopy," National Institute of Laser Enhanced Sciences (NILES), Cairo, Egypt, January 3, 2006.

B. E. A. Saleh, "Tutorial on Nonlinear Imaging," CenSSIS Symposium on Nonlinear and Quantum Imaging, Boston University, April 4, 2006.

B. E. A. Saleh, "Nonlinear and Quantum Imaging," Instituto Nacional de Astrofísica Óptica y Electrónica, Puebla, Mexico, May 22, 2006.

V. Saligrama, "Search and Discovery in an Uncertain Networked World," Plenary Speaker: 2nd Northeast Control Conference, MIT, Cambridge, MA, April 2006.

V. Saligrama, "Distributed Detection and Estimation over Sensor Networks," Ecole Polytechnique Fédérale de Lausanne, Lausanne, Switzerland, July 2005.

V. Saligrama, "Reliable Target Tracking with Unreliable Communications," IEEE International Conference on Acoustics, Speech and Signal Processing, Toulouse, France, May 2006.

J. Semeter, "Optical remote sensing of the aurora-borealis," IEEE Geoscience and Remote Sensing Society Meeting, MIT Lincoln Laboratory, October 2005.

J. Semeter, "Critical evaluation of time constants governing electrodynamic coupling of the magnetosphere and ionosphere," Yosemite workshop on Global Aspects of Magnetosphere-Ionosphere Coupling, February 2006.

A. V. Sergienko, "Quantum-Optical Measurement With Specially Engineered Entangled-Photon States," Department of Physics Colloquium, Vanderbilt University, Nashville, TN, February 24, 2006.

A. V. Sergienko, "Quantum Communication and Precise Optical Measurement with Engineered Entangled-Photon States," Special Seminar Department of Physics and Astronomy, University of Leeds, UK, February 8, 2006

D. Starobinski, "A Theory of Stability for Communication Networks," DOE PI Meeting, Brookhaven National Laboratory, September 2005.

D. Starobinski, "Towards a Theory of Stability for Communication Networks," Telecommunication and Networking Seminar Series, University of Pennsylvania, November 2005.

D. Starobinski, "On the Macroscopic Effects of Local Interactions in Wireless Mesh Networks," Center for Nonlinear Studies, Los Alamos, March 2006.

A. Swan, "Carbon nanotubes: Optical properties and applications," IEEE-LEOS Central New England LEOS Chapter, November 10, 2005.

A. Swan, "Lower limit of exciton binding energy in carbon nanotubes," Federation of Analytical Chemistry and Spectroscopy Societies, October 2005.

A. Swan, "Optical properties of carbon nanotubes," International Workshop on Nanophotonics and Nanobiotechnology, Koç, Turkey, July 2005.

A. Swan, "Unperturbed Optical Transition Energies in Carbon Nanotubes," Sixth International Conference on the Science and Application of Nanotubes, Gothenburg, Sweden, July 2005.

M. C. Teich, "Heart Rate Variability," Workshop on New Themes and Techniques in Complex Systems, University of Nottingham and Engineering & Physical Sciences Research Council, Grasmere, UK, September 2005.

M. C. Teich, "Applications of Entangled Photons in Photonics," National Engineers Week Lecture, Raytheon Radio Frequency Components Division, Andover, MA, February 2006.

M. C. Teich, "Fractal-Based Point Processes and Sensory-System Neural Spike Trains," Hearing Research Center, Boston University, April 2006.

T. Toffoli, "The question they all ask: How do you make up a rule to give a desired behaviour?" FENA Workshop on Computation in Nanoscale Dynamical Systems, Santa Fe, NM, January 19–20, 2006.

T. Toffoli, "Simple things work best: Computing with gases, qubits, and emergent phenomena," Lockheed Martin, Philadelphia, PA, June 5, 2006.

M. S. Ünlü, "Applications of Microresonators: From Photodetectors to Biological Sensing and Imaging," JSPS – UNT Joint Symposium on and Biotechnology Nanoscale Materials for Optoelectronics Denton, Texas, February 2-3, 2006.

M. S. Ünlü, "Applications of microresonators: from photodetectors to biological sensing and imaging (Keynote Presentation),"

European Optical Society Topical Meeting: Optical Microsystems, Capri, Italy, September 15, 2005.

M. S. Ünlü, "Nanoscale Imaging of Semiconductor and Biological Systems," LEOS Distinguished Lecture at Hampton Roads LEOS Chapter, September 2005.

M. S. Ünlü, "Nanoscale Imaging of Semiconductor and Biological Systems," LEOS Distinguished Lecture at Ottawa LEOS Chapter, October 2005.

M. S. Ünlü, "Nanoscale Imaging of Semiconductor and Biological Systems," LEOS Distinguished Lecture at Joint LEOS/MTTS/APS Montreal Chapter, October 2005.

M. S. Ünlü, "Nanoscale Imaging of Semiconductor and Biological Systems," LEOS Distinguished Lecture at Central New England LEOS Chapter, October 2005.

M. S. Ünlü, "Nanoscale Imaging of Semiconductor and Biological Systems," LEOS Distinguished Lecture at Washington-Northern Virginia LEOS Chapter, December 2005.

M. S. Ünlü, "Nanoscale Imaging of Semiconductor and Biological Systems," LEOS Distinguished Lecture at JSPS – UNT Joint Symposium on Nanoscale Materials for Optoelectronics and Biotechnology, February 2006.

M. S. Ünlü, "Nanoscale Imaging of Semiconductor and Biological Systems," LEOS Distinguished Lecture at Northern NJ LEOS Chapter, February 2006.

M. S. Ünlü, "Nanoscale Imaging of Semiconductor and Biological Systems," Electrical and Computer Engineering Department, Lehigh University, March 2006.

M. S. Ünlü, "Nanoscale Imaging of Semiconductor and Biological Systems," LEOS Distinguished Lecture at Santa Clara Valley LEOS Chapter with EDS Chapter, May 2006.

M. S. Ünlü, "Nanoscale Imaging of Semiconductor and Biological Systems," LEOS Distinguished Lecture at Italian LEOS Chapter, Milan, Italy, May 2006.

M. S. Ünlü, "Nanoscale Imaging of Semiconductor and Biological Systems," LEOS Distinguished Lecture at Denver LEOS Chapter with Rocky Mountain OSA (RMOSA), May 2006.

M. S. Ünlü, "Nanoscale Imaging of Semiconductor and Biological Systems," LEOS Distinguished Lecture at Turkish LEOS Chapter, Ankara, Turkey, June 2006.

M. S. Ünlü, "Nanoscale Imaging of Semiconductor and Biological Systems," LEOS Distinguished Lecture at Corning and Rochester LEOS Chapter, June 2006.

M. S. Ünlü, "Numerical Aperture Increasing Lens Microscopy: Applications in Si IC imaging and QD apectroscopy," International Workshop on Nanophotonics and Nanobiotechnology, Istanbul, Turkey, June 28-July 8, 2005.

M. S. Ünlü, "Resonant Cavity Biosensor," International Workshop on Nanophotonics and Nanobiotechnology, Istanbul, Turkey, June 28-July 8, 2005.

Patents and Patent Disclosures:

I. J. Bigio, "Polar nephelometer based on a rotational confocal imaging setup," Patent disclosure.

I. J. Bigio, "Biopsy forceps incorporating an optical spectroscopy fiber probe," Patent disclosure.

I. J. Bigio, "Biopsy snare incorporating an optical spectroscopy fiber probe," Patent disclosure.

A. Hubbard, "Biomimetic Acoustic Detection and Localization System," Patent disclosure no. 11/415,347, May 2006.

A. Hubbard, "Tunable current mode integrator for low-frequency filters," U.S. Patent, April 17, 2006.

K. J. Kulikowski, **M.G. Karpovsky,** and **A. Taubin,** "Robust codes for error detection," Patent disclosure, August 2005.

K. J. Kulikowski, **M. G. Karpovsky,** and **A. Taubin,** "Apparatus and methods for error detection based on systematic robust codes," Patent disclosure, August 2005.

R. W. Knepper, H. Dai, and W. Hemdan, "Substrate Noise Suppression Circuit and Methodology for RF/Mixed Signal IC Technology," Patent disclosure, March 28, 2006.

T. D. Moustakas, "Method of Making a Semiconductor Device with Exposure of Sapphire Substrate to Activated Nitrogen," U.S. Patent 6,953,703 B2, October 11, 2005.

T. D. Moustakas and J. Cabalu, "Optical Devices Featuring Textured Semiconductor Layers," International Application (PCT) no. WO 2005/104236 A2, November 3, 2005.

T. D. Moustakas and J. Cabalu, "Optical Devices Featuring Textured Semiconductor Layers," US provisional patent application no. 60/732,034, filed October 31, 2005.

T. D. Moustakas and A. Williams, "Planarization of GaN by Photoresist Technique using an Inductively Coupled Plasma," US provisional application no. 60/764,389, filed February 2, 2006.

R. Paiella, "Tunable Surface Plasmons in Coupled Metallo-Dielectric Multiple Layers for Light Emission Efficiency Enhancement," Patent disclosure.

T. Singh and **A. Taubin,** "A GALS Solution Based on Highly Scalable, Low Latency, Crossbar Using Token Ring Arbitration," Patent disclosure, April 2006.

D. J. MacDonald and **A. Taubin,** "DPA-Resistant Balanced-Power Standard Logic Cell Library," Patent disclosure, April 2006.

M. C. Teich, B. E. A. Saleh, A. V. Sergienko, J. T. Fourkas, R. Wolleschensky, M. Kempe, and M. C. Booth, "High-Flux Entangled Photon Generation via Parametric Processes in a Laser Cavity," U.S. patent no. 6,982,822, January 3, 2006, 20 claims.

5.5 Grants, Contracts, and Gifts

The following table delineates the new grants awarded over the 2006 fiscal year. The funding level for new grants, where an ECE faculty member is the Principal Investigator (PI) is approximately $5.2M. 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 $1.8M. The total of new grants is therefore approximately $7M.

New Grants with ECE Principal Investigators

Recipient	Title of Award	Source	Begin Date	End Date	Amount
Bellotti, Enrico	Deep UV Semiconductor Laser for in situ Organic and Biological Exploration (Sub-contract via Photon Systems, Inc.)	NASA	1/1/06	12/31/07	$25,000
Bellotti, Enrico	Young Investigator Program: Single-Photon 3D Image Sensors	DoD/Navy	3/15/03	4/30/06	$44,952
Bigio, Irving	Graduate Student Support (N. Kunapareddy)(Subcontract via Los Alamos National Laboratoy)	Department of Energy	6/1/05	2/28/07	$31,629
Castañón, David	Graduate Student Support (M. Rodehorst) (Subcontract via MIT/Lincoln Laboratory)	DoD/Air Force	9/1/05	12/31/05	$13,605
Castañón, David	Videotext Detection, Tracking, Extraction and Enhancement - Graduate Student Support (K. Subramanian)	BBNT Solutions LLC	4/1/04	7/31/05	$5,137
Castañón, David	Center for Subsurface Sensing and Imaging Systems (CenSSIS) – Research Thrust 2 (Subcontract via Northeastern University)	NSF	9/1/05	8/31/06	$294,717
Castañón, David; Cassandras, Christos	Cooperative Mission Control for Un-manned Air Vehicles in Complex Stochastic Environments (in conjunction with Center for Information and Systems Engineering)	DoD/Air Force	3/1/06	2/28/07	$157,435
Herbordt, Martin	Graduate Student Support (J. Model) (Subcontract via MIT/Lincoln Laboratory)	DoD/ Air Force	9/1/05	12/31/05	$13,605
Herbordt, Martin	Accelerated Fault-Tolerant Computing in Space with Reconfigurable Circuits	DoD/Navy	11/1/05	7/31/06	$60,869
Hubbard, Allyn	Photonics Technology Development and Insertion/Task 25: Acoustic Sniper Detection (in conjunction with the Photonics Center)	DoD/Army	6/1/05	4/30/06	$150,000
Ishwar, Prakash	CAREER: Information-Scaling Laws, "Bit-Conversation" Principles, and Robust Coding Architectures in Sensor Networks	NSF	12/15/05	11/30/07	$151,959
Karl, W. Clem	Anatomic Morphological Analysis of MR Brain Images (in conjunction with Center for Nanoscience and Nanobiotechnology) (Subcontract via Massachusetts General Hospital)	HHS/NIH/NINDS	9/1/05	8/31/06	$83,009
Karpovsky, Mark; Taubin, Alexander	Cryptographic Devices Resistant to Attacks	OmniBase Logic Inc.	5/26/05	12/31/05	$40,000

Recipient	Title of Award	Source	Begin Date	End Date	Amount
Karpovsky, Mark; Taubin, Alexander	Cryptographic devices resistant to attacks: Design methodology based on robust codes, asynchronous circuitry and multi-valued logic technology	Omnibase Logic Inc.	05/26/05	8/31/06	$132,500
Kotiuga, P. Robert	Advanced Computational Electromagnetics – ACE '06 Workshop (in conjunction with Center for Computational Science)	NSF	4/1/06	3/31/07	$25,000
Lee, Min-Chang	Controlled studies of whistler wave interactions with energetic particles in radiation belts	DoD/Air Force	3/1/06	11/30/06	$85,000
Little, Thomas; Alanyali, Murat; Kunz, Thomas; Phillips, Nathan; Saligrama, Venkatesh	NeTS - NOSS: Semantic Internetworking of Sensor Systems for Efficient In-Network Information Processing	NSF	1/1/05	12/31/06	$250,000
Little, Thomas; Alanyali, Murat; Kunz, Thomas; Phillips, Nathan; Saligrama, Venkatesh	NeTS-NOSS: Sematic Internetworking of Sensor Systems for Efficient In-Network Information Processing	NSF	1/1/05	12/31/07	$250,000
Morse, Theodore	Specialty Fibers for Clinical Applications	DoD/Air Force	2/1/05	1/31/07	$150,000
Moustakas, Theodore	Photonics Research and Development (Subcontract via University of Nevada Las Vegas Research Foundation)	Dep of Energy	4/1/06	10/31/06	$191,750
Moustakas, Theodore	MURI: Gas Cluster Ion Beam (GCIB) Epitaxy (Subcontract via Georgia Institute of Technology)	DoD/Air Force	5/1/03	5/14/06	$49,158
Moustakas, Theodore	Low-Cost Blue/UV LEDs with Very High Photon Conversion and Extraction Efficiency for White Lighting	Dep of Energy	9/1/04	9/30/07	$319,998
Moustakas, Theodore	Deep UV Semiconductor Laser for in situ Organic and Biological Exploration (Subcontract via Photon Systems, Inc.)	NASA	1/1/06	12/31/08	$125,000
Oliver, William	Incoherent Scatter Radar Studies of Hot Oxygen (in conjunction with Center for Space Physics)	NSF	11/15/05	10/31/06	$134,896
Ruane, Michael	Center for Subsurface Sensing and Imaging Systems (CenSSIS) – Education Program (subcontract via Northeastern University)	NSF	9/1/05	8/31/06	$59,537
Ruane, Michael; Swan, Anna	REU Site: Research Experiences for Undergraduate Students in Photonics	NSF	5/1/06	4/30/07	$109,820
Saleh, Bahaa	Center for Subsurface Sensing and Imaging Systems (CenSSIS) –Research Thrust 1 -Photonics (Subcontract via Northeastern University)	National Security Agency	9/1/05	8/31/06	$126,128
Saleh, Bahaa	CenSSIS Supplement - Quantum Optical Coherence Tomography	NSF/Northeastern University	2/1/03	8/31/26	$105,000

Recipient	Title of Award	Source	Begin Date	End Date	Amount
Saleh, Bahaa	Quantum Imaging: New Methods and Applications (DURIP) (Subcontract via University of Rochester)	DoD	5/5/06	5/5/07	$77,000
Saleh, Bahaa; Teich, Malvin; Sergienko, Alexander	Quantum Imaging: New Methods and Applications (MURI) (Subcontract via University of Rochester)	DoD/Army	5/1/05	9/30/06	$162,346
Saleh, Bahaa Teich, Malvin Sergienko, Alexander	Ultrafast Quantum Optics (Subcontract via BBN Technologies)	DoD/DARPA	8/1/01	6/30/06	$84,375
Saleh, Bahaa Sergienko, Alexander Teich, Malvin	Quantum Imaging: New Methods and Applications (MURI) (Subcontract via University of Rochester)	DoD/Army	5/1/05	9/30/06	$54,115
Saligrama, Venkatesh	Networked Sensing Systems for Urban Target Recognition	DoD/Navy	12/31/05	12/30/07	$75,000
Saligrama, Venkatesh	International Workshop on Networked Sensing, Information, and Control	NSF	9/15/05	8/31/06	$49,500
Saligrama, Venkatesh	A Systems Approach to Networked Decision Making in Uncertain Environments	NSF	5/1/05	5/31/07	$80,000
Semeter, Joshua	CAREER: Magnetosphere-Ionosphere Coupling Through Multi-Sensor Data Fusion	NSF	5/1/06	4/30/07	$82,870
Semeter, Joshua	Ground-Based Investigation of Upflowing Ions in the Discrete Aurora (in conjunction with Center for Space Physics)	NSF	1/1/06	12/31/06	$80,033
Semeter, Joshua	AMISR Graduate Studies: Development of Multi-Sensor Analysis Techniques and a Synergistic Educational Program	NSF	1/1/06	12/31/06	$72,670
Sergienko, Alexander; Teich, Malvin; Saleh, Bahaa	Ultrafast Quantum Optics (Subcontract via BBNTSolutions LLC)	DoD/DARPA	8/1/01	6/30/06	$84,375
Sergienko, Alexander; Teich, Malvin; Saleh, Bahaa	Ultrafast Quantum Optics (Subcontract via BBNT Solutions LLC)	DoD/DARPA	8/1/01	6/30/06	$168,750
Starobinski, David	A Theory of Stability for Communication Networks	Dept. of Energy	8/1/05	8/14/06	$99,999
Starobinski, David	A Theory of Stability for Communication Networks (in conjunction with Center for Information and Systems Engineering)	Dept. of Energy	8/1/06	8/14/07	$99,999
Teich, Malvin	Free Space Quantum Key Distribution (T. Yarnall) (Subcontract via MIT/Lincoln Laboratory)	DoD/ Air Force	9/1/05	12/31/05	$14,965
Teich, Malvin	Free Space Quantum Key Distribution (T. Yarnall) (Subcontract via MIT/Lincoln Laboratory)	DoD/ Air Force	1/1/05	1/31/06	$18,707

Recipient	Title of Award	Source	Begin Date	End Date	Amount
Teich, Malvin	Free Space Quantum Key Distribution (T. Yarnall) (Subcontract via MIT/Lincoln Laboratory)	DoD	06/01/06	08/31/06	$11,422
Trachtenberg, Ari	CAREER: Practical Data Synchronization – Minimizing Communication	NSF	2/1/02	1/31/07	$70,708
Ünlü, M Selim	MURI: New Instrumentation for Nanoscale Subsurface Spectroscopy and Tomography (Subcontract via University of Rochester) (	DoD/Air Force	6/13/03	1/14/07	$60,764
Ünlü, M. Selim	Design, Fabrication and Bench Testing of the FLAMES (in conjunction with Center for Nanoscience and Nanobiotechnology)	DHHS	9/20/05	08/31/07	$51,502
Ünlü, M. Selim; Swan, Anna; Goldberg, Bennett; DeLisi, Charles	International Collaboration on Resonant Structures for Biosensing and Imaging (in conjunction with Center for Nanobiology and Nanosciences)	NSF	5/1/06	4/30/09	$150,000
Ünlü, Selim	MOCVD Growth of GaAs Wafers for Heterojunction Bipolar Transistors with Reduced Burn-In (Subcontract via Kopin Co)	NSF	7/1/05	6/30/06	$45,250
Ünlü, Selim	MURI: New Instrumentation for Nanoscale Subsurface Spectroscopy and Tomography (Subcontract via University of Rochester)	DoD/Air Force	6/15/03	6/14/06	$40,349
Ünlü, Selim	High-Throughput, Label-Free, Promoter Sequence Discovery	HHS/NIH/NIGMS	7/1/06	06/30/07	$231,250

Subtotal	Grants with ECE PIs				$5,151, 653

New Grants with ECE co-PIs

Recipient	Title of Award	Source	Begin Date	End Date	Amount
Rebbi, Claudio; Brower, Richard	ITR-(ASE)-(sim): Optimized Dirac Inverter for Quantum Field Theory ($100,000)	NSF	9/1/05	8/31/06	$50,000
Caraminis, Michael; Coker, David; Giles, Roscoe; Grossberg, S	IGERT: Multidisciplinary Approach to the Integration of High-Performance Computing in Science Education ($541,210º	NSF	12/1/05	11/30/06	$108,242
Coker, David; Giles, Roscoe; Rebbi, Claudio; Grossberg, S	IGERT: Multidisciplanary Approach to the Integration of High-Performance Computing in Science Education ($100,980)	NSF	12/1/05	11/30/06	$20,196
Goldberg, Bennett;	An Atomic Force Microscope for Biological	NSF	9/1/05	8/31/08	$67,480

Recipient	Title of Award	Source	Begin Date	End Date	Amount
Klapperich, Catherine; Ünlü, Selim	Imaging, Lithography, and Force Measurements (additional co-PIs: Desai Tejal, M. Grinstaff) (in conjunction with Center for Nanobiology and Nanosciences) ($168,700)				
Goldberg, Bennett; Swan, Anna; Ünlü, Selim Karl, Clem	Nanoscale Imaging of Subcellular Processes	HHS/NIH/NIBIB	7/1/06	6/30/07	$340,213
Fraser, Donald; Hubbard, Allyn	Photonics Technology Development and Insertion/Task 25: Accoustic Sniper Detection (in conjunction with Photonics Center)	DOD	6/1/05	4/30/06	$150,000
Fritz, Theodore; Ruane, Michael; Hubbard, Allyn; Sullivan, James	Loss Cone Imager ($732,000)	Air Force	7/01/05	6/30/06	$366,000
Hubbard, Allyn; Mountain, David; Caraminis, Michael	Models of Beaked Whale Hearing and Responses to Underwater Noise (In conjunction with Hearing Research Center)(83469)	DOD/Navy	4/6/04	7/5/06	$27,823
Hubbard, Allyn; Mountain, David	EarLab: A Virtual Hearing Laboratory (in conjunction with Hearing Research Center)(490,152)	HHS/NIH/NIDCD	9/1/05	8/31/06	$245,076
Goldberg, Bennett; Ruane, Michael; Garik, Peter; Phillips, Constance; DeRosa, Donald	GK-12 Project STAMP – Science Technology and Mathematics Partnerships ($76,500)	NSF	6/1/05	5/31/06	$15,300
Goldberg, Bennett; Ünlü, Selim	MURI: New Instrumentation for Nanoscale Subsurface Spectroscopy and Tomography (Subcontract via University of Rochester) ($44,236)	DoD/Air Force	6/15/03	1/14/07	$22,118
Klapperich, Catherine; Goldberg, Bennett; Ünlü, Selim; Desai, Tejal	Research Assistantships for High School Students: An Atomic Force Miscroscope for Biological Imaging, Lithography and Force Measurements ($5,000)	NSF	6/1/06	8/31/08	$1,250
Mountain, David; Hubbard, Allyn	Active Filtering in the Cochlea (in conjuction with the Hearing Research Center) ($501,089)	HHS/NIH/NIDCD	7/1/06	6/30/07	$250,545
Moustakas, Theodore; Fraser, Donald	Photonics Research and Development (Subcontract via University pf Nevada Las Vegas Research Foundation) ($196,250)	Dept. of Energy	8/1/05	10/31/06	$98,125
Pi, So-Young; Lane, Kenneth; Brower, Richard; Cohen, Andrew; Rebbi, Claudio	Research in Particle Physics/Task E: Theoretical Particle Physics	Dept. of Energy	2/1/06	1/31/07	$98,000

Subtotal	Grants with ECE co-PIs				$1,860,368
Grand Total					**$7,012,021**

Continuing Grants and Contracts, FY06

Recipient	Title of Award	Source	Begin Date	End Date
Alanyali, Murat	CAREER: Scalable Architechture for Self-Managed Networks	NSF	7/1/03	7/31/08
Alanyali, Murat	Distributed Methods for Statistical Decision Making in Networked Environments	NSF	8/1/04	7/31/07
Alanyali, Murat	Distributed Methods for statistical Decision Making	NSF	8/1/02	7/31/07
Bellotti,Enrico	CAREER: Theoretical Investigation of Single Photon Detectors for Quantum Technology	NSF	5/1/05	4/30/10
Bigio, Irving J	Graduate Student Support N. Kunapareddy	Socities	6/1/05	5/31/06
Herbordt, Martin	Exploratory /Development Grant: FPGA-Based Computational Accelerators	PHS/NIH/NCRR	7/1/04	6/30/06
Karl, W. Clem	Foundations in Automatic Target Recognition	AFOSR	9/1/03	8/31/06
Konrad, Janusz	"US-France Cooperative Research: Segmentation and Reconstruction of Scenes with Dynamic Objects"	NSF	5/1/03	10/31/06
Little, Thomas	REU Supplements: NetS-NOSS: Semantic Internetworking of sensor systems for efficient in-network information processing	NSF	1/1/05	12/31/06
Morse, Theodore	Ultra-Sensitive Bio-Detection Using Whipering Gallery Spheres and Intra-Cavity Polarization Mode Beating (PMB)	NSF	9/1/04	8/31/07
Moustakas, Theodore	Deep Ultraviolet Laser Diod for UV Resonance Enhanced Raman Identification of Biological Agents	Photon/DARPA	2/15/04	2/15/06
Moustakas, Theodore	Novel Gan HBT for advanced T/R Modules for X-band Radar Performance Enhancement	Air Force thru Photronix	9/27/04	9/29/06
Moustakas, Theodore	Comparative Studies of UV LED's Emitting at 280 nm Grown along Polar and Non-Polar Direction of AIN Substrates and Templates	U.S. Air Force AFRL	5/10/05	8/10/06
Oliver, William	REU Suplement: Incoherent Scatter Radar Studies of Hot Oxygen	NSF	11/15/03	10/31/06
Roy, Ronald	Enhancement and Control of Remote Acoustic Hemostasis and Focused Ultrasonic Surgery by Acoustic Cavitation	CenSSIS Industrial	5/1/03	5/31/07
Saleh, Bahaa	Engineering Research Center (ERC): Center for Subsurface Sensing and Imaging Systems research thrust 1-acoustics	Northeastern University/NSF	9/1/04	8/31/06

Recipient	Title of Award	Source	Begin Date	End Date
Saleh, Bahaa	Quantitive Imaging and Coral Imaging (CenSSIS supplement)	CENSSIS Northestern Univ	1/1/03	6/30/06
Sergienko, Alexander	ITR-Integrated Source of High-Fidelity Entangled States for Quantum Information Processing	NSF	9/1/2003	8/31/2006
Starobinski, David	CAREER: Quality of Service Engineering with Multiple Time-Scale Traffic (REU)	NSF	5/1/2003	7/31/2007
Starobinski, David	NeTS-NOSS: SensorNet Architecture for indoor Location Detection: From Resolution to Robustness	NSF	9/1/2004	8/31/2007
Starobinski, David	REU Supplements: NetS-NOSS: SensorNet Architectures for Indoor Locations Detection: From Resolution to Robustness	NSF	9/1/2004	8/31/2007
Starobinski, David	CAREER: Quality of Service Engineering with Multiple Time-Scale Traffic	NSF	8/1/2002	7/31/2007
Swan, Anna	Nanometer Resolution Spectral Self-Interference Fluorescence Microscopy	NSF	5/1/2002	4/30/2007
Swan, Anna	4 Schools for WIE	Northeastern/NSF	12/15/2002	10/31/2006
Swan, Anna	Nanometer Resolution Spectral Self-Interference Flourescence Microscopy (REU and Travel)	NSF	1/1/2003	4/30/2007
Teich, Malvin	Functional imaging of synapses by entangled-photon microscopy	Packard Foundation	8/1/1999	8/31/2006
Trachtenberg, Ari	A Scalable Middleware For Data Reconciliation in PDA's and Mobile Networks	NSF	6/1/2003	5/31/2007
Unlu, Selim	U.S. Switzerland Cooperative Research: Monolithic High-speed Photoreceivers, Wavelength, and Polarization Sensors on Si	NSF	5/15/2002	4/30/2006
Unlu, Selim	NIRT: Advanced Characterization Techniques in NIRT: Advanced Characterization Technique in Optics for Nanostructures (ACTION)	NSF	10/1/2004	9/30/2006

Gifts and Other Awards

Recipient	Source	Amount
Castañón, David	BBN Technologies	$7,000
Knepper, Ronald	Analog Devices	$50,000
Qin, Wei	Intel Corporation	$25,000
Sergienko, Alexander	ELSAG Spa	$50,000
Total Gifts and Awards		$132,000

six: *Outlook*

6.1 Mission and Vision

The Department of Electrical and Computer Engineering (ECE) at Boston University is a medium-size Research-I department with a current enrollment of 273 BS, 79 MS, and 106 PhD students. The Department offers BS, MS and PhD degree programs in Electrical Engineering (EE) and Computer Systems Engineering (CSE) and a MS degree in Photonics. Both undergraduate programs are accredited by ABET. The Department has 43.5 FTE faculty, who earned approximately $7M of new grants and contracts this year. The Departmental facilities occupy about 55,000 sq. ft. in the Photonics Building.

ECE is a multidisciplinary department, with a strong systems perspective. There are three overlapping areas of research and instruction: Electrophysics, which includes photonics, solid state materials and devices, and electromagnetics and space physics; Information Systems and Sciences, which includes signal and image processing, control and communication systems, and networks; and Computer Systems Engineering, which includes hardware, software applications, and computer networks. The faculty have collegial ties to important Boston University research centers, most notably the Photonics Center, the Center for Nanoscience and Nanobiotechnology (CNN), the Center for Information Systems and Engineering (CISE), the Center for Computational Science, the Center for Space Physics, the Center for Subsurface Sensing and Imaging Systems (CenSSIS), and the Center for Cognitive and Neural Systems. We also have strong links with several other departments at Boston University (See Fig.1). Many faculty members pursue collaborative cross-disciplinary research with faculty in other Boston University departments and have strong extramural ties in larger centers, multi-university initiatives, and industry collaboratives.

Electrical engineering and computer systems engineering are fundamental technology disciplines. They address challenging research problems, support important applications, and offer strong opportunities for business development. Innovations from electrical and computer engineering define modern society and support much of the world's high-tech economy. Personal computers, cellular phones, fiber optics communications and the Internet, medical imaging systems, digital CDs and DVDs, laser materials processing, new energy sources, and modern defense systems are just a few of the many technologies arising from electrical and computer systems engineering.

Electrical engineering and computer systems engineering are also enabling disciplines. They are critical to the development of virtually every field of science, technology, and medicine. Electronic instrumentation for measurements on scales from nanometers to light years, environmental monitoring of pollution, land use and global warming; automatic control systems for industry and transportation; data communications for people, corporations, and governments; and computer modeling for economics, DNA, weather, and security are examples of how we support broad areas of inquiry and contributions to human knowledge and welfare.

Electrical and computer systems engineering have special significance and relevance as key technologies for the 21st century, where information and systems sciences will be vital to the solution of the significant problems facing society. Other areas of the university benefit from the technologies and training we provide to research, education, and outreach. The Massachusetts economy, especially along Route 128/I93, is strongly dependent on companies and industries rooted in electrical and computer systems engineering. Even the financial services economy of Boston relies on information sciences, communications, and computer systems supported by the disciplines we address. Finally, efficient, effective intelligence and defense systems increasingly rely on electrical and computer systems engineering innovations to collect data and project force in lieu of putting soldiers and military assets directly at risk.

The ECE Department has attracted outstanding students and faculty, instituted major centers, and built an excellent reputation in the professional community. ECE Ph.D. students have earned numerous Dean's Fellowships and prestigious external fellowships from NSF, DARPA and the Gates Foundation. Most of the ECE junior faculty have been recognized with CAREER awards and/or ONR Young Investigator awards, and many of the senior faculty are world-renowned figures in their fields.

The mission of the ECE Department is:

1. To educate our students to meet high standards of excellence in electrical and computer engineering in preparation for professional careers and advanced studies.

2. To create and disseminate new knowledge through basic and applied research in electrical and computer engineering.

3. To serve as a resource of electrical and computer engineering expertise at the local, regional, and national levels.

Our overall strategy for creating a prominent program in education, research, and outreach is to continue to focus on a few important interdisciplinary 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. This will require faculty stability and growth and continued University support for curriculum and laboratory development.

Plans for faculty growth (and replacements in response to attrition) have been motivated by the need to strengthen existing research areas to become more competitive at a na-

tional level, develop new expertise to keep up with the rapidly changing face of the 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 to exploit 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.

Figure 1. Links Between the ECE Department and Other Departments and Centers

6.2 History and Trends

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 larger graduate program, a substantial research program, and an increasingly distinguished faculty. In 1994, a new Department chair led an effort to expand research in a number of targeted areas and to improve the instructional programs. The relocation of the Department to the new Photonics Building in 1997 has provided faculty and students with excellent research and instructional facilities. The recent history of the Department is depicted by a number of vital statistics of enrollment, faculty size, and grant funding, as described in this section.

A. Students

Statistics of enrollment in the BS, MS, and PhD ECE programs are displayed in Fig. 2. Undergraduate enrollment has tended to mirror national patterns, including the following:

- After a period of stable undergraduate enrollment in 1996-2001, a demographic decline is occurring, as enrollment restrictions implemented to maintain high standards of quality of the student body continue.

- While the enrollment in the EE program has remained stable in the last decade, the large increase in CSE enrollment that occurred in the late 1990's has been followed by a sharp decline (Fig. 3). For the first time in ten years, the CSE undergraduate enrollment has dropped below that of the EE program.

At the graduate level, the emphasis has shifted from professional MS-oriented students and the number of MS and PhD students are now almost equal.

- MS degree enrollment has increased in the last few years after a period of low enrollment following a sharp decline in the late 1990's due to the demise of the Corporate Classroom program.

- PhD enrollment has risen. This year, we have reached an all-time high number of 106 PhD students.

- Graduate teaching fellowship resources have remained fixed, while RA support grew with grant funding.
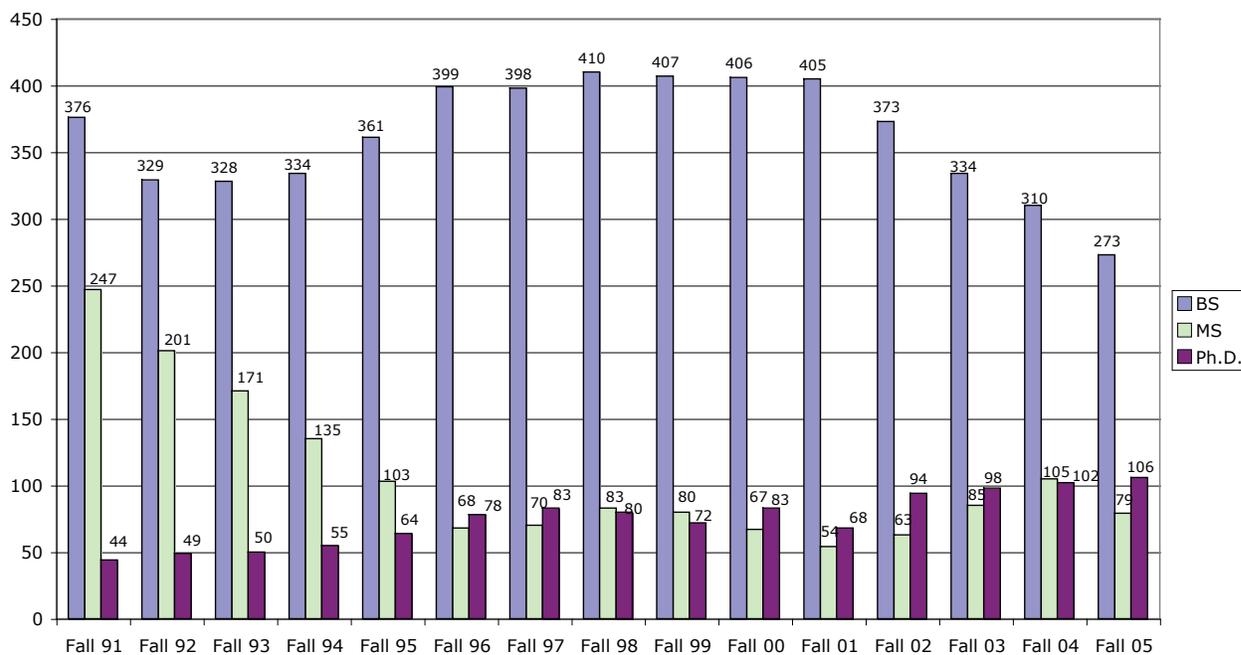

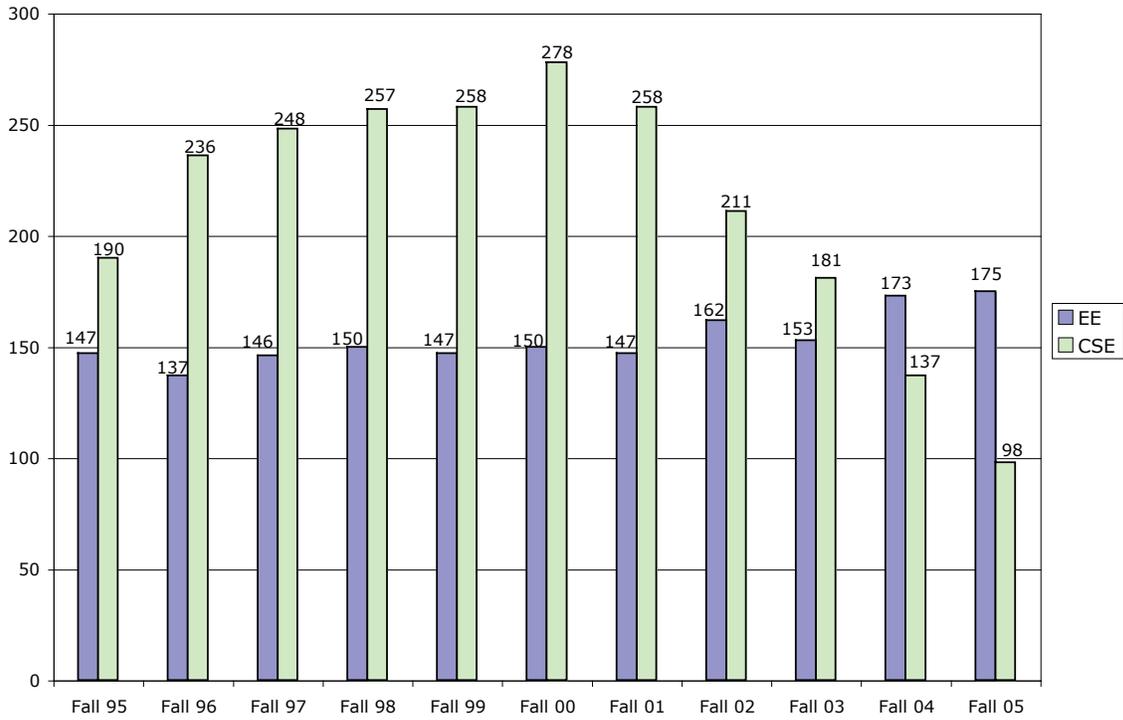**Figure 2. History of BS, MS and PhD Student Enrollment**

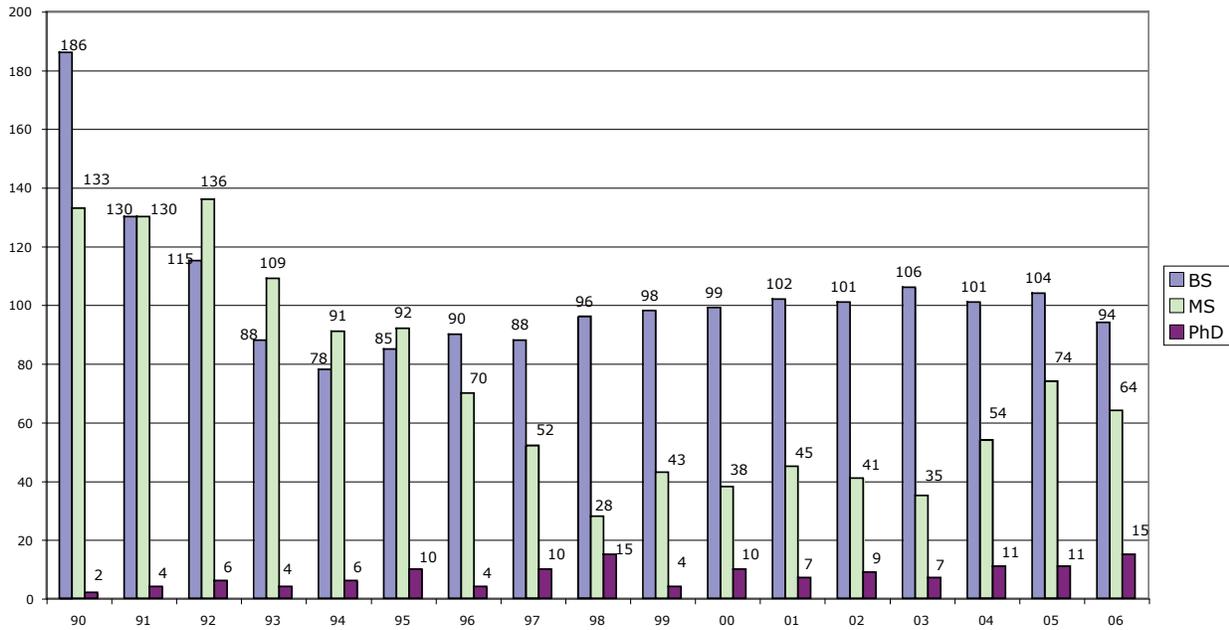**Figure 3. EE and CSE Undergraduate Enrollment Statistics**

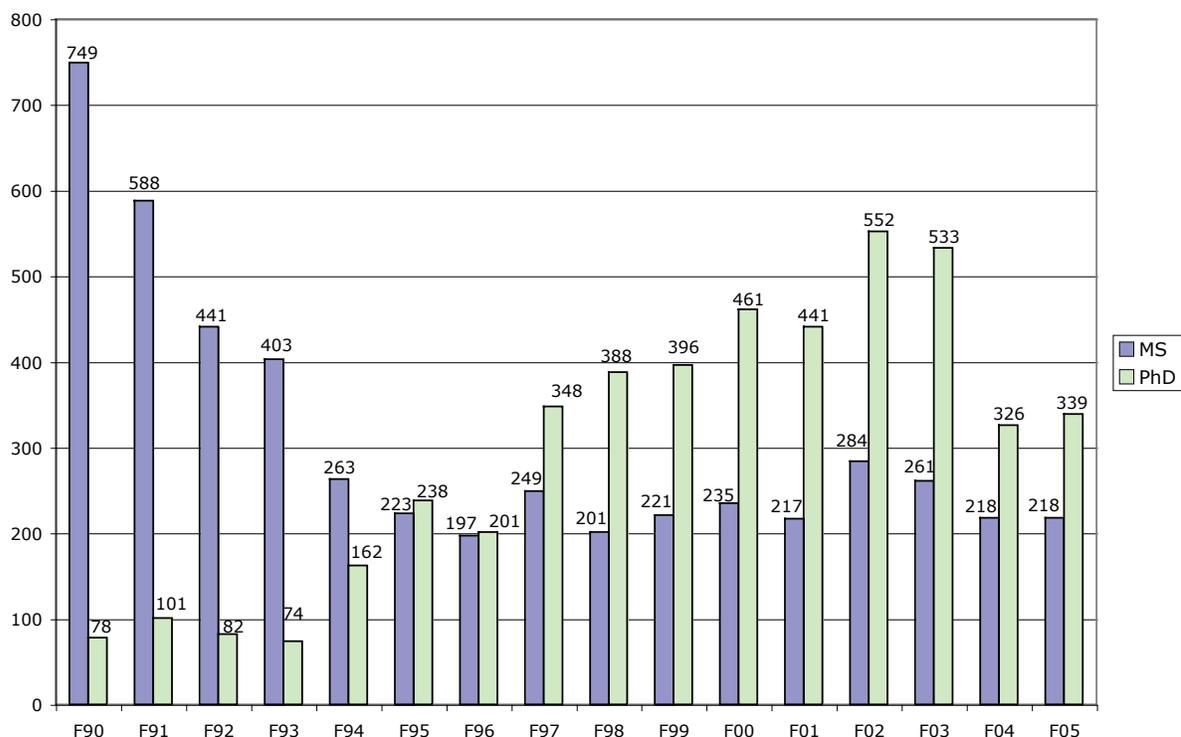**Figure 4. History of Degrees Awarded**

Figure 5. History of Graduate Applications

B. Faculty and Staff

Faculty hiring has largely replaced departures, with a small net growth in recent years. The appointment of three new faculty in AY04-05, and the absence of departures this year is a step in the right direction, but filling open faculty positions in key areas remains a key departmental goal. Additionally, new faculty are needed in certain strategic areas. Previous faculty attrition has been caused by retirement, non-renewal of inactive faculty, and competition from other institutions that made attractive offers to some of our successful faculty. Proactive action to prevent such attrition is necessary.
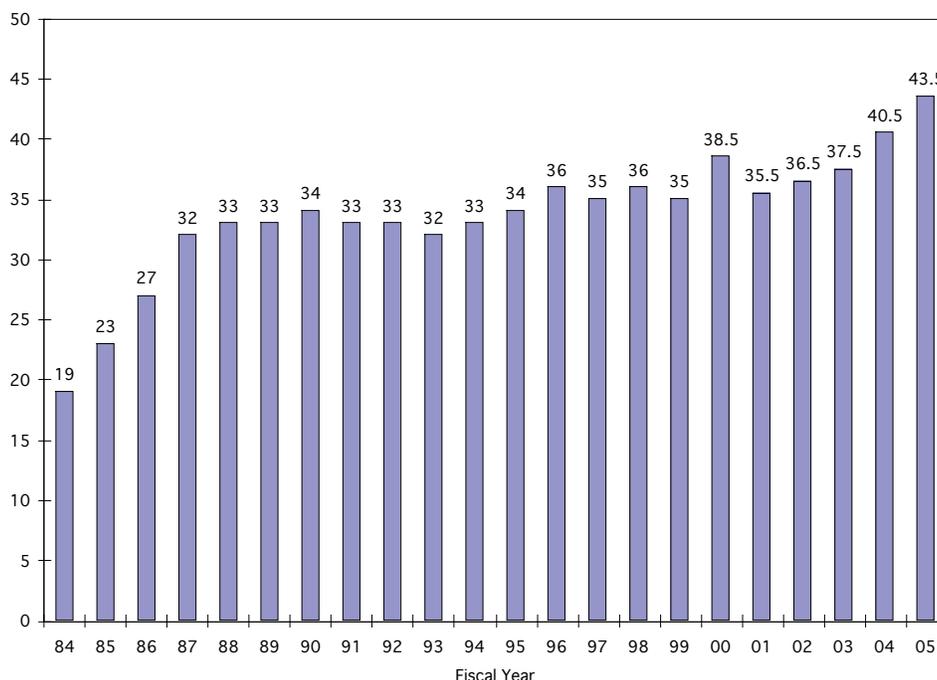
Figure 6. Number of faculty (FTE). Affiliate faculty and research faculty with no teaching responsibilities are not included in this chart. Teaching faculty without an active research program are included.

Research funding has grown significantly in the last decade. Total annual new research funding in the last five years averaged to approximately $7.2M, compared to $5.2M in the 1996-00 period, and $2.4M in 1990-95. The number of non-research-active faculty is diminishing, but still remains higher than we would like.

Staff development has lagged behind the faculty and programmatic changes. Scientific staff (research faculty, post-docs, visiting scholars) has increased with associated space and administrative demands, but the technical lab staff positions have remained at six. Administrative staff has grown much slower than the faculty/scientific staff head count and research volume.

New Funding
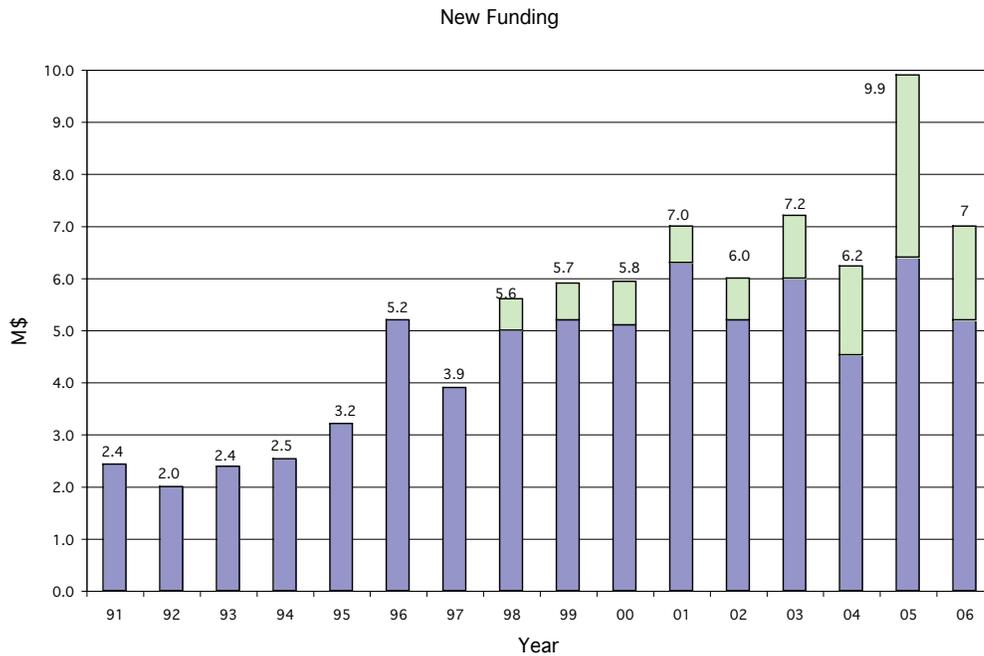
Figure 7. New research grants and contracts (the purple bars represent grants and contracts for which the principal investigators were ECE faculty; the green bars represent the share of ECE faculty in grants and contracts for which the PI are from other departments).

6.3 Areas of Research & Instruction: Needs & Targeted Growth

The ECE Department has three overlapping areas of research and instruction (see the schematic illustration in Fig. 8): Electrophysics, which includes photonics, solid state materials and devices, and electromagnetics and space physics; Information Systems & Sciences, which includes signal and image process- ing, and control and communication systems; and Computer Systems Engineering, which includes hardware, software applications, and computer and communication networks. The following is a description of each of these areas, including its present needs and its envisioned future.
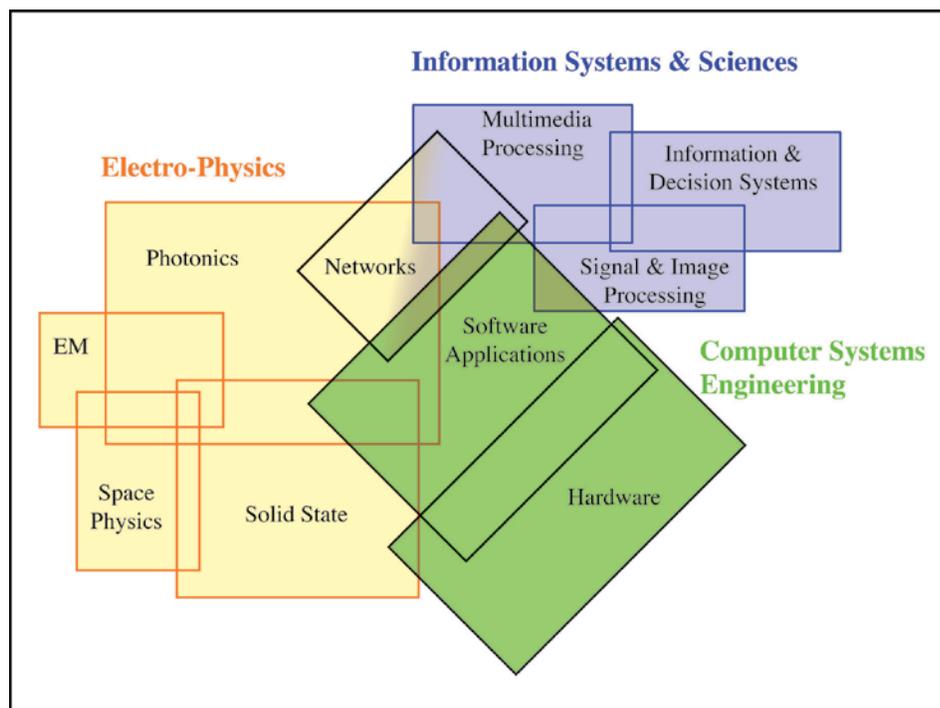

Figure 8. Areas of Research and Instruction

A. Electrophysics

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

Photonics

When BU established the Photonics Center, it made a strategic commitment to become a national center of excellence in photonics. World-class research facilities were developed and a number of senior and junior ECE faculty were added in the photonics area. The photonics faculty have infused many new courses into the curriculum, strengthening the PhD program and eventually leading to the creation of the new MS in Photonics degree program. The instructional program in pho- tonics has been supported by external fellowships from the Department of Education and from curriculum development funds from industry and the National Science Foundation.

Research in photonics includes: photonic materials and devices (led by Ted Moustakas, a world renowned leader in nitride technology, Roberto Paiella, an expert in quantum-cascade lasers, and new faculty member Luca Dal Negro, who is developing a new facility in photonic-crystal devices); optical fibers (with a unique fabrication facility led by Ted Morse); quantum optics and its applications to imaging and secure communication (with a group of distinguished senior faculty, Bahaa Saleh, Alexander Sergienko, and Malvin Teich); optical imaging and microscopy (Selim Ünlü, who leads research in nanobioimaging associated with the Center for Nanoscience & Nanobiotechnology) and carbon nanotubes (Anna Swan). Biophotonics research is pursued by Irving Bigio, Anna Swan, and Selim Ünlü, and research in magneto-optics and optical storage is led by Michael Ruane and Floyd Humphrey. Research funding in this area has grown substantially in recent years, with a small fraction of the funds received through the

Photonics Center. The 2000 award of Boston University's first NSF ERC, the Center for Subsurface Sensing and Imaging Systems (CenSISS), was a significant and widely publicized accomplishment that has strengthened the sensing and imaging component of photonics.

The future of the BU photonics program depends on our ability to maintain the present large momentum by continuing to strengthen this program with new outstanding faculty in relevant areas. We have an opportunity to benefit from the outstanding facilities offered by the Photonics Center to launch large research initiatives in photonics.

Solid State Materials & Devices

This area overlaps naturally with photonics and we have deliberately emphasized this connection in an effort to strengthen the photonics program while meeting our instructional needs in the semiconductor area. The most senior faculty member in this area, Ted Moustakas, continues to lead a large research program in the more advanced family of Nitride Semiconductors, an area for which the group is recognized as one of the leading organizations in the world. The research is a combination of theoretical/modeling work in parallel with experimental studies of these advanced materials and corresponding devices. Intellectual Property derived from this work has been licensed by the University to major US and Japanese companies producing blue LEDs and blue lasers. Junior faculty member Roberto Paiella is involved applications of the nitrides to long-wavelength devices, including quantum cascade lasers, and Enrico Bellotti pursues world class, and well funded, research in numerical modeling of semiconductor materials and devices. The group is funded by DOE (for applications in solid state lighting), by DARPA and NASA (for the development of UV lasers and LEDs for identification of biological and chemical agents, by the Air Force (development of transistors for high power and high frequency applications) and by ARL (development of quantum cascade lasers). Fundamental work is supported by NSF, ONR and AFOSR-MURI. The group collaborates closely with members of the Physics Department. The most recent addition to this group is Luca Dal Negro, who is developing a laboratory in silicon light sources.

It is of great concern that the ECE Department has lost its silicon microelectromechanical (MEMS) fabrication facility and has not yet replaced it. Further, the space that was previously allocated for this purpose in the original plans of the Photonics building has been acquired by the Photonics Center for its commercialization activities. Establishing a modest-size silicon fabrication facility and recruiting in the area of micro- and/or nanotechnology has been, and must remain, one of our high priorities. The lab is necessary for our EE instructional program and for research in MEMS, optical MEMS, and nanotechnology.

Identified at the national level as critical to economic and security needs, nanotechnology encompasses research in areas related to photonics, biophotonics, and sensing and imaging systems, areas of long-standing interest in the Department. This is also consistent with university-wide initiatives and with our objective of maintaining a strong interest in photonic solid-state materials and devices. Growth plans and recruiting in this area must therefore be well coordinated at the University level.

Electromagnetics & Space Physics

Both the EP and the ISS groups have maintained collaborations with the Center for Space Physics (CSP). Two ECE faculty members (Bill Oliver and Josh Semeter) are directly involved in atmospheric and remote sensing studies, and others are involved in signal processing applications (David Casta-ñon, Clem Karl, and Janusz Konrad) and instrumentation (Allyn Hubbard and Mike Ruane). Affiliate appointments for CSP/AST Professors Ted Fritz, Michael Mendillo, and Supriya Chakrabarti in the ECE Department have strengthened the collaboration and facilitated the involvement of ECE students in CSP projects in areas such as atmospheric studies using radio wave technology, remote sensing, and astronomical imaging. The recent addition of Prof. Semeter to the ECE faculty has created a stronger link, and continued collaboration remains of mutual benefit to both units. Other ECE faculty involved in electromagnetics research include Professors Mark Horenstein, who is engaged in novel designs of microelectromechanical systems; Robert Kotiuga, whose research addresses micromagnetics and numerical and topological aspects of electromagnetic fields; and Min-Chang Lee who is conducting experiments in radio communication via ionospheric plasma.

B. Information Systems and Sciences

The ECE department has established a strong, nationally recognized research group in the area of Information Sciences and Systems (ISS). This is evidenced by the fact that almost every ISS faculty member has been awarded the prestigious CAREER award and several faculty members have successfully competed against top institutions in garnering highly coveted MURI awards. ISS faculty members have also been instrumental in bringing the highly competitive Engineering Research Center (ERC) on subsurface imaging to Boston University, and another ERC is currently being contemplated in the area of video networks. Many of the faculty chose BU over competitive offers from higher ranked institutions. Our most recent addition in this area is Masoud Sharif, who recently received his PhD from CalTech.

Research in ISS deals with the dual aspects of uncertainty and information in physical as well as engineered systems. The

group works on applications including biomedical signal and image processing, coding for communication systems, multimedia communication, distributed and mobile computing, sensor networks, and advanced visual communication and entertainment. This area overlaps with the CSE group, and a program in computer networks benefits from this diverse expertise in the Department.

A particular strength of this group has been in establishing a pre-eminent position in the area of sensor networks. Indeed, it is not farfetched to say that, in this particular realm, we are the strongest in the Boston area and favorably viewed in comparison to other nationally recognized groups such as Berkeley, Stanford, UIUC and Michigan. To put this into perspective, an NSF funded workshop on networked sensing, information and control organized by BU has almost all faculty drawn primarily from these institutions and none from Boston area schools (other than BU). The area of sensor networks – a massive network of tiny sensors capable of measuring, processing and exchanging data over a wireless medium – has immense potential and the envisaged applications range from military surveillance to environmental biology and ecological monitoring. In this context our faculty has an ongoing collaboration with the BU biology department.

Another aspect of this group's research involves the extraction and interpretation of uncertain/incomplete information in bio-medical imaging contexts. The laboratory has established strong collaborative efforts with MGH and has an active ongoing collaboration with the BME department. A related area of research actively being pursued by our faculty in collaboration with MGH involves understanding the structure of very high dimensional data through information-theoretic methods. This area has recently received significant attention in the context of Bio-Informatics. The ISS group, with its strong emphasis on understanding information and its structure, is a natural home for this research endeavor. Our long-term vision would exploit our unique competitive advantage over other Boston-area schools and establish a first-rate research program in information sciences and its myriad applications ranging from wireless communications, networked sensing, and bio-informatics through active collaboration and well instituted faculty hires. The continuation of recruitment of new faculty members is essential to consolidation of the program and retention of "star" faculty members.

C. 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 CSE. 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 and sensor networks. The ECE Department has strengths consistent with these opportunities including research in computer architecture, VLSI, fault-tolerant computing, communications and computer networking, embedded systems, and, computational science.

Communications and computer networking lies at the boundary between the ISS group and the CSE group. There is no doubt that networks have dramatically changed our society and are expected to continue to have a significant economic impact and to drive much of electronics and computer technology. Student demand for telecommunication and networking courses has been high, and the Department has recently enhanced the curriculum in this area at both the undergraduate and graduate levels. A number of new faculty members have established research programs in this area. The Computer Science Department at BU has also targeted computer networks as a strong research thrust, the Department of Manufacturing Engineering has a strong systems group with a related interest in discrete event systems, and the Center for Information System Engineering (CISE) has linked research activities across the campus. Our combined effort has created a strong BU program in this important area.

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. The addition of more faculty in this area is essential to meet increased teaching needs, to reduce the burden on the few research productive faculty in this area, and to give this area the critical mass necessary to gain national recognition and competitiveness for research funds.

Other important areas in computer engineering include embedded systems and real time software design, reliable computing, design automation, asynchronous systems, test and diagnosis of computer hardware, and multimedia computing. Research in computational science is strong in ECE 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. Research in high-performance computing is strong in ECE 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.