

**BOSTON  
UNIVERSITY**

**Department of Electrical and  
Computer Engineering  
1999-2000  
Annual Report**

**July 1, 1999 - June 30, 2000**

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# 1. 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 1999-2000 academic year. The instructional activities reported are for the Fall 1999, Spring 2000, and Summer 2000 semesters. Publications and scholarly activities, as well as budget information, are reported for the 2000 fiscal year (July 1, 1999 to June 30, 2000). Key data for this year are also compared to previous years to show progress and identify areas of strength and weakness. Please refer to the Department's website (<http://bu.edu/ECE>) for more information on ECE's recent activities.

## Faculty

Two new faculty, Dr. Ronald Knepper and Dr. Theodore Morse, were appointed to the ECE Department at the rank of Professor, in September 1999. Dr. Ronald Knepper retired from the IBM Microelectronics in Hopewell Junction, New York, where he held a number of positions, including Senior Manager of Advanced Silicon Technology Laboratory. His research interests include integrated circuit design, microprocessor design, device design and modeling, and numerical device simulation (See sidebar on page 1-2). Dr. Theodore Morse has been a Professor of Engineering at Brown University from 1968 until his retirement in 1999. He is a world renowned expert in optical fiber sensors and optical fiber lasers. At Boston University, he has founded the Laboratory for Lightwave Technology (See sidebar).

The Department has also added three new research faculty. Dr. Fei Luo and Dr. Valery Kozlov are working with Professor Morse, while Dr. Anna Swan is working with Professors Selim Ünlü and Bennett Goldberg.

The Department has continued its vigorous efforts to recruit new faculty in selected strategic areas. From this extensive search, three new faculty members will join the ECE Department for Fall 2000, at the rank of Assistant Professor. Dr. Enrico Bellotti received the Ph.D. from the Department of Electrical Engineering at Georgia Institute of Technology in 1999. His area of research is semiconductor materials and device design and simulation. Dr. David Starobinski received the Ph.D. from the Electrical Engineering Department at the Technion, Israel Institute of Technology in 1999. Over the course of the past year, he was a post-doctoral fellow at the Electrical Engineering and Computer Science Department, University of California-Berkeley. His research interests include high-speed communication net-

works and wireless cellular networks. Dr. Ari Trachtenberg received the Ph.D., in 2000, from the Department of Computer Science at the University of Illinois, Urbana-Champaign. His research interests include error correcting codes, cryptography, algorithms, approximations, computation, and visualization. Also joining the ECE Department in Fall 2000, at the rank of Associate Professor with tenure, is Dr. Janusz Konrad, who received the Ph.D. from McGill University in 1989. He has served on the faculty of INRS-Télécommunications, Verdun, Quebec, Canada, from 1992 to 2000. His area of research is image/video processing, stereoscopic and 3-D imaging, and multimedia systems. Dr. David Campbell, who was appointed Dean of the College of Engineering beginning in Fall 2000, was also appointed Professor of Electrical and Computer Engineering.



*Theodore Morse joined the faculty of the Electrical and Computer Engineering Department, in September 1999, at the rank of Full Professor. Professor Morse received the Ph.D. in Mechanical Engineering from Northwestern University in 1961. He joined the faculty of Brown University in 1963, becoming Professor of Engineering in 1968 until his move to BU in 1999. At Brown University, he founded and directed the Laboratory for Lightwave Technology. He held visiting appointments at the Max Planck Institute in Munich, Germany, Woods Hole Oceanographic Institute, University of California at San Diego, and Northeastern University. He was a Fulbright Fellow in Germany. Dr. Morse is a world renowned expert on optical fiber sensors and optical fiber lasers. At Boston University, he has founded, and is currently the Director of, the Laboratory for Lightwave Technology. The DOD, Air Force and Navy, and the NSF fund his ongoing research.*



**Ronald Knepper** joined the faculty, in September 1999, at the rank of Full Professor. Professor Knepper received the Ph.D. in Electrical Engineering from Carnegie Mellon University in 1969. From 1969 until his retirement in 1999, he worked with IBM Microelectronics in Hopewell Junction, New York. While at IBM, he held a number of positions, including Project Manager of Exploratory Devices, Project Manager of Advanced Device Technology, Senior Manager of Technology Modeling, and Senior Technical Staff Member. In 1994, he was an IBM Visiting Scholar at the Center for Integrated Systems at Stanford University. Dr. Knepper's research interests include integrated circuit design, microprocessor design, device design and modeling, and process and device simulation. Holding 14 patents, he has made many contributions to the early circuit development and modeling of the MOSFET technology. Over the course of ten years, from 1983 to 1993, he served as editor of the *Solid-State Electronics Journal*. He received a number of awards, including two IBM Outstanding Technical Achievement awards for "conception and definition of circuit techniques for high performance arrays" and "semiconductor device modeling and design." Additionally, he was elected Fellow of the IEEE in January 2000.



**Mark Horenstein** was promoted to Full Professor in 1999. Professor Horenstein received the Ph.D. from the Massachusetts Institute of Technology, in 1978, and has been a faculty member in the ECE Department at Boston University since 1979. His research interests include applied electromagnetics, electrostatics, and micro-electromechanical systems (MEMS). He is an active member of the Electrostatics Society of America, currently serving as its President. Currently, he is a senior member of the IEEE. Dr. Horenstein has been a major player in designing the ECE undergraduate curriculum and has made numerous contributions to engineering education. He is the author of a popular textbook, *Microelectronic Circuits and Devices*, now in its second edition, and two other books on engineering design, *Engineering Design - A Day in the Life of Four Engineers* and *Design Concepts for Engineers*. During the 1990-98 period, he served as Associate Chair for the undergraduate program. In 1996, Professor Horenstein, received the Boston University College of Engineering Faculty Service Award. In 1999, the College of Engineering appointed him as Associate Dean for Research and Graduate Programs.



**William Clem Karl** was promoted to Associate Professor and granted tenure in 1999. Professor Karl received the Ph.D. in Electrical Engineering and Computer Science, in 1991, from the Massachusetts Institute of Technology (MIT) and continued as a Research Scientist with the MIT Laboratory for Information and Decision Systems through 1994. In 1995, he joined the faculty of Boston University as an Assistant Professor in the ECE Department, being appointed as an Assistant Professor in the Biomedical Engineering Department by 1996. His research interests include multidimensional and multiscale signal and image processing, with a particular focus on medical applications of image processing. Since 1995, he has been a Lecturer at the Harvard-MIT Division of Health Science and Technology. At BU, Dr. Karl founded the Multidimensional Signal Processing Research Laboratory, funded by NIH, AFOSR MURI, and ARO. During 1984-85, he served as Associate Editor of *Control Systems Newsletter*, and since 1996 he has served as Associate Editor of the *IEEE Transactions on Image Processing*, and remains a Senior Member of the IEEE. Professor Karl received the 1999-2000 ECE Teaching Award.

Furthermore, the appointment of **Professor Thomas Toffoli** will change from Research Associate Professor to Associate Professor, tenure track. For the 2000-01 school year, he will become active in teaching in the area of computer engineering.

Two ECE faculty members, **Dr. William Clem Karl** and **Dr. Alexander V. Sergienko**, were promoted this year to Associate Professor and awarded tenure (See sidebars on page 1-2, 1-3). Likewise, **Dr. Mark Horenstein** and **Dr. Truong Nguyen** were promoted to the rank of Full Professor (See sidebars on page 1-2, 1-3).

This year, **Professor Mari Ostendorf** and **Professor Scott Dunham** left Boston University, joining the faculty at the University of Washington. Dr. Dunham was on a leave of absence during the 1999-2000 academic year



**Truong Nguyen** was promoted to Full Professor effective for September 2000. Professor Nguyen received the Ph.D. from the California Institute of Technology in 1989 and was a member of the technical staff at MIT Lincoln Lab for five years. From 1994 to 1996, he was on the faculty of the University of Wisconsin-Madison, as Assistant Professor of Electrical and Computer Engineering. In 1996, he joined the faculty of the ECE Department at Boston University as an Assistant Professor. Two years later, he was promoted to Associate Professor and granted tenure. He served as Associate Editor of the *IEEE Transactions on Signal Processing* and the *IEEE Transactions on Circuits and Systems*. He was also a recipient of a NSF CAREER Award. Dr. Nguyen is widely recognized internationally in the area of wavelet transforms and filter banks and their applications to image and video compression. He is the co-author of *Wavelets and Filter Banks*, a highly cited textbook on this subject.



**Alexander Sergienko** was promoted to Associate Professor and granted tenure in 1999. Professor Sergienko received the Ph.D. from Moscow State University in 1987. In 1988, he became an Assistant Professor at Moscow State University. He moved to the U.S. in 1990 and held appointments at the University of Maryland, College Park, and the University of Maryland, Baltimore County, and the National Institute of Standards and Technology, before joining the ECE Department at Boston University in 1996 as Assistant Professor. His research interests include quantum optics, nonlinear optics, laser physics, and remote sensing and correlation spectroscopy. Receiving the NSF CAREER award in 1998, Professor Sergienko has become well known nationally and internationally as a pioneer in the area of spontaneous parametric down conversion of laser light and its applications to quantum communication, cryptography, and metrology. His contributions include the co-invention of a new method for the absolute measurement of the efficiency of photodetectors and a new source of high intensity entangled photons. Dr. Sergienko's research is supported by grants from NSF and NIST.

## Awards and Honors

The ECE faculty continue to be actively involved in national and international professional activities and to receive prestigious awards and recognitions.

**Leo Felsen** received the IEEE Third Millennium Medal. The IEEE Antennas and Propagation Society sponsored the nomination.

**Floyd Humphrey** received the IEEE Third Millennium Medal. The IEEE Magentics Society sponsored the nomination.

**Roscoe Giles** received the 2000 Computing Research Association (CRA) A. Nico Habermann Award. The award recognizes outstanding contributions to aiding members of underrepresented groups within the computing research community.

<http://www.cra.org/Activities/awards/habermann/winner00.html>

**Ronald Knepper** was elected Fellow of the IEEE for his contributions to semiconductor device design, modeling, and circuits. <http://www.ieee.org/organizations/pubs/newsletters/sscs/apr00/fellows.htm>

**E. Fred Schubert** was elected Fellow of the IEEE for his contributions to semiconductor doping and resonant-cavity devices. <http://www.ieee.org/organizations/pubs/newsletters/sscs/apr00/fellows.htm>

**Michael Mendillo** was elected Fellow of the American Geophysical Union.

**E. Fred Schubert** is one of the recipients of the Eleventh Annual Discover Magazine's Award for Technological Innovation. He is cited for his invention of the photon-recycling semiconductor light-emitting diode.

<http://perl.spie.org/cgi-bin/news.pl?id=1641>

**W. Clem Karl** received the 1999/00 Teaching Excellence Award. Additionally, he was elected as Senior Member of the IEEE.

An ECE design team, supervised by **Michael Ruane** and **Ronald Knepper**, received an Honorable Mention award and \$1000 at the finals of the first IEEE Computer Society International Design Contest (CSIDC-2000) held in Washington, DC. The team, *The Health Pilots*, consisted of ECE students **Benjamin Cahill**, **David LaCava**, **Alexandre Finkel**, and **Gustavo Moreira**. The team's submission was developed as their project in Senior Design, SC466, during the spring 2000 semester. The team designed a prototype wireless hand-held information appliance for improved health care. 180 colleges applied to enter the contest, with only 50, including BU, selected by lottery to compete. Ten finalists were invited to Washington. By reaching the 2000 finals, Boston University will automatically be invited to compete again next year.

**William Herzog** received the 2000 Photonics Technology Award. The award was presented at the Boston University Graduate Science Day. Herzog presented a poster entitled "Beam pointing and lateral shifting of frequency-locked modes in high-power laser diodes." The poster is co-authored by **Selim Unlu** and **Bennett Goldberg**.

**Lingmin Meng** received the 2000 Community Technology Fund Award. The award was presented at the Boston University Graduate Science Day. Lingmin Meng presented a project entitled "Can computers recognize us?" The poster is co-authored by **Truong Nguyen** and **David Castanon**.

## Undergraduate Program

Enrollment in the BS program showed no change and remains at 410 students. Enrollment in the Computer Systems Engineering (CSE) program now makes up roughly 64% of the total Undergraduate enrollment. Enrollment in the Electrical Engineering (EE) program has stabilized in the last three years after a period of decline in earlier years and is now increasing slightly.

Quality instruction continues to be of paramount importance to the ECE Department. The curriculum is continuously updated to meet the needs of tomorrow's engineers. Efforts to enhance the undergraduate laboratories are successfully ongoing, and new equipment has been added this year to update several laboratories. 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 Conference Day, and the Teaching Excellence Award, continued this past year. A new Advising Day has been initiated. These programs are described further in Sections 3 and 4.

## Graduate Program

Recruitment of graduate students has been one of our key challenges. While 1998-1999 was not particularly successful, we had an excellent year for the incoming 1999-2000 graduate student class (See Section 4).

Enrollment in the MS programs increased by 19% this year (70 to 83). This is the second year of increase after a 6-year period of enrollment decline (1990-1996).

The number of Ph.D. students dropped slightly from 83 in 1997 to 80 in 1998. This number remains significantly greater than the number of doctoral students 5 years ago, which was near 50.

In academic year 1998-1999, we made a thorough review of the graduate curriculum and planned changes and additions to enhance our course offering. We have streamlined the scheduling of advanced courses and added a number of advanced (700-level) courses in Photonics.

The weekly or bi-weekly Graduate Student Seminar series continued, but was absorbed in the new course *Graduate Teaching Fellow Seminar*, SC850. The *ECE Colloquium* continued for a second year, and prominent speakers from both outside and inside the university gave presentations on current research topics (See Section 4).

## Research

New Research funding this year totaled approximately \$5.1M. The average annual research funding in the last 5 years (1996-00) is \$4.9M, as compared to an average of \$2.5M in the 1991-95 period. These figures include only grants and contracts for which the Principal Investigator (PI) were ECE faculty. The share of grants for which ECE

faculty were Co-PI's totaled approximately \$0.7M this year and the total new funds is approximately \$5.7M.

This year, the ECE faculty and graduate students published 86 archived journal articles, co-authored 10 book chapters and 3 books, and made 95 conference contributions (papers, abstracts, and presentations). They also authored 15 patents or patent disclosures.

## **Workshops, Conferences, and Special Meetings**

### ***ECE Day 2000***

The tradition of a project conference day for ECE Seniors, which was initiated in May 1997, continued this year. Held at the end of the Spring term, ECE Day 2000 included 23 presentations on different projects conducted by groups of 2 to 4 students. The conference was attended by departmental faculty and alumni. More information on ECE Day 2000 can be found in Section 3.

### ***Teaching Workshop***

Teaching workshops, offered formally as part of a new 2-credit course, SC850, are required for all ECE graduate students who are serving as teaching fellows for the first time. Besides being a valuable educational experience for these graduate students, this workshop also ensures that our undergraduates are served by better trained teaching fellows in their ECE courses. The workshop included panel and solo discussions, as well as play-acting scenarios on such topics as teaching methodology; presentation techniques; pedagogy; and an outline of teaching policies, procedures, and ethics. More details on Teaching workshops are provided in Section 4.

### ***ECE Advising Day***

The ECE advising day is a major initiative launched last year to enhance the advising system for ECE undergraduates. Held in the fall and spring semesters on the Friday before telephone registration begins for the next term. In the Spring, the day included pre-registration advising throughout by faculty volunteers and a two hour "Advising Workshop" on upcoming changes in the EE and CSE curricula.

### ***ECE Retreat***

The ECE Department held its annual Faculty Retreat at BU's Photonics Center, on April 28, 2000. This year, the discussions focused on the ideal ECE Curriculum - Degrees without Walls. A number of specific proposals were discussed including redesigning the program to include five new electives. The discussion also included a debate on what material should be taught in the introductory engineering and computer programming courses to best prepare students for the material they will encounter in more advanced course work.

## 2. Faculty and Staff

### 2.1 Faculty

**Dimiter Avresky, Associate Professor**

- Ph.D., Moscow Institute of Engineering, 1971
- Fault tolerance in parallel and distributed systems; network computing; performance analysis of networks, routing verification, testing, and validation of software and protocols

**John Brackett, Professor Emeritus**

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

**Richard Brower, Professor**

- Ph.D., University of California-Berkeley, 1969
- Lattice gauge theory; molecular dynamics simulations

**Jeffrey Carruthers, Assistant Professor**

- Ph.D., University of California, Berkeley, 1997
- Wireless infrared communications; broadband communications; mobile and wireless networks
- NSF CAREER Award

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

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

**David Castañón, Professor**

- Ph.D., Massachusetts Institute of Technology, 1976
- Stochastic control; game theory; estimation optimization; parallel and distributed computation
- Member, IEEE Control Systems Society Board of Governors

**Scott Dunham, Associate Professor (Leave of Absence)**

- Ph.D., Stanford University, 1985
- Modeling and simulation of semiconductor fabrication processes and device operation; point-defect interaction in semiconductors; kinetics of extended defect evolution; atomic scale materials simulation
- Associate Editor, *Journal of Electronic Materials*

**Charles Eddy, Assistant Professor**

- Ph.D., Johns Hopkins University, 1998
- Semiconductor device processing and process characterization; electronic and optoelectronic device fabrication and characterization; novel III-V, especially III-V nitride, devices
- Naval Research Laboratory Alan Berman Research Publication Award, 1994

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

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

**Carol Espy-Wilson, Associate Professor**

- Ph.D., Massachusetts Institute of Technology, 1987
- Speech processing, speech variability, acoustic and articulatory modeling and lexical access.
- Clare Boothe Luce Professor (1990-1995)
- NIH Independent Scientist Award

**Azza Fahim, Assistant Professor**

- Ph.D., Cairo University, 1984
- Electric machines; computations in electromagnetics

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



D.E.E., Polytechnic Institute of Brooklyn, 1952  
 Wave propagation and diffraction in various disciplines; high-frequency and time domain asymptotics; wave-oriented data-processing and imaging  
 Member, National Academy of Engineering;  
 Fellow – IEEE, Optical Society of America, and Acoustical Society of America  
 IEEE Heinrich Hertz Gold Medal for 1991  
 URSI Balthasar Van der Pol Gold Medal for 1975

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

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

**Roscoe Giles, Professor**

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

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

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

**Mark Horenstein, Associate Professor**

Ph.D., Massachusetts Institute of Technology, 1978

- Applied electromagnetics; electrostatics, micro-electromechanical systems (MEMS)
- President Electrostatics Society of America
- Registered Professional Engineer

**Allyn Hubbard, Professor**

- Ph.D., University of Wisconsin-Madison, 1977
- VLSI circuit design; digital, analog, subthresh-

old analog, biCMOS, CMOS; information processing in neurons, neural net chips, synthetic aperture radar (SAR) processing chips, sonar processing chips; auditory models and experiments

**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
- IEEE Magnetics Society 1988 Achievement Award

**W. Clem Karl, Assistant 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
- Associate Editor, *IEEE Transactions on Image Processing*

**Mark Karpovsky, Professor**

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

**Thomas Kincaid, Professor**

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

**Ronald Knepper, Professor**

- Ph.D., Carnegie Mellon University, 1969
- VLSI integrated circuit technology; silicon CMOS & bipolar devices; numerical device simulation
- Fellow, IEEE

**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
- Member, Electromagnetics Academy

**Valery Kozlov, Research Assistant Professor**

- Ph.D., General Physics Institute of the Russian

Academy of Science, 1987  
Fiber Optics and Laser Physics

**Lev Levitin, Distinguished Professor**

- Ph.D., USSR Academy of Sciences, Gorky University, 1969
- Information theory; physics of communication and computing; quantum theory of measurements; complex and organized systems; reliable computing
- Fellow, IEEE; Member, New York Academy of Sciences

**Thomas Little, Associate Professor**

- Ph.D., Syracuse University, 1991
- Multimedia computing, computer networking, software engineering
- Editorial Board Member, *IEEE Multimedia, Multimedia Systems*
- Member, Executive Committee for the IEEE Computer Society Technical Committee on Multimedia Computing

**Fei Lou, Research Associate Professor**

- Ph.D., Chongqing University, 1991
- Distributed fiber optic sensors and systems; optical fiber grating sensors; interferometric sensors and fiber optic smart structures

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

- Ph.D., Boston University, 1971
- Signal processing in Space Physics; Low-light-level imaging instrumentation; GPS applications
- Fellow, American Geophysical Union

**Theodore Morse, Professor**

- Ph.D., Northwestern University, 1961
- Photonic material processing; optical fiber fabrication, lasers, and sensors

**Theodore Moustakas, Professor**

- Ph.D., Columbia University, 1974
- III-V nitrides, semiconductor properties and devices (blue-UV lasers, light-emitting diodes, detectors and transistors for high temperature and power applications)
- Fellow, American Physical Society; Fellow, Electrochemical Society; Member-at-large, governing body of Dielectric Division of the Electrochemical Society; Member, Electronic Materials Committee
- 1997/98 ECE Faculty Award for Excellence in Teaching

**S. Hamid Nawab, Associate Professor, Associate Chairman for Undergraduate Studies**

- Ph.D., Massachusetts Institute of Technology, 1982
- Digital signal processing, integrated DSP environments and architectures, knowledge-based signal processing, and applications in auditory scene interpretation, music and EMG signal analysis.
- 1988 Best Paper Award, *IEEE Signal Processing Society*
- 1993 Metcalf Award for Excellence in Teaching
- 1998 College of Engineering Award for Excellence in Teaching

**Truong Nguyen, Associate Professor**

- Ph.D., California Institute of Technology, 1989
- Digital image processing; wavelets; filter banks and applications; image and video compression
- Associate Editor, *IEEE Transactions on Signal Processing*; Associate Editor, *IEEE Transactions on Circuits and Systems II*
- 1992 Best Paper Award, *IEEE Signal Processing Society*
- 1999 Boston University Technology Award

**William Oliver, Associate Professor, Associate Chairman for Graduate Studies**

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

**David Perreault, Professor**

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

**Tatyana Roziner, Associate Professor**

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

**Michael Ruane, Associate Professor**

- Ph.D., Massachusetts Institute of Technology, 1980
- Magneto-optical materials; optical data storage; optical systems; communications
- 1998-99 ECE Faculty Award for Excellence in Teaching

**Bahaa E.A. Saleh, Professor and Chair**

- Ph.D., Johns Hopkins University, 1971

Quantum optics; statistical optics; optical processing; image Processing; Liquid Crystal Displays  
 Fellow – IEEE, Optical Society of America, and John Simon Guggenheim Foundation  
 Editor in Chief, *Journal of the Optical Society of America A* (1991-1997); Chairman, Board of Editors, *Optical Society of America* (1999)  
 Optical Society of America Beller Award (1999)

**E. Fred Schubert, Professor**

- Ph.D., University of Stuttgart, 1986
- Technology and physics of lasers and light-emitting diodes; semiconductor devices research
- Fellow, IEEE, SPIE
- Literature Prize of the German Engineering Society, 1993

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

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

**Alexander Sergienko, Assistant Professor**

- Ph.D., Moscow State University, 1987
- Quantum optics, including quantum radiometry and metrology; laser physics; nonlinear optics; quantum communications; remote laser sensing; correlat field optical microscopy and spectroscopy of semiconductor materials and devices ion spectroscopy
- NSF CAREER Award

**Thomas Skinner, Associate Professor**

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

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

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

**Johannes Smits, Associate Professor**

- Ph.D., Twente University of Technology, the Netherlands, 1978
- Integrated sensors and actuators; piezo electric thin films; silicon bulk machining; MEMS

devices; optical scanners; micropumps; DNA sequencing tools  
 Fellow, IEEE; Elected Member, ADCOM, IEEE Ultrasonics, Ferroelectrics and Frequency Control Society  
 Chair, IEEE Standards Committee on Actuators and Transducers  
 Associate Editor, *IEEE Transactions Ultrasonics, Ferroelectrics and Frequency*

**Neeraj Suri, Associate Professor**

- Ph.D., University of Massachusetts at Amherst, 1992
- NSF CAREER Award
- Distributed, dependable, real-time systems; distributed algorithms and architectures

**Anna Swan, Research Assistant Professor**

- Ph.D., Boston University, 1993
- High resolution thermal imaging of semiconductor using inelastic light scattering

**Malvin C. Teich, Professor**

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

**Tomasso Toffoli, Research Associate Professor**

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

**Selim Ünlü, Associate Professor**

- Ph.D., University of Illinois, Urbana-Champaign, 1992
- Design, processing, characterization and simulation of semiconductor optoelectronic devices; near-field optical microscopy and spectroscopy of semiconductor materials and devices
- NSF CAREER Award, Lightwave Technology Program

## ONR Young Investigator Award

**Richard Vidale, Professor**

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

**Moe Wasserman, Professor Emeritus**

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

**IEEE Fellows**

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

**NSF PYI/CAREER Awards**

Jeffrey Carruthers  
 Thomas Little  
 Truong Nguyen  
 Alexander Sergienko  
 Neeraj Suri  
 Selim Ünlü

**2.2 Adjunct Faculty**

The ECE Department looks outside the 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. Below is a list of people who have helped the Department meet its teaching needs over the past year.

**Charles Bures, SC511 Software System Design (Spring 2000)**

- M.S., Electrical Engineering, Stanford University, 1970

**Ernesto Guerrieri, SC504 Advanced Data Structures (Spring 1999)**

- Ph.D., Rensselaer Polytechnic Institute, 1989
- Director of Technology at Inso Corporation, Electronic Publishing Solutions Division

**Yefim Levin, SC453 Electromagnetics I (Summer 1999)**

- Ph.D., Leningrad University, 1975
- Manager of Microprocessor Laboratory in ECE Department

## 2.3 Scientists

Name	Title	Sponsor
Boyce, Suzanne	Research Affiliate	Carol Espy-Wilson
Chari, Vankatesh	Research Associate	Carol Espy-Wilson
Cohen, Howard	Clinical Instructor	Allyn Hubbard
Dauler, Eric	Research Assistant	Alexander Sergienko
Dusek, Miloslav*	Visiting Scholar	Malvin Teich
Emre, Erol	Research Associate	David Castañon
Godivier, Xavier*	Research Associate	Malvin Teich
Han, Seung-Ryong*	Research Assistant	Theodore Morse
Kakay, Attilia	Visiting Scholar	Floyd Humphrey
Kawahara, Tadidsha	Visiting Scholar	Theodore Morse
Kleptsyn, Vladimir*	Instructor	Johannes Smits
Nguyen, Hang*	Research Assistant	Truong Nguyen
Nishino, Katsushi*	Visiting Scholar	Theodore Moustakas
O'Neil, Jeffrey	Research Associate	Clem Karl
Redjdal, Makloul	Research Associate	Floyd Humphrey
Rice, Dean*	Visiting Scholar	Alexander Sergienko
Sans, Laurent	Visiting Scholar	Alexander Sergienko
Taibi, Guiseppi	Visiting Scholar	Hamid Nawab
Tsegaye, Tedros	Research Assistant	Alexander Sergienko

\*Completed Appointment during 1999/2000

## 2.4 Technical Staff

Yuri Fedyunin	<i>Wide Band Gap Semiconductors Laboratory Manager</i>
Dencho Kojucharov*	<i>VLSI Laboratory Manager</i>
Yefim Levin	<i>Microprocessor Laboratory Manager</i>
Raul Rodriguez	<i>Electronics Laboratory Manager</i>
Vladimir Kleptsen	<i>Distributed Semiconductor Processing Lab Engineer</i>

\*Resigned during 1999/2000

## 2.5 Administrative Staff

Curtis Nordstrom*	<i>Administrative Assistant</i>
Joy Field*	<i>Academic Programs Administrator</i>
Wayne Rennie	<i>Department Director</i>
James Bransford	<i>Grants Administrator</i>
Adam DiNicola	<i>Financial Administrator</i>
Loretta Hawkes**	<i>Academic Programs Administrator</i>
Jae Kim	<i>Senior Administrative Secretary</i>

\* Resigned during 1999/2000  
 \*\* Served as Senior Administrative Secretary and was promoted during 1999/2000

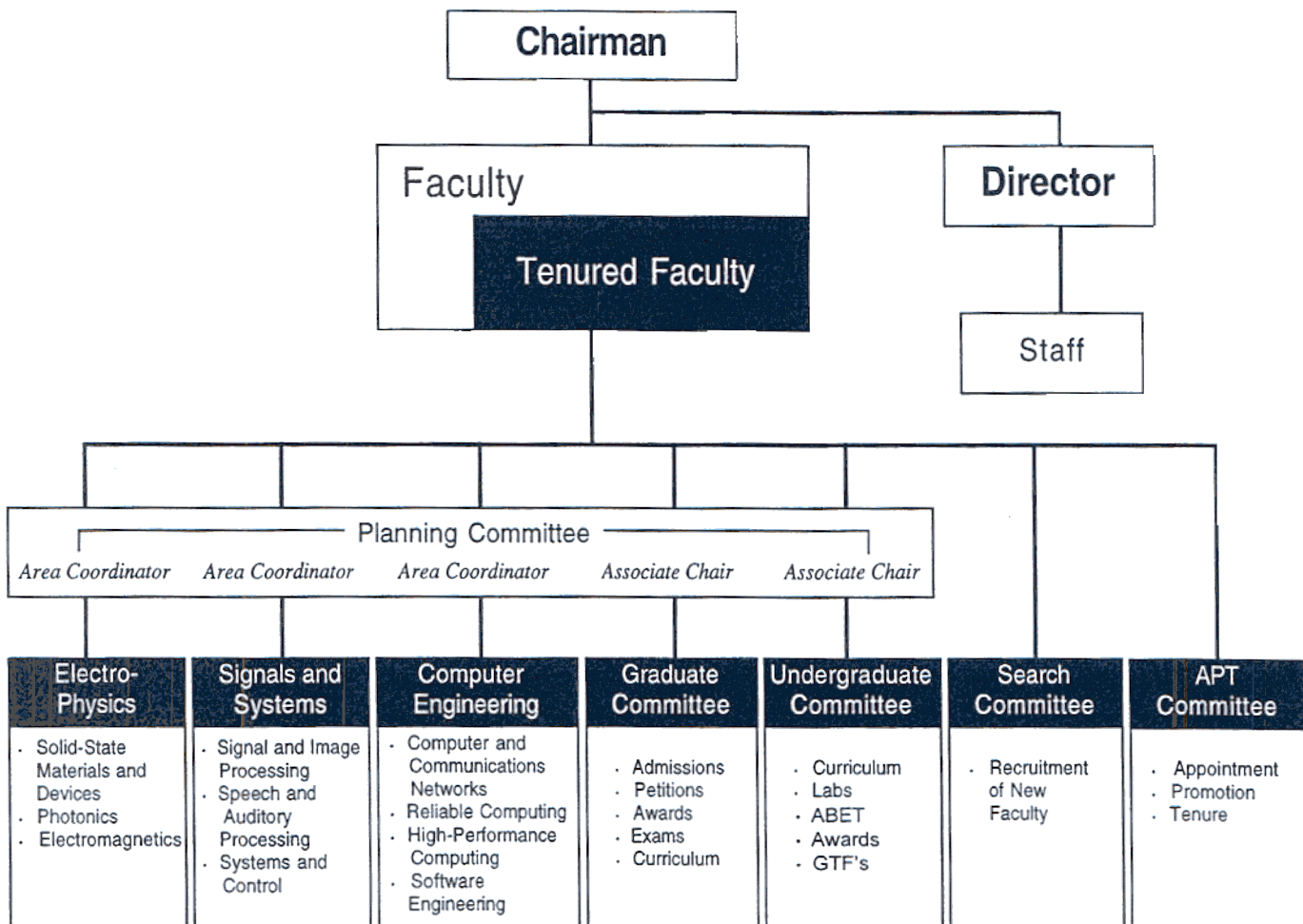
## 2.6 Department Administration & Committees

Bahaa Saleh	<i>Department Chair</i>
Hamid Nawab	<i>Associate Chair for Undergraduate Studies</i>
William Oliver	<i>Associate Chair for Graduate Studies</i>

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 comprises the coordinators of the three areas of research and instruction (electro-physics, signals and systems, 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
<b>Saleh (Chair)</b> Oliver (Assoc. Chair) Nawab (Assoc. Chair) Ruane (Electro-Physics) Karl (Systems) Vidale (Computer Eng.) Rennie (ex-officio)	<b>Oliver (Chair)</b> Nguyen Perreault (LEAP) Avresky Ünlü Sergienko Smits Lee Levitin	<b>Nawab (Chair)</b> Horenstein (transfer advisor) Fahim Eddy Knepper Kincaid Espy-Wilson Roziner Ruane	<b>Saleh (Chair)</b> Castañon Moustakas Carruthers Karpovsky Giles Vidale Rennie (ex officio)	<b>Saleh (Chair)</b> Brower Hubbard Schubert Levitin Castañon Teich Rennie (ex-officio)

## 2.7 Organizational Chart



## 2.8 ECE Representation in College of Engineering Committees

COMMITTEE	FACULTY
COE GRADUATE COMMITTEE	Horenstein (Chair); Oliver
COE SCHOLARSHIP EXAM COMMITTEE	Horenstein (Chair); Ünlü
COE UNDERGRADUATE COMMITTEE	Nawab
COE STUDENT CONDUCT COMMITTEE	Smits
COE PROFESSIONAL PRACTICE ADVISORY GROUP	Perreault
ADVISOR TO MINORITY ENGINEERS' SOCIETY (MES)	Giles
ADVISOR TO STUDENT ASSOCIATION OF GRADUATE ENGINEERS (SAGE)	Ruane
ADVISOR TO SOCIETY OF HISPANIC PROFESSIONAL ENGINEERS (SHPE)	Castañon
ADVISOR TO TAU BETA PI	Nawab
ADVISOR TO ALPHI PHI OMEGA	Ruane
ENGINEERING HOUSE ADVISOR	Nawab
COE APT COMMITTEE	Castañon; Karpovsky; Moustakas

# 3. Undergraduate Programs

## 3.1 Highlights

### Department Goals and Program Objectives

The ECE Undergraduate Committee in consultation with all interested ECE faculty formulated the following statements regarding department goals and program objectives. These statements were presented and discussed at ECE faculty meetings and at the ECE Departmental retreat.

#### Departmental Goals:

- 1) Educate our students to meet high standards of excellence in electrical and computer engineering in preparation for professional careers and advanced studies.
- 2) Create and disseminate knowledge through basic and applied research in electrical and computer engineering.
- 3) Serve as a resource of electrical and computer engineering expertise at the local, regional, and national levels.

#### Program Objectives:

To produce graduates who have...

- 1) a strong foundation in EE/CSE with an appropriate balance between theory and application.
- 2) a wide repertoire of techniques and skills for the effective practice of modern EE/CSE.
- 3) an integrated view of the subfields of EE/CSE.
- 4) a broad education and ethical awareness to serve as responsible professionals.
- 5) an ability to expand their knowledge to adapt to changes in technology.

The ECE Undergraduate committee also made significant progress in formulating a systematic outcomes-based framework (See Figure 1) for the evaluation of objectives, the assessment of outcomes, and the adjustment of the means of delivery of our undergraduate programs. Within the context of this framework, the ECE Undergraduate Committee has recommended seeking outcomes that demonstrate what our graduates possess:

- 1) the understanding of scientific laws and their mathematical underpinnings.
- 2) the knowledge of principles of current technology
- 3) the ability to identify, formulate, and solve diverse EE/CSE problems.
- 4) the ability to design and implement systems, components and processes to meet desired needs.

- 5) the ability to conduct experiments and analyze and interpret data.
- 6) the ability to organize, critique and communicate complex technical information.
- 7) the ability to function as valuable members of multidisciplinary teams.
- 8) the ability to conduct discovery in technical areas.
- 9) a broad knowledge of EE/CSE subfields.
- 10) the knowledge of interrelationships between subfields.
- 11) the ability to integrate concepts from different subfields.
- 12) awareness of the interrelationships of technology, society and ethics.
- 13) a sense of professional and ethical responsibility
- 14) knowledge of contemporary issues.
- 15) an appreciation for the humanities.
- 16) the ability to communicate in broad social contexts.
- 17) awareness of the importance of life-long learning.
- 18) knowledge and experience with the use of resources for lifelong learning.
- 19) experience in collaborative learning.
- 20) understanding and control over their own learning processes.

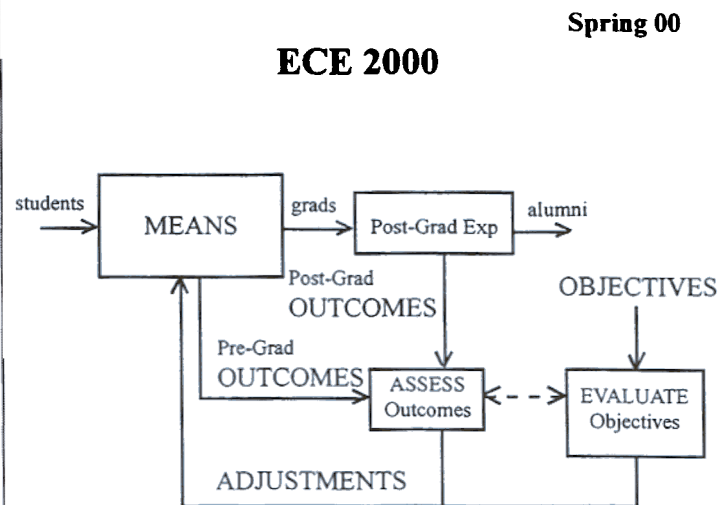


Figure 1: Outcomes-based Framework for Evaluation/Assessment/Adjustment of ECE Undergraduate Programs



## ECE Advising Days

A major initiative was launched in the 1998-99 academic year to enhance the advising system for ECE students. Each semester an "ECE Advising Day" was held just prior to the commencement of the telephone registration period for the next term. Many ECE faculty volunteered up to four hours of advising time for their students. Each day also included an advising workshop for all ECE undergraduates. The Fall workshop, held on October 29, 1999, took the form of a reception to which all ECE students were invited to meet the Department Chairman and several other ECE faculty for the purpose of providing feedback on the department's advising system. The Spring workshop, held on March 31, 2000, featured two 1-hour presentations by the Associate Chairman for Undergraduate Studies on the upcoming changes in the EE and CSE degree programs for the class of 2002 and beyond.

## Changes in Degree Programs

This year the ECE Department formally approved changes in the EE and CSE programs as recommended by the ECE Undergraduate Committee. These changes, which were also approved by a vote at the May 2000 College of Engineering faculty meeting, will take effect with the graduating classes of 2002 and beyond. Summaries of the changes in the two programs and the rationale behind them are given below.

### *Electrical Engineering.*

- 1) ADDED 4 extra credits of Senior Design Project
- 2) REDESIGNED the 2-course Electromagnetics sequence
- 3) REMOVED Electromagnetics II Requirement (4 credits)
- 4) ADDED Electrophysics Elective (4 Credits)
- 5) REMOVED Track Elective (4 credits)

Rationale: The new 8-credit senior design project (SC463 and SC464) is motivated by the desire to enable more ambitious student projects, to give ample time for project completion, and to institute an "apprenticeship" mechanism in which students may learn from the experience of others who are further along in the design process. The former Electromagnetics sequence (SC453, SC454) was replaced by a redesigned electromagnetics sequence (SC455, SC456). The course SC455, "Electromagnetic Systems I," will be required of all EE majors. It is designed to give an application-oriented introduction to both electrostatics and electrodynamics, although with greater emphasis on the

latter. The second course, SC456 (Electromagnetics Systems II), provides a more in-depth treatment of the theoretical foundations of electromagnetic systems. This second course is not required of EE majors. Instead, EE students will now have to select from among SC456 and SC471 (Physics of Semiconductor Devices) to fulfill the 4 credits of the new Electrophysics Elective. The Electrophysics Elective joins the already existing Computer Elective, Electronics Elective, and Systems Elective in the EE curriculum. It replaces the Track Elective in which the students had a choice between SC471 (Physics of Semiconductor Devices) and SC416 (Introduction to Digital Signal Processing). The entire set of changes in the EE program does *not* change the total number of credits needed for graduation.

### *Computer Systems Engineering.*

- 1) ADDED 4 extra credits of Senior Design Project
- 2) REMOVED 4 credits of Technical Elective

Rationale: The senior design project was expanded for the same reasons as in the EE program. Removal of one Technical Elective ensures that the total number of Credits required of CSE majors remains unchanged.

## Teaching Workshop

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 ECE, six 1-hour workshops were held each semester. These workshops included panel and solo discussions and play-acting scenarios on teaching methodology, presentation techniques, pedagogy, and ethics.

**ECE Teaching Award**

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

This year's winner was Professor W. Clem Karl (See sidebar).

**ECE Day 2000**

The ECE Project Conference Day, an annual feature at the end of the Spring term, once again was successful in showcasing the work of our seniors and graduate students to other students, faculty, alumni, and company representatives. This year, the Senior Project presentations were held in two parallel sessions from 9am to 1pm.

The parallel sessions were chaired respectively by Profs. M. Ruane and R. Knepper, the two Senior Design instructors for Spring 2000. An awards ceremony was held from 2pm to 3pm to recognize outstanding oral presentations and to announce the ECE Faculty and GTF teaching awards.

**P.T. Hsu Award**

See page 3-9.

**ECE Teaching Award:**

Professor Clem Karl is the winner of the 1999/2000 ECE Faculty Award for Excellence in Teaching, for the introduction of innovative and highly acclaimed improvements in the graduate course on stochastic processes. His contributions include extensive revisions of course notes, introduction of a series of application-oriented MATLAB laboratories, and the use of web-based components in the course. Students admire his enthusiasm, excellent preparation, and his ability to provide a "big picture" view of highly mathematical material. It is not unusual for his former students to count him among the best teachers they have had at Boston University.

(See page 1-2 for William Clem Karl's biography)

### 3.2 Enrollment

#### Fall 1999

	Electrical	Comp. Sys.	TOTAL
Freshmen*	23	62	85
Sophomores*	29	59	88
Juniors	50	52	102
Seniors	50	83	133
<b>TOTAL</b>	<b>152</b>	<b>256</b>	<b>408</b>

#### Spring 2000

	Electrical	Comp. Sys.	TOTAL
Freshmen*	20	63	83
Sophomores*	38	69	107
Juniors	56	48	104
Seniors	45	73	118
<b>TOTAL</b>	<b>159</b>	<b>253</b>	<b>412</b>

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

### 3.3 Degrees Awarded

Degrees Awarded		Honors Students	
Electrical Engineering	37	Summa Cum Laude	20
Computer Systems Engineering	73	Magna Cum Laude	7
		Cum Laude	17
<b>TOTAL</b>	<b>110</b>	<b>TOTAL</b>	<b>44</b>

## 3.4 Instructional Labs

### Circuits and Electronics Laboratory

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

### Control Systems Laboratory

This laboratory houses four ECP Model 220 Industrial Emulator/Serve Trainers for studying control of practical systems. *Vidale*

### Distributed Semiconductor Processing Laboratory

This laboratory contains equipment for the fabrication of silicon integrated circuits. Facilities include wet etching and cleaning stations, diffusion/oxidation furnaces, a mask aligner, film deposition systems, and wafer probing and characterization stations. The core equipment in this laboratory was donated through the Massachusetts Microelectronics Center. *Smits*

### 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*

### Microprocessor and PC Laboratory

This lab features instruction in the programming and interfacing of microcomputers and digital controllers. Higher-level courses emphasize the design of systems using microprocessors. For networking studies, the laboratory contains four PC systems connected in a local loop with access to a larger local loop in the nearby microprocessor lab and to the campus area network.

Networking software, various simulators, and analysis packages are available. *Perreault*

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

### Networks Laboratory

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

### Photonics Laboratory

The Photonics Laboratory serves the introductory and intermediate photonics courses—Introduction to Photonics, SC560; Fiber Optic Communication Systems, SC563; and Lasers, SC570. The lab is equipped with lasers, vibration-isolated optical tables, optical fiber components and systems, and facilities for experiments in diffraction, interferometry, holography, and acousto- and electro-optic modulation and scanning. *Ruane, Ünlü, Teich*

### Radio Communication Laboratory

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

### Senior Project Laboratory

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

### Signals Laboratory

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

### Software Engineering Laboratory

An instructional and research lab, the Software Engineering Laboratory (SEL) supports courses and research on the economical design of reliable software for large-scale, computer-based systems. The lab includes a group of Silicon Graphics and Gateway 2000 networked workstations and provide students with state-of-the-art development tools for the design, implementation, and testing of software systems. *Vidale*

### VLSI/CAD Laboratory

In this lab, students design circuits using state-of-the-art computer automated design systems. Facilities include four HP B180L workstations, eight DEC Micro VAXs, seven DECstation 3100's, two DECstation 5000's, six DEC Alphas, and four HPs, plus chip-testing electronics, and associated display and software systems. Software tools include ViewLogic, Synopsis, Mentor Graphics, and Cadence. *Hubbard, Knepper*

Expenditures for Instructional Laboratories 1999/00

FACILITY	EQUIPMENT	APPROXIMATE COST
Electronics Lab	Amplifiers, Etherlink, etc.	\$ 10,869
Semiconductor Lab	Photo-resist spinner, Upgrades	\$ 5,000
Senior Project Lab	Logic Analyzer, CAD Software, QuickCircuit, PC's	\$ 41,572
Signals/Networks Lab	PC's, Software	\$ 44,183
Microprocessing Lab	Printer, Co-axials, etc.	\$ 9,000
Software Design Lab	LCD Projector	\$ 9,000
VLSI Lab	Network Upgrades, HP workstation	\$ 79,016
<b>TOTAL</b>		<b>\$ 198,640</b>

### 3.5 Undergraduate Courses

Course	Course Title	Fall 1999	Spring 2000	Summer 2000
<b>EK 100</b>	Freshman Seminar	Faculty		
<b>EK 130</b>	Intro. to Engineering	Kincaid Smits	Kincaid Ruane Saleh	
<b>EK 307</b>	Electric Circuit Theory	Fahim	Kotiuga Roziner Kincaid	<b>Lee</b>
<b>EK 317*</b>	Electronic Circuit Theory I	Oliver		
<b>EK 318*</b>	Electronic Circuit Theory II		Oliver	
<b>EK 420</b>	Intro. Parallel Computing	Giles		
<b>EK 501</b>	Math Methods I	Brower		
<b>SC 311</b>	Intro. Logic Design	Roziner Perreault	Roziner	<b>Roziner</b>
<b>SC 312</b>	Computer Organization	Knepper	Knepper	
<b>SC 330</b>	Applied Algorithms/Data Structures	Castanon	Brower	
<b>SC 401</b>	Signals and Systems	Kincaid	Nguyen	<b>Nawab</b>
<b>SC 402</b>	Control Systems	Gevelber		
<b>SC 410</b>	Intro. to Electronics	Eddy Unlu Sergienko	Eddy	<b>Lee</b>
<b>SC 412</b>	Analog Electronics		Sergienko	
<b>SC 415</b>	Communication Systems	Roziner	Carruthers	
<b>SC 416</b>	Intro. to Digital Signal Processing	Nguyen	Nawab	<b>Nawab</b>
<b>SC 440</b>	Intro. to Operating Systems	Skinner	Skinner	<b>Skinner</b>
<b>SC 447</b>	Software Design	Skinner	Skinner	<b>Skinner</b>
<b>SC 450</b>	Microprocessors	Perreault	Perreault	
<b>SC 453</b>	Intro. to Electromagnetics	Lee	Fahim	<b>Levin</b>
<b>SC 454</b>	Electrodynamics	Kotiuga	Lee	
<b>SC 466</b>	Senior Design Projects	Ruane	Ruane Knepper	<b>Ruane</b>
<b>SC 467</b>	Senior Honors Thesis	Nawab Toffoli	Moustakas	
<b>SC 471</b>	Physics of Semiconductor Devices		Schubert	

\*MET courses taught by ECE professors to support the MET SEP program.

### 3.6 Freshman Research Opportunity Program (FROP)

	Name	Lab/Professor
	David Hotchkiss	Goldberg
	Kenneth Lopez	Ruane
	Robert Osterhoudt	Morse
	Gregory Mazzaro	Sergienko
	Zakhar Raskin	Toffoli
	Richard Williams	Teich

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### 3.7 Senior Design Projects

The Senior Project Laboratory, located on the first floor of the Photonics Building, supports the ECE Department's capstone senior design course, required of all ECE students. This course, first introduced in 1990, provides graduating seniors with an engineering apprenticeship that models the experience of a real engineering company. Students work in teams of two to four to design a product, electronic device, or software system for a real-life corporate or social-service client. Students make presentations to their customer, write inter- and intra-office memos, design their project to meet customer specifications, manage the project budget, and deliver the working product, complete with a detailed instruction manual. The ECE Department has made a major investment in space and equipment to provide every team with 24-hour access to its own dedicated, fully-equipped laboratory bench. Although the course has been offered for nearly a decade, much has changed since its early days. Student design teams now work for the department's official company – Xebec Technologies. Students gain valuable practical skills and training in project management, product development, and engineering design by working on projects for real-life clients.

#### 2000 P.T. Hsu Award

The best senior design project in the ECE Department is chosen by a faculty committee, based on the projects, written materials, and the team presentations. This year's winners were The Highway Hunters, working on the IR Highway Transponder project. Team members included Izzat Abou-Amarah, Igor Golger, Imad Kassis, and Masood Mahmood. The IR Highway Transponder project was developed for a highway safety application in which an emergency vehicle would like to identify a vehicle's license plate (and possibly other information) from a distance of up to 100 m. The Highway Hunters developed a transmitter unit based on IR LEDs that encoded and broadcast continuously the car data. They also designed and built a hand-held receiver that detected and decoded the data. The receiver featured Fresnel lens optics and automatic gain control. The system was tested extensively indoors before meeting its 100 m specification along the length of Cummington Street.

#### SPECTRE Blasts Off!

The SPECTRE sounding rocket, supported by a NASA student launch project with Prof. S. Chakrabarti (Astronomy), blasted from the rail at Wallops Island, VA, on June 13, 2000. The payload, which contained hardware designed by over 50 senior design students since 1997, successfully collected its multispectral data, and was recovered by the NASA search plane and ship, 42 miles offshore. The payload, powered by a Nike-Orion rocket, reached a height of 81 miles and had a flight of about seven minutes before its parachute opened. SPECTRE students manned the ground station and were monitoring the downlink telemetry throughout the flight. We plan to display the hardware around ECE in the fall 2000.

#### Notable 1999-2000 Senior Projects

##### Team Members

Benjamin Cahill, David La Cava, Alexandre Finkel,  
Gustavo Moreira

Johanna Bunn, Alejandro Rey, April Slowik

Jorge Champin, Michael Haapaoja,  
Tomobumi Tamaki, Lukas Thulin

John Licorish, Biren Shah, Kirk Stewart,  
Manette Wete

Jason Mitchell, Roderick Campell, Erica Sarli

Lawrence Deutsch, Justin Matthews,  
Kerry Twibell

Richard Goldforb, Jorge Sanchez de Lozada

##### Project Name

Health Pilots  
(See Awards and Honors, page 1-4)

Active Art Display

Discovery 18 System Controller (LABVIEW)

Active Art Display

ADI Ethernet Downloader

WWW Data Acquisition

2m Radio Phone Interface



# 4. Graduate Programs

## 4.1 Course & Program Development

### Curriculum Development

In AY 1999-2000, six new graduate courses were developed under the SC 500, SC 700 and SC 760 "topic-course" rubrics while two others formerly offered under the SC 700 rubric are now being placed in the permanent course registry. These latter two courses have been approved by the Department and must now be approved by the College.

### New Courses

Six new graduate courses were approved.

**SC500 Introduction to Web Based Information Systems** emphasizes programming of distributed information systems. It was taught in Spring 2000 by Professor Giles and attracted a large undergraduate and graduate enrollment.

**SC500 Optical Fiber Sensors** will focus on laboratories involving the use of various types of sensors. It will be offered in Fall 2000 by Professor Morse.

**MN/SC708 Advanced Process Control** was renumbered from MN/SC508 to reflect its true advanced content and to make way for the Manufacturing Engineering prerequisite course MN507 Process Modelling and Control.

**SC711 Software Architecture** will emphasize large, distributed concurrent software systems. It will form an advanced sequel to SC511 Software System Design. SC711 was previously taught in trial form as SC700 Advanced Software Design and will now become a permanent course with a new title.

**SC715 Wireless Communications** was developed to form the advanced component of the sequence of communications courses SC415 Communication Systems, SC515 Digital Communication, and now SC715 Wireless Communication. SC562 was renumbered to SC515 to accomplish the "-15" numbering sequence.

**SC760 Semiconductor Light Emitters** will address the device physics of LEDs and lasers and issues on fabrication and manufacture. This course will be taught in Fall 2000 by Professor Schubert.

### Graduate Student Recruitment

The department experienced a good year of graduate-student recruiting for AY2000-2001. Four of our 8 full-scholarship offers, made to top students sought nationally were accepted while 9 of 16 top-ranked students invited to our Graduate Recruitment Weekend have accepted. This incoming group of graduate students will have a decidedly higher domestic-student ratio than we have experienced in recent years: 10 of 19 students coming with BU financial aid (either scholarships or research or teaching assistantships) will be from the U.S. or Canada.

### Graduate Student Seminars

The weekly or bi-weekly series of ECE Graduate Student Seminars was absorbed again this year into SC850, the Graduate Teaching fellow Seminar. The first half of each semester was devoted to teaching instruction while the latter half was devoted to research talks by ECE professors, aimed at facilitating the placement of students into the professors' research programs. Lab tours were an emphasized aspect of these talks. The research talks given for the year are listed below.

October 29 - Mark Horenstein  
13 students

*Microelectromechanical systems: An overview and some current projects in the College of Engineering*

November 5 - Center for Space Physics  
22 students

*A tour of the BU Center for Space Physics*

November 12 - Johannes Smits  
10 students

*A tour of the Silicon Processing and MEMS Processing Facility at Boston University*

November 19 - Selim Ünlü  
10 students

*Research in the Picosecond and Nearfield Spectroscopy Labs*

December 3 - Bahaa Saleh  
27 students

*How to write a technical paper*

December 10 - Theodore Moustakas  
9 students

*Research in the Wide Bandgap  
Semiconductors and Optoelectronic Materials  
Labs*

February 25 - David Racz (for Richard Vidale)  
*The ECE Software Engineering Lab (SEL)*

April 21 - Theodore Morse  
*A tour of the Laboratory for Lightwave  
Technology*

### **Fellowship Workshop**

In an effort to make seniors and 1st-year graduate students aware of the many Scholarship/Fellowship opportunities to which they are eligible to apply, ECE held a Fellowship Workshop in early Fall. Kimani Toussaint has been selected as a Gates Millennium Scholar as a result of an application started at the workshop.

### **ECE Colloquium**

The ECE Colloquium series continued for a third year. Prominent speakers from both outside and inside the university gave research talks on issues of current prominence. Graduate students are expected to attend these talks. A listing of speakers for the 1999/00 Academic year is given later in this section.

### **Graduate Teaching Fellows**

ECE's allocation of the College of Engineering's 53 GTF slots has increased from 17 to 19 to 20 over the past 3 years and will increase further to 21 for AY00-01 owing to our growing enrollment, primarily in Computer Systems Engineering. ECE also provides an additional GTF (and a professor) to teach the Electric Circuits course in the BU Metropolitan College Science and Engineering Program, most of whose students join the College of Engineering formally in their junior year.

### **Undergraduate Teaching Fellows**

ECE instituted a trial UTF program this year. Its goal is to provide top undergraduate students an opportunity to join the academic program at a higher level, as an instructor as opposed to a student, and to interest these students to continue to the graduate level. UTF duties are similar to those of a GTF: lab or discussion-section instruction. We had 1 UTF each semester, to cover an Electronics lab in the Fall and Electromagnetics Discussion sections in the Spring.

## 4.2 New Matriculants

### New Students Entering Fall 1999

		Male	Female	FT	PT	GTF	RA	Fellow	Other
MS	US	15	4	17	2	1	2	0	0
	Intl.	17	3	20	0	5	2	0	0
Ph.D.	US	5	4	8	1	1	1	2	2
	Intl.	13	2	15	0	4	7	0	2
<b>TOTAL</b>		<b>50</b>	<b>13</b>	<b>60</b>	<b>3</b>	<b>11</b>	<b>12</b>	<b>2</b>	<b>4</b>

### New Students Entering Spring 2000

		Male	Female	FT	PT	GTF	RA	Fellow	Other
MS	US	6	0	5	1	0	0	0	0
	Intl.	2	1	3	0	1	0	0	0
Ph.D.	US	1	0	1	0	0	0	0	0
	Intl.	1	1	2	0	1	1	0	0
<b>TOTAL</b>		<b>10</b>	<b>2</b>	<b>11</b>	<b>1</b>	<b>2</b>	<b>1</b>	<b>0</b>	<b>0</b>

## 4.3 GRE Scores

### Fall 1999 Mean GRE Scores

		Verbal	%	Quantitative	%	Analytical	%
MS	US	546	63	717	83	696	83
	Intl.	496	52	757	91	684	83
Ph.D.	US	470	48	760	92	670	81
	Intl.	534	51	763	92	696	85
<b>Mean</b>		<b>512</b>	<b>54</b>	<b>749</b>	<b>90</b>	<b>687</b>	<b>83</b>

### Spring 2000 Mean GRE Scores

		Verbal	%	Quantitative	%	Analytical	%
MS	US	557	69	688	77	632	68
	Intl.	457	45	698	79	587	58
Ph.D.	US	NA	NA	NA	NA	NA	NA
	Intl.	410	22	717	76	653	75
<b>Mean</b>		<b>475</b>	<b>45</b>	<b>701</b>	<b>77</b>	<b>624</b>	<b>67</b>

## 4.4 MS Students

## Electrical Engineering and Computer Systems Engineering

<i>Student Name</i>	<i>Advisor</i>	<i>Advisor Type</i>	<i>Research Area or Thesis</i>
Adhikari, Chandan	Skinner	Academic	Computer Systems Engineering
Adhikary, Rajiv	Nawab	Both	Approximate IIR Filtering
Agarwal, Anurag	Karpovsky	Both	Multicasting Algorithms in Network of Workstations
Agha, Mazen	Avresky	Academic	Computer Systems Engineering
Bach-Davis, Edward	Toffoli	Both	Electrical Engineering
Barrientos, Laura	Carruthers	Academic	Signal Processing and Communications
Biswas, Santanu	Karpovsky	Academic	Electrical Engineering
Burmistrov, Sergey	Perreault	Academic	Computer Systems Engineering
Canikoglu, Ayhan	Skinner	Academic	Computer Systems Engineering
Chan, Alan	Vidale	Academic	Computer Systems Engineering
Chan, Jeffrey	Chakrabarti	Both	Solid State, Circuits, & Devices
Cheema, Randeep	Carruthers	Both	Computer Systems Engineering
Chipolone, Michael	Levitin	Academic	Computer Systems Engineering
Conery, Joseph	Skinner	Academic	Computer Systems Engineering
Craft, Eric	Espy-Wilson	Both	Speech Recognition
Crager, Joseph	Kotiuga	Both	Computational electromagnetics
Dawson, Matthew	Brackett	Academic	Computer Systems Engineering
Dekow, Gary	Perreault	Academic	Electrical Engineering
Demirel, Pelin	Espy-Wilson	Research	Improving Electrolaryngeal Speech
Dondurmacioglu, Ozer	Carruthers	Both	Wireless Infrared Communications
Dupre, Joseph	Little	Academic	Electrical Engineering
Emsley, Matthew	Ünlü	Both	Photonics
Faris, Edward	Carruthers	Academic	Computer Systems Engineering
Fisher, Yakov	Perreault	Academic	Computer Systems Engineering
Foreman, Eric	Fritz	Research	Satellite/Rocket Instrumentation Design and Data Analysis
Graff, John	Schubert	Research	Electrical Engineering
Guo, Ye	Carruthers	Academic	Electrical Engineering
Hebsur, Shashidhar	Castañon/Nawab	Research	Electrical Engineering
Horii, Masaki	Ünlü	Both	Hyperpolarizing Gas for MRI
Jaspal, Biren	Carruthers	Research	Testing Capacity of Infrared Channels
Juneja, Amit	Espy-Wilson	Both	Speech Recognition
Kale, Samesh	Hubbard	Both	Ultra High Throughput Screening
Kannan, Prasanna	Carruthers	Both	Communication Systems
Karnchanarchari, Parimol	Skinner	Academic	e-Event online (XML and Java development)
Khan, Naved	Little	Both	Routing in Mobile Ad Hoc Networks
Kiely, Matthew	Carruthers	Academic	Computer Systems Engineering
Kim, Duk Joong	Horenstein	Research	Electrical Engineering
Krishnamoorthy, Vishwanathan	Nguyen	Academic	Electrical Engineering

## Electrical Engineering and Computer Systems Engineering

<i>Student Name</i>	<i>Advisor</i>	<i>Advisor Type</i>	<i>Research Area or Thesis</i>
Lander, Todd	Skinner	Academic	Computer Systems Engineering
Lang, Li	Castañon	Both	Image Processing/BDU method
Lee, Dong-Hoon	Carruthers	Both	Communication
Leyfer, Michael	Perreault	Academic	Computer Systems Engineering
Li, Yun-Li	Schubert	Research	Electrical Engineering
Lim, Eric	Voigt	Research	Electrical Engineering
Lobacheva, Yuliya	Ostendorf	Both	Discourse Mixture Language Modeling
Ma, Kun	Espy-Wilson	Research	Speech Processing
Mandal, Arindam	Espy-Wilson	Research	Signal Processing/Speech Recognition
Mishra, Apurva	Hubbard	Both	A Digital Cochlear Filter Chip
Nasr, Magued	Saleh/Teich	Both	Quantum Optics
Nguyen, Nguyen	Kincaid	Academic	Electrical Engineering
Noble, Kenneth	Castañon	Academic	Computer Systems Engineering
Onat, Burak	Skinner	Academic	Computer Systems Engineering
Padma, Sachin	Carruthers	Research	Numerical Estimation of Channel Capacity of Multipath Infrared Channels
Paradis, Daniel	Karl/Castañon	Research	Electrical Engineering
Patel, Jignesh	Avresky	Both	Distributed Network Behavior
Pazhayanur-Shanmukham, Parvathy	Carruthers	Both	Electrical Engineering
Prisco, Frank	Nawab	Academic	Electrical Engineering
Psychouli, Alexandra	Vidale	Academic	Computer Systems Engineering
Racz, David	Brackett	Academic	Computer Systems Engineering
Read, Timothy	Nawab/Ostendorf	Research	Speech Processing
Rho, Mina	Vidale	Academic	Computer Systems Engineering
Rubinshteyn, Yevgeniya	Perreault	Academic	Computer Systems Engineering
Saimont, Krittiya	Suri	Academic	Computer Systems Engineering
Salomon, Ariel	Espy-Wilson	Both	Temporal Parameters for Speech Recognition
Saralaya, Shruthi	Skinner	Academic	Computer Systems Engineering
Seth, Kshitij	Moustakas	Research	Development of III-V Nitrides by HVPE
Shao, Peijun	Carruthers	Academic	Computer Systems Engineering
Shenoy, Ananth	Avresky	Academic	Computer Systems Engineering
Shivakumar, Hariharan	Ostendorf/Nawab	Both	Electrical Engineering
Sodhi, Ashish	Chakrabarti	Academic	Computer Systems Engineering
Srinivasan, Karthikeyan	Little	Research	Computer/Communication Networks
Srinivasan, Nandini	Espy-Wilson	Research	Electrical Engineering
Tang, Songyue	Oliver	Research	Computer Systems Engineering
Trunk, Tibor	Ruane/Humphrey	Both	Micromagnetic simulation
Wilson, Danielle	Gevelber	Research	Modeling for better control of Czochralski crystal growth
Xia, Kun	Espy-Wilson	Both	A New Strategy of Formant Tracking Based on Dynamic Programming
Xing, Xinyu	Hubbard	Both	Characterization and Redesign of an Electronic Cochlea Chip
Zoran, Kahric	Smits	Academic	Microelectronics
Zuccarino, Federico	Avresky	Both	Routing Protocol Fault Recovery

## 4.5 Ph.D. Students

## Electrical and Computer Engineering

<i>Student Name</i>	<i>Research Advisor</i>	<i>Research Area or Thesis Title</i>
	Saleh	Quantum optical imaging
	Nawab	Signal Processing - Using knowledge-based techniques to perform signal decomposition on EMG signals
Acosta, Juan	Avresky	Computer Engineering
Aleksanyan, Arnak	Karl	Solid State Devices
Atatüre, Mete	Sergienko	Quantum Optics
Basu, Prithwish	Little	Wireless Ad Hoc Networks, Scalable video delivery
Bhattacharyya, Anirban	Moustakas	Electrical Engineering
Blasche, Gregory	Ünlü/Goldberg	Physics
Booth, Mark	Teich	Entangled-Photon Microscopy
Bunea, Gabriela	Ünlü	Physics
Bunea, Marius	Dunham	Physics
Bynoe, Wayne	Carruthers	Broadband Wireless LANs
Carroll, Sarah	Carruthers	Wireless Communication Networks
Cetin, Mujdat	Karl	Statistical Processing of Synthetic Aperture Radar Signals
Chakravarthi, Srinivasan	Dunham	Manufacturing Engineering
Chen, Yingjui	Nguyen	Detection, Low-cost (integer) implementation of transform
Choi, Jeeyae	Brackett	A Language and an Authoring Tool for the Creation of Clinical Guidelines
Colerico, Marlene	Mendillo	Electrical Engineering
Deshmukh, Om	Espy-Wilson	Electrical Engineering
Dobson, Jennifer	Ünlü	Electrophysics
Dubord, Regina	Horenstein	Electrical Engineering
Eakman, Greg	Brackett	A Scalable Approach to Automated Object-Oriented Integration Testing
Emsley, Matthew	Ünlü	Photonics
Fastenko, Pavel	Dunham	Electrical Engineering
Fujimoto, Koji	Smits	Electrical Engineering
Goepfert, Ian	Schubert	"Electrical and Optical Characteristics of Gallium Nitride and (Aluminum Gallium) Nitride..."
Gokkavas, Mutlu	Ünlü	Electrical Engineering
Guo, Xiaoyun	Schubert	White Light Emitting Diode
Hasan, Qadeer-Ul	Levitin	Computer Engineering
Herzog, William	Ünlü	"Near-Field Scanning Optical Microscopy of Semiconductor Lasers and Materials"
Hink, Todd	Hubbard	Extending the Smart Pixel Paradigm: Integrated Image Acquisition and Imaging Processing Circuitry
Howell, Geoffrey	Baillieul	Analysis of Simple Biped Robots
Iliopoulos, Eleftherios	Moustakas	Growth, Modeling and Optoelectronic Properties of Ordered III-V Nitride Alloys
Ippolito, Stephen	Ünlü	Electrical Engineering
Iyer, Sandeep	Moustakas	GaN Thin Films
Jaiswal, Sharad	Karpovsky/Suri	Wormhole Routing in Network of Workstations
Jastrzebski, Piotr	Lee	Trans-hemispheric Propagation of the VLF signals in the presence of Ionospheric HF Heating
Jones, Lawrence	Carruthers	Computer Engineering
Karra, Maria	Fritz	Energetic Particles in the Earth's Magneto Sphere
Ke, Wang	Little	Multimedia Networks, Video-on-Demand Systems

## Electrical and Computer Engineering

<i>Student Name</i>	<i>Research Advisor</i>	<i>Research Area or Thesis Title</i>
Khan, Naved	Little	Electrical Engineering
Laurent, Sophie	Mendillo	Tomography on Auroras
Li, Xiaojun	Morse	High Power Fiber Laser
Lin, Bosheng	Mendillo	Electrical Engineering
Litvin, Andrey	Oliver	Space Physics
Liu, Chenhui	Levitin/Saleh	Natural language understanding using statistical models
Liu, Huajun	Perreault	Networking, Microcomputer systems
Mao, Junjie	Perreault	Computer Engineering
Meng, Lingmin	Nguyen	Template-based Approaches for Human Face Detection and Classification
Morrissey, Ronald	Humphrey/Ruane	Grooved Magnetic Materials
Mustafa, Mehmet	Perreault	Reliable Computing
Nam, Kyung	Moustakas	Growth of GaN on Pre-Patterned Substrates by Vapor Phase Epitaxy for Optoelectronic Applications
Natchev, Natcho	Avresky	Network Computing
Nelson, Kenric	Ruane	Overwrite Noise in Phase-Change Optical Storage
Oraintara, Soontorn	Nguyen	“Regular Linear Phase Perfect Reconstruction Filter Banks for Image Compression”
Perreault, Julie	Horenstein	MEMS
Polimeni, Jonathan	Schwartz	Computational Neuroscience, Computer Vision, AVLSI
Sampath, Anand	Moustakas	Solar-blind P-i-n AlGaIn Photodectors
Schaeffer, Thomas	Perreault	“Distribution of Fuzzy Logic on a Microcontroller Network”
Shapurian, Golnaz	Nguyen	Electrical Engineering
Shi, Yonggang	Karl	Signal Processing
Shurbanov, Vladimir	Avresky	“Traffic-Control Methods for Performance Enhancement of Computer Networks”
Singh, Rajwinder	Eddy	High Density Plasma Processing of Nitride semiconductors
Sinha, Purnendu	Suri	“A Framework for Formal Methods Driven Verification and Validation of Dependable Real-time Protocols”
Sivaramakrishnan, Kamakshi	Nguyen	Electrical Engineering
Su, Bangliang	Perreault	Software engineering, microprocessor
Tian, Yi	Perreault	Computer Engineering
Toussaint, Kimani	Sergienko	Electrical Engineering
Ulu, Gokhan	Ünlü	Physics
Vander-Rhodes, Gregory	Ünlü	Near-field Scanning Optical Microscopy of Guided-Wave and Photonic Bandgap Structures
Vassilaras, Spyridon	Paschalidis/Castañon	Telecommunication Networks
Waldron, Erik	Schubert	Physics of AlGaIn/GaN superlattices
Wedzinga, Gosse	Carruthers	Electrical Engineering
Weisenseel, Robert	Karl	Sensor Fusion for Subsurface Object Detection
Williams, Adrian	Oliver	Photonics
Wotiz, Robert	Nawab	Knowledge Based Signal Processing
Wynne, Rosalind	Sergienko	Photonics
Xu, Xiangdong	Carruthers/Mountain	Network Communication
Yang, Zibing	Hubbard/Mountain	VLSI Circuit Design
Ying, Zhengrong	Castañon	Object Recognition
Zakrevski, Lev	Karpovsky	Fault-Tolerant Routing
Zuo, Yingtao	Castañon	Multimedia Networks

**MS Degrees Awarded**

Electrical Engineering	29
Computer Systems Engineering	26
<b>TOTAL</b>	<b>55</b>

**Ph.D. Degrees Awarded**

Electrical Engineering	6
Computer Engineering	4
<b>TOTAL</b>	<b>10</b>



## 4.6 Graduate Teaching Fellows

## Fall 1999

Student Name	Course
Parvathy Pazhayanur-Shanmukham	EK 307/EK 317
Ananth Shenoy	EK 307/EK 317
Bharti Shukla	SC 311
Matthew Dawson	SC 311
Michael Chipolone	SC 312
Lev Zakrevski	SC 330
Ozer Dondurmacioglu	SC 401
Rosalind Wynne	SC 410
Adrian Williams	SC 410
Vishwanathan Krishnamoorthy	SC 410
Arnak Aleksanyan	SC 410
Prasanna Kannan	SC 415
Om Deshmukh	SC 416
Natcho Natchev	SC 447
Bangliang Su	SC 450
Joseph Crager	SC 453
Joseph Crager	SC 454
Amit Juneja	SC 466
Alan Chan	SC 546
Sharad Jaiswal	SC 571
David Racz	Software Eng. Lab
Kimani Toussaint	Photonics Lab

## Spring 2000

Student Name	Course
Ozer Dondurmacioglu	EK 307/EK 318
Parvathy Pazhayanur-Shanmukham	EK 307/EK 318
Matheen Siddiqui	EK 307/EK 318
Ananth Shenoy	EK 307/EK 318
Adrian Williams	EK 307/EK 318
Burak Onat	SC 311
Matthew Dawson	SC 312
Lev Zakrevski	SC 330
Om Deshmukh/Anurag Agarwal	SC 401
Vishwanathan Krishnamoorthy	SC 410
Rosalind Wynne	SC 412
Prasanna Kannan	SC 415
Salma Abu Ayyash	SC 416
Natcho Natchev	SC 447
Bangliang Su	SC 450
Arnak Aleksanyan	SC 454
Alan Chan	SC 466
Bharti Shukla	SC 546
Sharad Jaiswal	SC 571
David Racz	Software Eng. Lab
Kimani Toussaint	Photonics Lab

## Summer 2000

Ananth Shenoy	EK 307
Lev Zakrevski	SC 311
Anurag Agarwal	SC 401
Adrian Williams	SC 410
Jonathan Polimeni	SC 416
Natcho Natchev	SC 447
Arnak Aleksanyan	SC 453
Sarah Carroll	SC 466

## 4.7 Research Assistants

Student	Advisor	Student	Advisor
Abouraddy, Ayman	Saleh	Li, Xiaojun	Morse
Atatüre, Mete	Sergienko (physics)	Li, Yun-Li	Schubert
Basu, Prithwish	Little	Lim, Eric	Voigt
Bhattacharyya, Anirban	Moustakas	Litvin, Andrey	Oliver
Blasche, Gregory	Ünlü/Goldberg (physics)	Liu, Chenhui	Levitin/Saleh
Booth, Mark	Teich (BME)	Liu, Huajun	Perreault
Bunea, Gabriela	Ünlü (physics)	Lobacheva, Yuliya	Ostendorf
Bunea, Marius	Dunham (physics)	Ma, Kun	Espy-Wilson
Bynoe, Wayne	Carruthers	Mandal, Arindam	Espy-Wilson
Cetin, Mujdat	Karl	Meng, Lingmin	Nguyen
Chakravarthi, Srinivasan	Dunham (MFG)	Mishra, Apurva	Hubbard
Chan, Jeffrey	Chakrabarti	Nam, Kyung	Moustakas
Chen, Yingjui	Nguyen	Nasr, Magued	Saleh/Teich
Chipolone, Michael	Levitin	Oraintara, Soontorn	Nguyen
Choi, Jeeyae	Brackett	Padma, Sachin	Carruthers
Demirel, Pelin	Espy-Wilson	Paradis, Daniel	Karl/Castañon
Deshmukh, Om	Espy-Wilson	Read, Timothy	Nawab/Ostendorf
Dobson, Jennifer	Ünlü	Salomon, Ariel	Espy-Wilson
Emsley, Matthew	Ünlü	Sampath, Anand	Moustakas
Fastenko, Pavel	Dunham	Seth, Kshitij	Moustakas
Foreman, Eric	Fritz	Shi, Yonggang	Karl
Fujimoto, Koji	Smits	Shivakumar, Hariharan	Ostendorf/Nawab
Goepfert, Ian	Schubert	Shurbanov, Vladimir	Avresky
Gokkavas, Mutlu	Ünlü	Singh, Rajwinder	Eddy
Graff, John	Schubert	Sinha, Purnendu	Suri
Guo, Xiaoyun	Schubert	Sivaramakrishnan, Kamakshi	Nguyen
Hasan, Qadeer-Ul	Suri	Srinivasan, Karthikeyan	Little
Hebsur, Shashidhar	Castañon/Nawab	Srinivasan, Nandini	Espy-Wilson
Herzog, William	Ünlü	Su, Bangliang	Perreault
Hink, Todd	Hubbard	Tian, Yi	Perreault
Horii, Masaki	Ünlü	Trunk, Tibor	Ruane/Humphrey
Howell, Geoffrey	Moustakas	Ulu, Gokhan	Ünlü (physics)
Iliopoulos, Eleftherios	Moustakas	Vander-Rhodes, Gregory	Ünlü (physics)
Ippolito, Stephen	Ünlü	Waldron, Erik	Schubert (physics)
Iyer, Sandeep	Moustakas (MFG)	Weisenseel, Robert	Karl
Jaiswal, Sharad	Karpovsky/Suri	Wotiz, Robert	Nawab
Juneja, Amit	Espy-Wilson	Xia, Kun	Espy-Wilson
Kale, Samesh	Hubbard	Xing, Xinyu	Hubbard
Ke, Wang	Little	Xu, Xiangdong	Carruthers/Mountain
Khan, Naved	Little	Yang, Zibing	Hubbard/Mountain
Kim, Duk Joong	Horenstein	Ying, Zhengrong	Castañon
Lang, Li	Castañon	Zuo, Yingtao	Castañon

## 4.8 Graduate Courses

Course Number and Title	Fall 99	Spring 00	Summer 00
SC 500 Special Topics in ECE		Eddy	
SC 500 Special Topics in ECE		Giles	
SC 501 Dynamic Systems Theory	Dupont		
SC 504 Advanced Data Structures		Guerrieri	
SC 505 Stochastic Processes	Karl	Karl	
SC 511 Software Systems Design	Vidale	Bures	
SC 512 Digital Signal Processing	Nawb	Nawb	
SC 513 Computer Architecture	Skinner		
SC 518 Software Project Management		Brackett	
SC 533 Introduction to Discrete Mathematics	Levitin		
SC 534 Stochastic Models in Engineering		Levitin	
SC 546 Computer Communications and Networks	Carruthers	Carruthers	
SC 560 Introduction to Photonics	Teich		
SC 561 Error-Control Codes	Karpovsky		
SC 562 Digital Communication	Ruane		
SC 563 Fiber Optic Communication Systems		Morse	
SC 565 Electromagnetic Energy Transmission	Kotiuga		
SC 570 Lasers		Teich	
SC 571 VLSI Principles and Applications	Hubbard	Hubbard	
SC 572 VLSI Design Project	Hubbard		
SC 574 Quantum Mechanics and Semiconductors	Schubert		
SC 575 Semiconductor Devices		Hubbard	
SC 577 Solid State Devices	Moustakas	Moustakas	
SC 578 Fabrication Technology for Integrated Systems		Smits	
SC 580 Modern Active Circuit Design	Horenstein		
SC 700 Advanced Special Topics	Brackett/ Sergienko Caramanis	Little	
SC 710 Dynamic Programming and Stochastic Control			
SC 712 Advanced Software for Computer Engineers		Skinner	
SC 714 Software Performance Engineering		Vidale	
SC 725 Queuing Systems	Hu		
SC 730 Information-Theoretical Design of Algorithms		Levitin	
SC 731 Applied Plasma Physics		Lee	
SC 741 Network Computing		Avresky	
SC 745 Digital Signal Processing	Espy-Wilson		
SC 748 Multimedia Computer System Design		Little	
SC 749 Interconnection Networks for Multicomputers	Avresky		
SC 757 Advanced Microprocessor Design		Perreault	
SC 761 Information Theory and Coding	Levitin		
SC 772 VLSI Graduate Design Projects	Hubbard		

## 5.2 Publications

### Books

C. G. Cassandras and S. Lafortune, *Introduction to Discrete Event Systems*, Kluwer Academic Publ., (1999).

T. D. Moustakas, S. Mohny, and S. J. Pearton, eds., *III-V Nitride Materials and Processes III*, 98-18, Electrochemical Society, Pennington, N.J., 1999.

M. S. Ünlü, J. Piqueras, N. Kalkhoran, and T. Sekiguchi, eds., *Optical Microstructural Characterization of Semiconductors*, Materials Research Society Proceedings, Warrendale, PA, 2000.

### Book Chapters

C. R. Eddy, Jr., "Mass Spectrometric Characterization of Plasma Etching Processes," *Advanced Plasma Processing Techniques*, S.J. Pearton and R.J. Shul, eds., Springer-Verlag Publishers, New York, NY, 2000, pp. 411-463.

A. E. Hubbard, L. Shatz, Z. Yang, and D. C. Mountain, "Multi-mode Cochlear Models," *Symposium on Recent Developments in Auditory Mechanics*, H. Wada, T. Takasaka, K. Ikeda, K. Ohyama, T. Koike, eds., World Scientific Publishing, Singapore, 2000, pp. 167-173.

D. C. Mountain, H. H. Nakajima, S. Rafee, and A. E. Hubbard, "Forward and Reverse Traveling Waves in the Gerbil Cochlea," *Symposium on Recent Developments in Auditory Mechanics*, H. Wada, T. Takasaka, K. Ikeda, K. Ohyama, T. Koike, eds., World Scientific Publishing, Singapore, 2000, pp. 102-108.

H. H. Nakajima, A. E. Hubbard, and D. C. Mountain, "A Physiologically-based Nonlinear Active Feedback Model of the Cochlea," *Symposium on Recent Developments in Auditory Mechanics*, H. Wada, T. Takasaka, K. Ikeda, K. Ohyama, T. Koike, eds., World Scientific Publishing, Singapore, 2000, pp. 202-208.

W. C. Karl, "Regularization in Reconstruction and Restoration," in *Handbook of Image and Video Processing*, A. Bovik, ed., Academic Press Limited, April 2000.

E. L. Schwartz, *MIT Encyclopedia of Cognitive Sciences*, Robert A. Wilson and Frank C. Keil, eds., MIT Press, 1999, pp. 164-166.

S. B. Lowen and M. C. Teich, "Toward Fractal Coding in Auditory Prostheses," *Cochlear Implants*, S. B. Waltzman and N. L. Cohen, eds., Thieme Medical Publishers, New York, 1999, pp. 57-59.

M. C. Teich, S. B. Lowen, B. M. Jost, K. Vibe-Rheymer, and C. Heneghan, "Heart Rate Variability: Measures and Models," *Nonlinear Biomedical Signal Processing*, M. Akay, ed., IEEE Press, New York, 2000, Ch. 6, pp. 159-213 (invited).

A. V. Sergienko, M. Atatüre, B. M. Jost, J. Perina, Jr., B. E. A. Saleh, and M. C. Teich, "Quantum Cryptography with Femtosecond Parametric Down-Conversion," *Quantum Communication, Computing, and Measurement 2*, P. Kumar, G. M. D'Ariano, and M. Hirota, eds., Kluwer, New York, 2000, pp. 405-412.

T. Melamed and L.B. Felsen, "Pulsed Beam Propagation in Lossless Dispersive Media," *Ultrawideband Short-Pulse Electromagnetics 4*, E. Heyman, B. Mandelbaum, and J. Shiloh, eds., Plenum Press, New York, 1999, pp. 277-288.

### Journal Articles

R. C. Brower and B. Svetitsky, "Hamiltonian domain wall fermions at strong coupling," *Phys. Rev D* 61, 114, 511 (2000).

R. C. Brower, S. D. Mathur and C. Tan, "Discrete spectrum of the graviton in the AdS(5) black hole background," *Nucl. Phys. B* 574, 219-244 (2000).

S. R. Kimura, R. C. Brower, C. Zhang, and M. Sugimori, "Surface of active polarons: A semi-explicit solvation method for biomolecular dynamics," *J. Chem. Phys.*, 112, 7723-7734 (2000).

R. C. Brower, "From black holes to QCD: The Glueball spectrum at strong coupling," *Chinese Journal of Physics*, Vol. 38, No. 3, pp. 687-697 (2000).

J. B. Carruthers and J. M. Kahn, "Angle diversity for non-directed Wireless infrared communication," *IEEE Trans. on Communications* 48, 6 (2000).

C.G. Panayiotou and C.G. Cassandras, "Optimization of Kanban-Based Manufacturing Systems," *Automatica*, Vol. 35, pp. 1521-1533 (1999).

Y.C. Ho, C.G. Cassandras, C-H. Chen, and L. Dai, "Ordinal Optimization and Simulation," *J. of Operational Research Society*, Vol 51, 4, pp. 490-500 (2000).

L. Dai, C.G. Cassandras, and C.G. Panayiotou, "On the Convergence Rate of Ordinal Optimization for a Class of Stochastic Discrete Resource Allocation Problems," *IEEE Trans. on Automatic Control*, AC-45, 3, pp. 588-591 (2000).

- P. M. Bursac, T. W. Obitz, S. R. Eisenberg, D. Stamenovic, "Confined and unconfined stress relaxation of cartilage: appropriateness of a transversely isotropic model," *J. Biomechanics*, 32, 1125-1130 (1999).
- N. Bursac, M. Papadaki, R. J. Cohen, F. J. Schoen, S. R. Eisenberg, R. Carrier, G. Vunjak-Novakovic, L. E. Freed, "Cardiac muscle tissue engineering: towards an in-vitro model for electrophysiological studies," *American J. Physiol., Heart and Circ. Physiol.*, 46, H433-H444 (1999).
- P. M. Bursac, C. V. McGrath, S. R. Eisenberg, D. Stamenovic, "A microstructural model of elastostatic properties of articular cartilage in confined compression," *J. Biomech. Eng. (Aug 2000)*.
- C. Y. Espy-Wilson, S. Boyce, M. Jackson, S. Narayanan and A. Alwan, "Acoustic Modeling of American English /r/," *Journal of the Acoustical Society of America* (July 2000).
- F. Capolino, M. Albani, S. Maci and L. B. Felsen, "Frequency Domain Green's Function for a Planar Periodic Semi-Infinite Phased Array: Part I-- Truncated Floquet Wave Formulation," *IEEE Trans. Ant. Propagat* 48, 67-74 (2000).
- F. Capolino, M. Albani, S. Maci and L. B. Felsen, "Frequency Domain Green's Function for a Planar Periodic Semi-Infinite Phased Array: Part II-- Diffracted Wave Phenomenology," *IEEE Trans. Ant. Propagat*, 48, 75-85 (2000).
- F. Capolino, S. Maci, and L. B. Felsen, "Asymptotic High Frequency Green's Function for a Planar Phased Sectoral Array of Dipoles," *Radio Science (special issue)* 35, 579-593 (2000).
- M. Mongiardo, P. Russer, C. Tomassoni and L. B. Felsen, "Analysis of N-Furcation in Elliptical Waveguides via the Generalized Network Formulation," *IEEE Trans. Microwave Theo. and Techniques* 47, 2473-2478 (1999).
- B. P. de Hon, E. Heyman and L. B. Felsen, "Spectral Alternatives for the Synthesis of Short-Pulse Wavefields in Waveguides," *Ultrawideband Short-Pulse Electromagnetics* 4, 289-299 (1999).
- R. Holmes and R. Giles, "Minorities Participation in Computational Science," *Invited guest editorial, Computing in Science and Engineering* 2, 11-13 (2000).
- M. J. Manfra, B. B. Goldberg, J. C. Pniower, A. Pinczuk, V. Pellegrini, L. N. Pfeiffer, and K. W. West, "Absorption Spectroscopy In Electron Double Layers: Evidence for Broken Symmetry States," *Physica E* 6, 590 (2000).
- H. D. Robinson, B. B. Goldberg, "Interdot Coupling and Spectral Diffusion: Consequences of Wetting Layer Potential Fluctuations in Self-Assembled Quantum Dots," *Physica E* 6, 444 (2000).
- H. D. Robinson and B. B. Goldberg, "Light induced spectral diffusion in single self-assembled quantum dots," *Phys. Rev. B Rapid Comm.* 61, R5086 (2000).
- K. Knopp, D. A. Christensen, G. Vander Rhodes, J. M. Pomeroy, B. B. Goldberg, M. S. Ünlü, "Spatio-Spectral Mapping of Multimode Vertical-Cavity Surface-Emitting Lasers," *IEEE J. Lightwave Tech.*, 17, 1429 (1999).
- K. Knopp, D. A. Christensen, G. Vander Rhodes, J. M. Pomeroy, B. B. Goldberg, M. S. Ünlü, "Spectral Mapping of Multimode Vertical-Cavity Surface-Emitting Lasers by Near-Field Scanning Optical Microscopy," *SPIE* 3626, 208 (1999).
- M. N. Horenstein, J. A. Perreault, T. G. Bifano, "Differential Capacitive Position Sensor for Planar MEMS Structures with Vertical Motion," *Sensors and Actuators* 80, 53-61 (2000).
- M. N. Horenstein, "Lumped-Element Model for Computing the Equilibrium Charge Distribution Along a Moving Web," *IEEE Transactions on Industry Application*, IAS-36 (01) (2000).
- H. H. Nakajima, A. E. Hubbard, and D. C. Mountain, "The effects of acoustic trauma on the enhancement of electrically-evoked otoacoustic emissions," *J. Acoust. Soc. Amer.* 107, 2603-2614 (2000).
- M. K. Schneider, P. W. Fieguth, W. C. Karl, and A. S. Willsky, "Multiscale Statistical Methods for the Segmentation of Images," *IEEE Trans. on Image Processing*, 9, 456-468 (2000).
- Kannan, M. Ostendorf, W. C. Karl, D. A. Castañón, R. K. Fish, "ML Parameter Estimation of a Multiscale Stochastic Process using the EM Algorithm," *IEEE Transactions on Signal Processing*, 48, 1836-1847 (2000).
- M. Takajo, J. Yamasaki and F. B. Humphrey, *IEEE Trans. Magn.* 35, 3904 (1999).
- M. G. Karpovsky, K. Chakrabarty, L. B. Levitin, D. Avresky, "On the Covering of Vertices for Fault-Diagnosis in Hypercubes," *Information Processing Letters* 69, 99-103 (1999).
- Y. Fang, T. G. Kincaid, and S. Li, "Robust Stability Criteria for a Class of Systems Arising in Neural-Network Control and Fuzzy Systems," *Proc. Instn. Mech. Engrs.*, 214 Part I, 1-7 (2000).

- V. Kozlov, J. Hernandez-Cordero, T. F. Morse, "All-fiber coherent beam combining of fiber lasers," *Opt. Lett* 24, 1814-1816 (1999).
- J. Hernandez-Cordero, V. Kozlov, A. Carter, T. F. Morse, "Polarization effects in a high-birefringence elliptical fiber laser with a Bragg grating in a low-birefringence fiber," *J. Appl. Optics* 36, 971-976 (2000).
- S. P. Kuo and M. C. Lee, "On the generation of a broad downshifted spectrum of HF wave enhanced plasma lines in the ionospheric heating experiments," *Geophysical Research Letters* 26, 3289 (1999).
- J. A. Vladimer, P. Jastrebski, M. C. Lee, P. H. Doherty, D. T. Decker, and D. N. Anderson, "Longitude structure of ionospheric TEC at low latitudes measured by the TOPEX/Poseidon satellite," *Radio Science* 34, 1239 (1999).
- S. P. Kuo, M. C. Lee, and P. A. Kossey, "Excitation of short-scale field-aligned electron density irregularities by ionospheric topside sounders," *Journal of Geophysical Research*, 104, 1989 (1999).
- M. J. Starks and M. C. Lee, "Matched filtering for the measurements of conjugately inducted VLF transmissions," *Radio Science* 35, 351 (2000).
- S. P. Kuo, M. C. Lee, P. Kossey, K. Groves, J. Heckscher, "Stimulated thermal instability for ELF and VLF wave generation in the polar electrojet," *Geophysical Research Letters* 27, 85 (2000).
- T. F. Morse, Y. He, F. Luo, "An optical fiber sensor for the measurement of elevated temperatures," *IEICE Trans. Electron.*, E-83-C, 3, 298-302 (2000).
- Y. He, B. Sheldon, T. F. Morse, "In situ fiber optical sensor for the measurement of thin films," *IEICE Trans. Electron.*, E-83-C, 3, 315-325 (2000).
- J. Hernandez-Cordero, T. F. Morse, "Fiber laser intra-cavity spectroscopy (FLICS)," *IEICE Trans. Electron.*, E-83-C, 3, 371-377 (2000).
- C. K. Y. Leung, N. Elvin, N. Olson, T. F. Morse, Y. He, "A novel distributed optical crack sensor for concrete structures," *Eng. Fract. Mech* 65, 133-148 (2000).
- K. Oh, A. Kilian, T. F. Morse, "Analysis of spectroscopic properties of erbium doped Ta<sub>2</sub>O<sub>5</sub>-Al<sub>2</sub>O<sub>3</sub>-SiO<sub>2</sub> optical fiber," *J. Non-Cryst. Solids* 259, 10-16 (1999).
- K. Oh, T. F. Morse, "Thermal effects on the excited state absorption and upconversion process of erbium ions in germanosilicate optical fiber," *J. Non-Cryst. Solids* 259, 51-56 (1999).
- M. Misra, A. V. Sampath, and T. D. Moustakas, "Investigation of Vertical transport in n-GaN Films grown by Molecular Beam Epitaxy using Schottky barrier diodes," *App. Phys. Lett.* 76, 1045 (2000).
- H. M. Ng and T. D. Moustakas, "High Reflectivity and Broad bandwidth AlN/GaN distributed Bragg reflectors grown by Molecular Beam Epitaxy," *App. Phys. Lett.* 76, 2818 (2000).
- A. V. Sampath, M. Misra, K. Seth, Y. Fedyunin, H. M. Ng, E. Iliopoulos, Z. Feit and T. D. Moustakas, "A Comparative Study of GaN Diodes Grown by MBE on Sapphire and HVPE-GaN/Sapphire Substrates," *MRS Internet J. Nitride Semicond. Res.* 5S1, W11.1 (2000).
- H. M. Ng, T. D. Moustakas, and K. F. Ludwig, Jr., "Structural and optical characterization of InGaN/GaN multiple quantum wells grown by Molecular Beam Epitaxy," *Journal of Vacuum Science and Tech.-B* 18, 1457 (2000).
- H. M. Ng and T. D. Moustakas, "High Reflectance III-Nitride Bragg Reflectors Grown by Molecular Beam Epitaxy," *MRS Internet J. Nitride Semicond. Res.* 5S1, W1.8 (2000).
- M. Misra, A. V. Sampath, and T. D. Moustakas, "Vertical Transport Properties of GaN Schottky Diodes Grown by Molecular Beam Epitaxy," *MRS Internet J. Nitride Semicond. Res.* 5S1, W11.2 (2000).
- M. Holtz, M. Seon, T. Prokofyeva, H. Temkin, R. Singh, F. P. Dabkowski, and T. D. Moustakas, "Micro-Raman Imaging of GaN Hexagonal Island Structures," *Appl. Phys. Lett.* 75, 1757 (1999).
- M. Katsikini, M. Fieber-Erdmann, B. Holub-Krappe, D. Korakakis, T. D. Moustakas, and E. C. Paloura, "Nitrogen K-edge NEXAFS measurements on group III binary and Ternary nitrides," *J. of Synchrotron Radiation*, 6, 558 (1999).
- M. Katsikini, T. D. Moustakas and E. C. Paloura, "Nitrogen K-Edge EXAFS measurements on Mg and Si doped GaN," *J. of Synchrotron Radiation*, 6, 555 (1999).
- M. Katsikini, H. Rossner, M. Rieber-Erdmann, B. Holub-Krappe, T. D. Moustakas, and E. C. Paloura, "Gallium K-Edge EXAFS measurements on cubic and hexagonal GaN," *J. Synchrotron Radiation*, 6, 561 (1999).
- M. Katsikini, B. C. Paloura, M. Fieber-Erdmann, B. Holub-Krappe, D. Korakakis and T. D. Moustakas, *J. of Electron Spectroscopy and Related Phenomena*, 101-103, 695 (1999).
- C. W. Kok, M. Ikehara and T. Nguyen, "Design and Factorization of FIR Paraunitary Filter Banks Given Several Analysis Filters," *IEEE Transactions on Signal Processing*, 38, 2157-2161 (2000).

- T. Tran, R. deQueiroz and T. Nguyen, "Linear Phase Perfect Reconstruction Filter Bank: Lattice Structure, Design and Application in Image Coding," *IEEE Trans. on Signal Processing*, 38, 133-147 (2000).
- T. Tran and T. Nguyen, "A Progressive Transmission Image Coder Using Linear Phase Uniform Filter Banks as Block Transforms," *IEEE Trans. on Image Processing*, 38, 1497-1507 (1999).
- T. Tran and T. Nguyen, "Linear Phase Paraunitary Filter Bank with Filters of Different Lengths and Its Application in Image Compression," *IEEE Trans. on Signal Processing* 35, 2730-2744 (1999).
- S. Zhang, S. Fukao, and W. L. Oliver, "Data modeling and assimilation studies with the MU radar," *Journal of Atmospheric and Solar Terrestrial Physics*, 61, pp. 563-583 (1999).
- W. L. Oliver and J. Schoendorf, "Variations of hot O in the thermosphere," *Geophysical Research Letters* 26, pp. 2829-2832 (1999).
- S. Igi, W. L. Oliver, and T. Ogawa, "Solar cycle variations of thermospheric meridional winds over Japan derived from F2 peak heights," *Journal of Geophysical Research*, 104, pp. 22427-22431 (1999).
- S. Zhang, S. Fukao, W. L. Oliver, and Y. Otsuka, "The height of the maximum ionospheric electron density over the MU radar," *Journal of Atmospheric and Solar Terrestrial Physics*, 61, pp. 1367-1383 (1999).
- S. Kawamura, Y. Otsuka, S.-R. Zhang, S. Fukao, W. L. Oliver, "A climatology of middle and upper atmosphere radar observations of neutral winds," *Journal of Geophysical Research*, 105, pp. 12777-12788 (2000).
- A. Litvin, W. L. Oliver, J. M. Picone, and M. J. Buonsanto, "The upper atmosphere during June 5-11, 1991," *Journal of Geophysical Research*, 105, pp. 12789-12798 (2000).
- J. Schoendorf, L. A. Young, and W. L. Oliver, "Hot oxygen profiles for incoherent scatter radar analysis of ion energy balance," *Journal of Geophysical Research*, 105, pp. 12823-12832 (2000).
- M. A. Saleh, M. M. Hayat, B. E. A. Saleh, and M. C. Teich, "Dead-Space-Based Theory Correctly Predicts Excess Noise Factor for Thin GaAs and AlGaAs Avalanche Photodiodes," *IEEE Trans. Elect. Dev.*, Vol. 47, pp. 625-633 (March 2000).
- X. Guo, J. Graff, and E. F. Schubert, "Photon Recycling Semiconductor Light Emitting Diode," *IEDM Technical Digest*, IEDM-99, 600 (1999).
- I. D. Goepfert, E. F. Schubert, A. Osinsky, and P. E. Norris, "Efficient acceptor activation in  $\text{Al}_x\text{Ga}_{1-x}\text{N}/\text{GaN}$  doped superlattices," *MRS Internet Journal Nitride Semicond.*, Res., 5S1, W3.85 <<http://nsr.mij.mrs.org/5S1/W3.85/>> (2000).
- D. Stocker, I. D. Goepfert, E. F. Schubert, K. Boutros, and J. Redwing, "Crystallographic wet chemical etching of p-type GaN," *J. Electrochem. Soc.*, 147, pp. 763 (2000).
- X. Guo, J. W. Graff, E. F. Schubert, and R. Karlicek Jr., "Photon Recycling Semiconductor Light Emitting Diode," *SPIE Photonics West Proceedings Series*, "Light-Emitting Diodes: Research, Manufacturing, and Applications" (2000).
- S. Jade and J. Smits, "Measurement of Elastic Modulus  $S_{11}^p$  of Thin Film ZnO by Resonance Method," *IEEE Trans. on Ultrasonics, Ferroelectrics and Frequency Control* 46, 768-770 (1999).
- C. Walter, N. Suri, T. Monaghan, "Evaluation of COTS Standards for Dependable Systems Design," *FTCS-30/DSN*, pp. 87-92 (2000).
- A. Mendelson, N. Suri, "Designing High-Performance & Reliable Superscalar Architectures," to appear *FTCS-30/DSN*, pp. 473-481 (2000).
- M. Atatüre, A. V. Sergienko, B. M. Jost, B. E. A. Saleh, and M. C. Teich, "Partial distinguishability in femtosecond optical spontaneous parametric down-conversion," *Phys. Rev. Lett.* 83, 1323-1326 (1999).
- A. V. Sergienko, M. Atatüre, Z. Walton, G. Jaeger, B. E. A. Saleh, and M. C. Teich, "Quantum Cryptography Using Femtosecond-Pulsed Parametric Down-Conversion," *Phys. Rev. A* 60, R2622-R2625 (1999).
- M. Atatüre, A. V. Sergienko, B. E. A. Saleh, and M. C. Teich, "Dispersion-Independent High-Visibility Quantum Interference in Ultrafast Parametric Down-Conversion," *Phys. Rev. Lett.* 84, 618-621 (2000).
- A. Czitrovsky, A. Sergienko, P. Jani, and A. Nagy, "Measurement of Quantum Efficiency Using Entangled Photons," *Laser Physics*, 10, 86-89 (2000).
- G. Ulu, A. V. Sergienko, and M. S. Ünlü, "Influence of hot-carrier luminescence from avalanche photodiodes on time-correlated photon detection," *Optics Letters*, 25, 758-760 (2000).
- A. Trifonov, T. Tsegaye, G. Björk, J. Söderholm, E. Goobar, M. Atatüre and A. V. Sergienko, "Experimental Demonstration of the Relative Phase-Difference Operator," *Journal of Optics B: Quantum and Semiclassical Optics* 2, 105-112 (2000).
- G. E. Bunea, M. S. Ünlü, B. B. Goldberg, "Carrier dynamics studies of thick GaN grown by HVPE," *MRS Internet J. Nitride Semic. Research* (2000).
- G. H. Vander Rhodes, M. S. Ünlü, B. B. Goldberg, S. T. Chu, and B. Little, "Measurement of Internal Spatial Modes in Microring Resonators," *IEEE J. Selected Topics in Quantum Electron* 6, 1077 (2000).

G. H. Vander Rhodes, M. S. Ünlü, B. B. Goldberg, S. T. Chu, W. Pan, T. Kaneko, Y. Kokobun, and B. E. Little, "Measurement of internal spatial modes and local propagation properties in optical waveguides," *Appl. Phys. Lett.* 75, 16, 2368-2370 (1999).

M. Gökkavas, G. Ulu, and M. S. Ünlü, "Resonant Cavity Enhanced Photodiodes with a Flat Spectral Response," *Trends in Optics Series, Ultrafast Electronics and Optoelectronics*, 28, 208 (1999).

G. Ulu, M. Gökkavas, M. S. Ünlü, N. Biyikli, I. Kimukin, E. Özbay, R. P. Mirin, K.A. Bertness, and D. H. Christensen, "High Speed Resonant Cavity Photodiodes with Near-Unity Quantum Efficiency," *Trends in Optics Series, Ultrafast Electronics and Optoelectronics*, 28, 115-122 (1999).

G. E. Bunea, W. D. Herzog, M. S. Ünlü, B. B. Goldberg, R. J. Molnar, "Time Resolved Photoluminescence Studies of Free and Donor-Bound Exciton in GaN grown by HVPE," *Appl. Phys. Lett.*, 75, 6, 838 (1999).

## Conference Papers

R. C. Brower, S. D. Mathur and C. Tan, "From black holes to glueballs: The QCD(3) tensor glueball at strong coupling," *Nucl. Phys. Proc. Suppl.* 83-84, 923-925 (2000).

D. Chen, R. C. Brower, J. W. Negele and E. Shuryak, "Heavy quark potential in the instanton liquid model," *Nucl. Phys. Proc. Suppl.* 73, 512 (1999).

D. Dolgov, R.C. Brower, J. W. Negele and A. Pochinsky, "Study of instanton contributions to moments of nucleon spin-dependent structure functions," *Nucl. Phys. Proc. Suppl.* 73, 300 (1999).

R. C. Brower, S. D. Mathur and C. Tan, "Glueball spectrum for QCD from Ad Supergravity duality," *Proc. of the 1998 UIC Workshop on Particle Distributions in Hadronic and Nuclear Collisions*, World Scientific, pp. 139 (1999).

R. C. Brower, D. Chen, J. Negele, K. Orginos, C-I Tan "Magnetic Monopole Content of Hot Instantons," *Nucl. Phys. Proc. Suppl.*, 73, 557-559 (1999).

R. C. Brower, S. D. Mathur and C. Tan, "From black holes to pomeron: Tensor glueball and pomeron intercept at strong coupling," *Proc. of ISMD99*, World Scientific (2000).

R. C. Brower, J. McGreevy and C. I. Tan, "Stringy model for QCD at finite density and generalized Hagedorn temperature," *Proc. of the 1998 UIC Workshop on Particle Distributions in Hadronic and Nuclear Collisions*, World Scientific, pp. 139 (1999).

I. Chlamtac, A. Fumagalli, G. Wedzinga, and J. B. Carruthers, "Upgradable photonic slot routing networks to cope with increasing capacity demands," *SPIE International Symposium on Voice, Video, and Data Communications*, Boston, Vol. 3843, pp. 100-111 (1999).

C. G. Cassandras and D. L. Pepyne, "Hybrid System Models for Integrated Manufacturing," *Proc. of IEEE Hong Kong Symposium on Robotics and Control*, Vol. II, pp. 615-620 (Hong Kong, China, July 1999).

C. Panayiotou and C. G. Cassandras, "Optimization of Kanban-Based Manufacturing Systems," *Proc. of 14th IFAC World Congress*, Vol. J. pp. 139-144 (Beijing, China, July 1999).

Y. Wardi and C. G. Cassandras, "Enterprise Engineering: A Framework for Optimal Control of Hybrid Dynamical Systems," *Proc. of JFACC Symposium on Advances in Enterprise Control* (Monterey, CA, November 1999).

K. Gokbayrak and C. G. Cassandras, "Stochastic Discrete Optimization Using a Surrogate Problem Methodology," *Proc. of 38th IEEE Conf. Decision and Control*, pp. 919-924 (Phoenix, AZ, December 1999).

C. G. Cassandras, Q. Liu, D. Pepyne, and K. Gokbayrak, "Optimal Control of a Two-Stage Hybrid Manufacturing System Model," *Proc. of 38th IEEE Conf. Decision and Control*, pp. 450-455 (Phoenix, AZ, December 1999).

C. G. Cassandras, J-Q. Hu, P. Vakili, Y. C. Ho, and W.-B. Gong, "Instructional material and Interactive Modules for Discrete Event Dynamic Systems," *Proc. of 38th IEEE Conf. Decision and Control*, pp. 3022-3023 (Phoenix, AZ, December 1999).

K. Gokbayrak, and C. G. Cassandras, "Stochastic Optimal Control of a Hybrid Manufacturing System Model," *Proc. of 38th IEEE Conf. Decision and Control*, pp. 919-924 (Phoenix, AZ, December 1999).

C. Panayiotou and C. G. Cassandras, "A Sample Path Approach for Solving the Ground Holding Policy Problem in Air Traffic Control," *Proc. of 38th IEEE Conf. Decision and Control*, pp. 2450-2455 (Phoenix, AZ, December 1999).

K. Gokbayrak and C. G. Cassandras, "Hybrid Controllers for Hierarchically Decomposed Systems," *Proc. of 2000 Hybrid System Control Conf.*, pp. 117-129 (Pittsburgh, PA, December 1999).

C. G. Cassandras, C. G. Panayiotou, G. Diehl, W. B. Gong, Z. Liu, and C. Zou, "Clustering Methods for Multi-Resolution Simulation Modeling," *Proc. of SPIE 14th Annual Intl. Symposium* (Orlando, FL, April 2000).

C. G. Cassandras, and R. Yu, "A 'Surrogate Problem' Approach for Lot Size Optimization in Manufacturing Systems," *Proc. of 2000 American Control Conference*, (Chicago, IL, June 2000).



Z. Ying and D. A. Castañon, "Statistical Models for Human Face Detection Using Multi-Resolution Features," Proc. of the IEEE International Conference on Information, Intelligence and Systems, pp. 560-566 (Bethesda, MD, November, 1999).

Z. Ying and D. A. Castañon, "Statistical Models for Occluded Object Recognition," Proc. of the IEEE International Conference on Information, Intelligence and Systems, pp. 32-329 (Bethesda, MD, November 1999).

D. P. Bertsekas, D. A. Castañon, M. L. Curry, and D. Logan, "Adaptive Multi-Platform Scheduling in a Risky Environment," Proceeding of Symposium on Advances in Enterprise Control (San Diego, CA, November 1999).

H. Feng, D. A. Castañon, W. C. Karl, "Underground Imaging Based on Edge-Preserving Regularization," Proc. of the IEEE International Conference on Information, Intelligence and Systems, pp. 460-464 (Bethesda, MD, November 1999).

H. Feng, D. A. Castañon, and W. C. Karl, "A Shape-Based Approach to Buried Landmine Imaging," Proc. Of JCIS, International Conference on Computer Vision, Pattern Recognition, and Image Processing 2000 (Atlantic City, NJ, March 2000).

H. Feng, D. A. Castañon, W. C. Karl, and E. L. Miller, "GPR Imaging Approaches for Buried Plastic Landmine Detection," Detection and Remediation Technologies for Mines and Mine-Like Targets V, A.C. Dubey, J. F. Harvey, J. T. Broach, and R. E. Dugan editors, Proc. SPIE V 4038, SPIE (Orlando, FL, April 2000).

C. Wu, M. L. Curry, D. P. Bertsekas and D. A. Castañon, "Approximate Dynamic Programming for Multi-Platform Scheduling in a Risky Environment," Proceeding of Symposium on Advances in Enterprise Control (Minneapolis, MN, June 2000).

H. Feng, D. A. Castañon, and W. C. Karl, "Tomographic Reconstruction Using Curve Evolution," Proc. Of IEEE International Conference on Computer Vision and Pattern Recognition 2000 (Hilton Head, SC, June 2000).

C. Y. Espy-Wilson and S.E. Boyce, "A Simple Tube Model for American English /r/," Proceedings of the International Congress of Phonetic Sciences, pp. 2137-2140 (1999).

C. Y. Espy-Wilson, Z. McCaffrey and P. Demirel and J. MacAuslen, "Using a Natural Glottal Source to Improve Artificial Larynx Speech," Proceedings of Eurospeech, pp. 323-326 (1999).

A. Saloman and C. Y. Espy-Wilson, "Automatic Detection of Manner Events for a Knowledge-Based Speech Signal Representation," Proceedings of Eurospeech, pp. 2797-2800 (1999).

A. Mandal, L. J. Davis, C. Y. Espy-Wilson, M. Matthies, "The Use of Spectral vs. Temporal Cues to Recognize Speech," 140th Meeting of the Acoustical Society of America (Columbus, Ohio, 1999).

S. E. Boyce and C. Y. Espy-Wilson, "Acoustic and Articulatory Differences Across Word Position for American English /r/," 140th Meeting of the Acoustical Society of America (Columbus, Ohio, 1999).

H. D. Robinson, B. B. Goldberg, and J. L. Merz, "Lateral coupling of self-assembled quantum dots studied by near-field spectroscopy," Semiconductor Quantum Dots, MRS Conference Proceedings, pp. 571 (2000).

B. B. Goldberg and M. S. Ünlü, "Mapping Internal Optical Modes by Near-field Scanning Optical Microscopy," APS Meeting (2000).

B. B. Goldberg, M. S. Ünlü, G. Vander Rhodes, "Internal Spatial Modes And Local Propagation Properties In Optical Waveguides Measured Using Near-Field Scanning Optical Microscopy," Materials Research Society Proceedings (1999). (Invited)

M. Horenstein, S. Pappas, A. Fishov and T. Bifano, "Binary Electrostatic MEMS Actuators for Subaperture Imaging in an Adaptive Optics System," Electrostatics Society of America Annual Conference (Niagara Falls, 2000).

M. Horenstein, P. Stone, T. Bifano, "A Micro-Miniature Field Mill Based on MEMS Technology," Electrostatics Society of America Annual Conference (Niagara Falls, 2000).

D. F. Kacher, E. Gao, H. M. O'Leary, W. E. Kyriakos, J. P. Kauphold, Q. Y. Ma, W. M. Wells, W. C. Karl and F. A. Jolesz, "RF Coil Sensitivity Estimation for Intensity Correction or Encoding," Proc. of the International Society for Magnetic Resonance in Medicine 8th Annual Meeting, pp. 1405 (Denver, CO, 2000).

M. Cetin, W. C. Karl, and D. A. Castañon, "Evaluation of a regularized SAR imaging technique based on recognition-oriented features," Algorithms for Synthetic Aperture Radar Imagery VII, E.G. Zeh-uo. editors, Proc. SPIE V 4053, SPIE (Orlando, FL, April 2000).

R. C. Chan, J. Kaufold, W. C. Karl, and R.S. Lees, "Ultrasound Analysis of Vascular Structure and Deformation," Battlefield Biomedical Technologies 11, H. H. Pien editor, Proc. SPIE V 4037B, SPIE (Orlando, FL, 2000).

Mujdat Cetin and W. C. Karl, "Enhanced, High Resolution Radar Imaging based on Robust Regularization," Proc. 2000 IEEE Int'l Conf. on Acoustics, Speech, and Signal Processing (Istanbul, Turkey, 2000).

L. Zakrevski, M. G. Karpovsky, "Fault-Tolerant Routing in Computer Networks," Proc. Int. Conf. On Parallel and Distributed Processing Techniques and Applications, 4, 2279-2287 (1999).

- L. Zakrevski, S. Jaiswal, M. G. Karpovsky, "Unicast Message Routing in Communication Networks with Irregular Topologies," Proc. of CAD-99 (1999).
- L. Zakrevski, S. Jaiswal, L. B. Levitin, M. G. Karpovsky, "A New Method for Deadlock Elimination in Computer Networks with Irregular Topologies," Proc. Int. Conf. On Parallel and Distributed Computer Systems (1999).
- L. Zakrevsky, S. Jaiswal, L. B. Levitin, M. G. Karpovsky, "A New Method for Deadlock Elimination," Conf. on Parallel and Distributed Computing Systems (Cambridge, MA, 1999).
- L. B. Levitin, T. Toffoli, Z. Walton, "Information and Distinguishability of Quantum States," 5th Intern. Conf. on Quantum Communication, Measurement, and Computing (Capri, Italy, 2000).
- L. B. Levitin, L. Zakrevsky, M. G. Karpovsky, "Codes for Breaking Cycles in Non-Oriented Graphs," IEEE Intern. Symp. on Inform. Theory, ISIT-2000 (Sorrento, Italy, 2000).
- L. B. Levitin, "Information in Repeated Quantum Measurements," IEEE Intern. Symp. on Inform. Theory, ISIT-2000 (Sorrento, Italy, 2000).
- P. Basu, A. Narayanan, W. Ke, T. D. C. Little, and A. Bestavros, "Optimal Scheduling of Secondary Content for Aggregation in Video-on-Demand Systems," Proc. of 8th International Conference on Computer Communications and Networks (ICCCN '99), pp. 104-109 (Boston, MA, 1999).
- G. Ahanger and T. D. C. Little, "Data Semantics for Improving Retrieval Performance of Digital News Video Systems," IEEE Trans. Knowledge and Data Engineering (Shorter version presented at 8th IFIP 2.6 Working Conference on Database Semantics, New Zealand, 1999).
- R. Mani, S. H. Nawab, and G. Taibi, "Domain Constraints for Polyphonic Music Understanding," Workshop on Computational Auditory Scene Analysis, 16th International Joint Conference on Artificial Intelligence (IJCAI) (Stockholm, Sweden, July 31-August 6, 1999).
- R. Mani, S. H. Nawab, and G. Taibi, "Time-Frequency Signal Representation for Polyphonic Music," SCI 1999 Proceedings, Vol. 6, pp. 406-410 (Orlando, FL, July 31-August 4, 1999).
- S. H. Nawab, S.A. Ayyash, S. Hebsur, G. Taibi, "Extraction of Simultaneous Fundamental Frequencies in Western Polyphonic Music," Proceedings of the World MultiConference on Systemics, Cybernetics, and Informatics, SCI 2000 (Orlando, FL, 2000).
- R. Adikhary, S. H. Nawab, "Evaluation of IIR Approximate Filtering for Speech Applications," Proceedings of the World MultiConference on Systemics, Cybernetics, and Informatics, SCI 2000 (Orlando, FL, 2000).
- J. Hernandez-Cordero and T. F. Morse, "Gas sensors based on fiber laser intra-cavity spectroscopy (FLICS)," Fiber Optic Sensor Technology and Applications, SPIE conference, Proceedings of SPIE, pp. 171-178 (Boston, MA, September 20-22, 1999).
- J. Hernandez-Cordero and T. F. Morse, "Fiber Laser Intra-Cavity Spectroscopy," Annual Meeting of the Optical Society of America (Santa Clara, CA 1999).
- H. M. Ng, T. D. Moustakas, "Group III Nitride VCSELS structures grown by Molecular Beam Epitaxy," *Physics and Simulation of Optoelectronic Devices*, Proceedings of SPIE 3944, 22 (2000). (Invited)
- A. V. Sampath, E. Iliopoulos, K. Seth, M. Misra, H. M. Ng, P. Lamarre, Z. Feit, T. D. Moustakas, "GaN photodiodes by MBE on HVPE and ELO-HVPE GaN/ Sapphire Substrates," *Photodetectors: Materials and Devices V*, Proceedings of SPIE 3948, 311 (2000).
- M. Misra, A. V. Sampath, E. Iliopoulos, T. D. Moustakas, "GaN Schottky diode ultraviolet detectors grown by Molecular Beam Epitaxy," *Photodetectors: Materials and Devices V*, Proceedings of SPIE 3948, 342 (2000).
- L. Meng, T. Q. Nguyen, and D. A. Castañon, "An Image-based Bayesian Framework for Face Detection," CVSP (2000).
- L. Duval, Van Bui Tran, T. Q. Nguyen and Trac Tran, "GenLOT optimization Techniques for Seismic Data Compression," ICASSP (2000).
- D. Rabinkin and T. Q. Nguyen, "Optimum Subband Filter Bank Design for Radar Array Signal Processing with Pulse Compression," SAM (2000).
- L. Duval, V. B. Tran, T. Q. Nguyen and T. Tran, "Seismic data compression using GenLOT: towards 'optimality'," Proc. of DCC (2000).
- Y. J. Chen, S. Oraintara and T. Q. Nguyen, "Integer Discrete Cosine Transform," Proc. 2nd Int. Conf. on Information, Communications and Signal Processing (Singapore, 1999).
- L. Meng and T. Q. Nguyen, "Frontal face localization using linear discriminant," 33rd Asilomar Conference on Signals, Systems, and Computers (1999).
- L. Duval, J. Oksman, and T. Q. Nguyen, "New class of filter banks for seismic data compression," Proc. SEG (1999).
- H. D. Tuan, P. Apkarian, T. Q. Nguyen, "Robust and reduced-order filtering: new characterizations and methods," Proc. of American Control Conference, IEEE Press, pp. 1327-1331 (Chicago, IL, 2000).
- J. Pniower, M. F. Ruane, B. B. Goldberg, M. S. Ünlü, "Web-Based Educational Experiments," ASEE Annual Conference, American Society for Engineering Education (1999).

K. Nelson, T. Frey, O. Lopez, J. Guerra, M. Ruane, "Immersion Microscope for Static Testing of Nearfield Phase-change Optical Disks," SPIE International Symposium on Optical Science, Engineering and Instrumentation (Denver, CO, 1999).

M. Redjidal, T. Trunk, M. F. Ruane, F. B. Humphrey, "Transitional Domain Wall Structure in Magnetic Films with Decreasing Thickness," InterMag 2000 Conference, Digest of Technical Papers, paper BA-10 (Toronto, Canada, 2000).

K. Nelson, O. Lopez, M. Ruane, "Effect of Partial Crystallization on Formation of Amorphous Marks," Optical Data Storage Topical Meeting (Whistler, British Columbia, Canada, 2000).

B. E. A. Saleh, A. Abouraddy, A. V. Sergienko, and M. C. Teich, "Experimental Demonstration of the Complementarity of One-particle and Two-Particle Interference," Fifth International Conference on Quantum Communication, Measurement & Computing (Capri, Italy, 2000). (Invited)

G. Bonmassar and E. L. Schwartz, "Real-time restoration of images degraded by uniform motion blur in foveal active vision systems," IEEE Transactions on Image Processing, 1838-1842 (1999).

B. Fischl and E. L. Schwartz, "Adaptive Non-Local Filtering: A Fast Alternative to Anisotropic Diffusion for Image Segmentation," IEEE Patt. Anal. and Mach. Intell., 22, 42-48 (1999).

A. V. Sergienko, M. Atatüre, B. E. A. Saleh, and M. C. Teich, "Dispersion-Independent High-Visibility Quantum Interference in Ultrafast Parametric Down-Conversion," Annual Meeting of the Optical Society of America (Santa Clara, CA 1999).

T. Tsegaye, J. Söderholm, A. Trifonov, G. Björk, M. Atatüre, A. V. Sergienko, B. E. A. Saleh, and M. C. Teich, "Polarization in Quantum Optics: A New Formalism and an Experiment," Fifth International Conference on Quantum Communication, Measurement & Computing (Capri, Italy, 2000).

A. V. Sergienko, M. Atatüre, B. E. A. Saleh, and M. C. Teich, "Non-Additivity of Entanglement in Cascaded-Crystal Spontaneous Parametric Down-Conversion," Fifth International Conference on Quantum Communication, Measurement & Computing (Capri, Italy, 2000). (Invited)

A. V. Sergienko, M. Atatüre, B. E. A. Saleh, and M. C. Teich "Coherence of Entangled-Photon Pairs Generated from Separate Crystals Using a Highly Monochromatic Laser Pump," Technical Digest Quantum Electronics and Laser Science Conference, pp. 22 (San Francisco, CA, May 7-12, 2000).

T. Tsegaye, A. Trifonov, G. Björk, J. Söderholm, M. Atatüre, A. V. Sergienko, E. Goobar, B. E. A. Saleh, and M. C. Teich "High Visibility Experimental Demonstration of the Relative Phase Operator," Technical Digest Quantum Electronics and Laser Science Conference, pp. 35 (San Francisco, CA, May 7-12, 2000).

A. Czitrovsky, A. V. Sergienko, P. Jani, and A. Nagy, "Photometric Measurements of Quantum Efficiency Using Quantum Two-Photon Field," 8th International Workshop on Laser Physics (LPHYS99) (Budapest, Hungary, July 2-6, 1999).

A. V. Sergienko, A. F. Abouraddy, B. E. A. Saleh, and M. C. Teich, "Spatial Entanglement and Quantum Interferometry," 8th International Workshop on Laser Physics (LPHYS99) (Budapest, Hungary, July 2-6, 1999). (Invited)

A. Czitrovsky, A. V. Sergienko, P. Jani, and A. Nagy, "Absolute Measurement of Quantum Efficiency of Photon-Counting Photomultiplier Using Quantum Two-Photon Field and a Ratio Between Single- and Double-Electron Peaks," International Commission for Optics - 18th Tri-Annual Meeting (ICO XVIII) (San Francisco, CA, August 2-6, 1999).

A. Czitrovsky, A. V. Sergienko, P. Jani, A. Nagy, "Measurement of Quantum Efficiency of a Photon-Counting Photomultiplier Using Entangled Photon Pairs and a Ratio Between Single- and Double-Electron Peaks," 7th International Conference on New Developments and Applications in Optical Radiometry (NEWRAD) (Madrid, Spain, 1999).

M. C. Teich, A. V. Sergienko, M. Atatüre, and B. E. A. Saleh, "Interference and Distinguishability in Ultrafast Parametric Downconversion," Second Workshop on Fundamental Problems in Quantum Theory (Baltimore, MD, August 8-13, 1999). (Invited)

M. C. Teich, "Assessing Cardiac Dysfunction with Time-Scale ECG Analysis," Invited Lecture, Joint Twenty-First Annual Conference of the IEEE Engineering in Medicine and Biology Society and the Biomedical Engineering Society (Atlanta, GA, 1999). (Invited)

M. C. Teich, M. C. Booth, A. V. Sergienko, and B. E. A. Saleh, "Entanglement Microscopy," Annual Meeting of the Optical Society of America (Santa Clara, CA, 1999). (Invited)

M. C. Teich, M. C. Booth, B. E. A. Saleh, and A. V. Sergienko, "Entangled-Photon Photoemission," Fifth International Conference on Quantum Communication, Measurement & Computing (Capri, Italy, 2000). (Invited)

G.E. Bunea, G. Ulu, M.S. Ünlü, and B.B. Goldberg, "Photogenerated carrier dynamics in GaN," CLEO (San Francisco, CA, 2000).

N. Biyikli, I. Kimukin, O. Aytur, E. Ozbay, M. Gokkavas, and M. S. Ünlü, "High-speed transparent ITO based RCE Schottky photodiode with Si<sub>3</sub>N<sub>4</sub>/SiO<sub>2</sub> top Bragg mirror," CLEO (San Francisco, CA, 2000).

G. E. Bunea, M. S. Ünlü, and B. B. Goldberg, "Strain effect on carrier dynamics in epitaxial lateral overgrowth GaN," APS Meeting (2000).

G. H. Vander Rhodes, B. B. Goldberg, M. S. Ünlü, Sai-Tak Chu, B. Little, "Near-field Scanning Optical Microscopic Studies of Micro-ring Resonators," LEOS Annual Meeting (1999).

G. E. Bunea, W. D. Herzog, M. S. Ünlü, B. B. Goldberg, and R. Molnar, "Carrier Dynamics Studies of thick GaN Grown by HVPE," Materials Research Society Proceedings (1999).

M. S. Ünlü, Mutlu Gökavas, G. Ulu, R. P. Mirin, and D. Christensen, "High-Speed, High-Efficiency Photodetectors for Short Pulse Applications," LEOS Annual Meeting (1999). (Invited)

M. Scherer, V. Schwegler, M. Seyboth, F. Eberhard, C. Kirchner, M. Kamp, G. Ulu, M. S. Ünlü, R. Gruhler, O. Hollricher, "Characterization of Etched Facets for GaN-based Lasers," 4th European GaN Workshop (Nottingham, UK, 2000).

V. Schwegler, M. Scherer, M. Kamp, G. Ulu, M. S. Ünlü, A. Lell, S. Bader, B. Hahn, H. J. Lugauer, F. Kühn, A. Weimar, V. Härle, "Mirror Reflectivity Influence on the L-I Characteristics of Cleaved GaN/SiC Lasers," 4th European GaN Workshop (Nottingham, UK, 2000).

## Patents and Patent Disclosures

M. S. Ünlü and M. K. Emsley, "Reflecting Layer Buried in Silicon and Method for Fabrication," U.S. Patent Application 60/132,854 (filed May 2000).

M. S. Ünlü, B. B. Goldberg and C. Worth, "Waveguide Sensors Optimized for Discrimination against Non-specific Binding," U.S. Provisional Patent Application (filed June 2000).

B. B. Goldberg and M. S. Ünlü, "Ultra-sensitive Biochip Arrays using Waveguide Phase Tomography Techniques," U.S. Provisional Patent Application (filed June 2000).

M. S. Ünlü, B. B. Goldberg, S. B. Ippolito, "Numerical Aperture Increasing Lens (NAIL) Techniques for High Resolution Sub-Surface Imaging," U.S. Provisional No. 60/140,138 (1999).

B. B. Goldberg, M. S. Ünlü, G. Garber, "Silicon-on-Insulator Waveguides for Sensors," U.S. Patent Application No. 60/123,923 (1999).

C. Espy-Wilson, "Process to Introduce Realistic Pitch Variation in Artificial Larynx Speech," U.S. Patent (filed September 1999).

C. Espy-Wilson and Nabil Bitar, "A Hierarchical, Speaker-Independent and Event-based System for Recognizing Speech Sounds," U.S. Patent Application (filed August 2000).

T. Bifano and M. Horenstein, "MEMS-based Spatial Light Modulator with Integrated Electronics," U.S. Provisional Patent (2000)

J. Ludwig, S. H. Nawab, "Low-Power Digital Filtering Using Adaptive Approximate Filtering," U.S. Patent Number 5999954 (Issued December 7, 1999).

H. M. Ng and T. D. Moustakas, "Group III Nitrides VCSEL structures (Vertical Cavity Surface Emitting Lasers)," U.S. Patent Application No. 60/178,236 (filed January 26, 2000).

H. Hajj, T. Q. Nguyen and R. Chin, "Multiscale Feature Detection and Applications in Medical Imaging," U.S. Patent Number 6064768 (Issued May 16, 2000).

Y.-J. Chen, S. Oraintara and T. Q. Nguyen, "Integer Discrete Cosine Transform (IntDCT)," The patent discusses an efficient implementation for Discrete Cosine Transform. No multiplication is needed.

S. Oraintara, T. Q. Nguyen and Y.-J. Chen, "Integer Fast Fourier Transform (IntFFT)," The patent discusses an efficient implementation for Fast Fourier Transform. No multiplication is needed.

J. D. Joannopoulos, S. Fan, P. R. Villeneuve, and E. F. Schubert, "Light emitting device utilizing a periodic dielectric structure," U.S. Patent No. 5,955,749 (issued September 21, 1999).

J. Graff, Y.-L. Li, and E. F. Schubert, "Low-resistance metal-semiconductor ohmic contacts to p-type GaN using polarization effects," invention disclosure filed with Boston University (December 1999), provisional patent application (filed March 2000).

## Invited Lectures & Presentations

R. C. Brower, "From Black Holes to Pomeron: Tensor Glueball and Pomeron Intercept at Strong Coupling," ISMD99: QCD and Multiparticle Production (July 1999).

R. C. Brower, "FROM BLACK HOLES TO QCD: The Glueball Spectrum at Strong Coupling," Chiral 99 (Taipei, Taiwan, September 1999).

R. C. Brower, "Pomeron Intercept and Glueball Spectra for QCD from AdS Supergravity Duality," Physics Department, Brown University (February 2000).

R. C. Brower, "Glueball Spectra for QCD from AdS Supergravity Duality," Massachusetts Institute of Technology Research Seminar, Center for Theoretical Physics (March 2000).

**R. C. Brower**, "Glueball Spectra for QCD from AdS Supergravity Duality," University of Maryland (April 2000).

**R. C. Brower**, "Glueball Spectrum for QCD from AdS Supergravity Duality," Institute for Nuclear Theory, Workshop on QCD at non-zero Baryon Density (Seattle, Washington, May 2000).

**R. C. Brower**, "Lattice QCD at Fixed Topology," Thomas Jefferson National Acceleration Facilities (Newport News, VA, June 2000).

**J. B. Carruthers**, "Wireless Infrared Communications Research," Electrical and Computer Engineering Department, University of Massachusetts, Amherst (December 1999).

**J. B. Carruthers**, "Wireless Infrared Communications: Capacity and Wavelength Division Multiplexing," Boston University MDSP Group (March 2000).

**C. G. Cassandras**, *Hybrid System Models for Integrated Manufacturing*, Chinese University of Hong Kong (Hong Kong, China, July 1999).

**C. G. Cassandras**, *Optimal Control of Hybrid Systems*, Hong Kong University of Science and Technology (Hong Kong, China, July 1999).

**C. G. Cassandras**, *On-Line Lot Size Optimization in Manufacturing Systems*, invited session at INFORMS Conference (Philadelphia, PA, November 1999).

**C. G. Cassandras**, *Optimal Control of a Two-Stage Hybrid Manufacturing System Model*, invited session at 38th IEEE Conf. Decision and Control (Phoenix, AZ, December 1999).

**C. G. Cassandras**, *Instructional material and Interactive Modules for Discrete Event Dynamic Systems*, invited session at 38th IEEE Conf. Decision and Control (Phoenix, AZ, December 1999).

**C. G. Cassandras**, *Stochastic Optimal Control of a Hybrid Manufacturing System Model*, invited session at 38th IEEE Conf. Decision and Control (Phoenix, AZ, December 1999).

**C. G. Cassandras**, *Control Challenges for the New Century*, IEEE Boston Chapter Distinguished Speaker Series (Cambridge, MA, January 2000).

**C. G. Cassandras**, *From Programmable Logic Control to Discrete Event Systems*, Plenary Speaker - NSF Workshop on Logic Control for Manufacturing Systems (Ann Arbor, MI, June 2000).

**C. G. Cassandras**, *A 'Surrogate Problem' Approach for Lot Size Optimization in Manufacturing Systems*, invited session at 2000 American Control Conference (Chicago, IL, June 2000).

**C. G. Cassandras**, *When Computers Control: Joys and Perils of Automation*, Plenary Speaker - NSF National Workshop for High School Teachers of Math and Science (Chicago, IL, June 2000).

**C. R. Eddy, Jr.**, "Plasma Damage and Passivation in GaN," Presented at the 196th Meeting of the Electrochemical Society (Honolulu, HI, October 18-22, 1999).

**R. Singh, C. R. Eddy, Jr., A. Aleksanyan, H.M. Ng and T.D. Moustakas**, "Contacts to Plasma Processed GaN Surfaces," 6th Wide Bandgap Nitride Semiconductor Workshop (Richmond, VA, March 13-15, 2000).

**R. Giles**, "Changing the Face of Education & Training in the 21<sup>st</sup> Century," Alliance Chautauqua at Boston University, Access Grid webcast to about 10 institutions from Maui to Moscow (September 1999).

**R. Giles**, "Completing the Circle: from computational science to the next generation of computational scientists," Physics Colloquium, University of Illinois, Champaign-Urbana (October 1999).

**R. Giles**, "Computational Science: The real world of ideas," Saturday Physics Honors Program, University of Illinois Champaign-Urbana (October 1999).

**R. Giles**, "The Grid: A Gateway to Science and Engineering Opportunities for Minority Serving Institutions," EDUCAUSE-99 Conference (Long Beach, CA, October 1999).

**R. Giles**, *Computational Science Curricula, High Performance Computing and the Professional Organizations*, Panel Presentation at EDUCAUSE-99 Conference (Long Beach, CA, October 1999).

**R. Giles**, "Community Model Building," Panel at SC-99 Conference (Portland, OR, November 1999).

**R. Giles**, "Progress on Advanced Networking with Minority Institutions," National Science Foundation (Washington, DC, January 2000).

**R. Giles**, "Computational Science, Bioinformatics, Pride," Bioinformatics Teachers Workshop, Boston University (June 2000).

**A. Hubbard**, "Acoustic, Visual, and Pharmaceutical Applications of Computer Chip Technology," Biotech Day at Boston University (November 21, 2000).

**A. Hubbard**, "Some Results from a Sandwich Model of the Cochlea," Association for Research in Otolaryngology (February 2000).

**A. Hubbard**, "Acoustic, Visual, and Pharmaceutical Applications of Computer Chip Technology," Lucent Technologies (March 2000).

**A. Hubbard and D. Mountain**, "Sensing Scenes with Silicon," NASA Workshop for the creation of Biology Inspired Technology (April 2000).

**W. C. Karl**, "Ultrasound Analysis of Vascular Structure and Deformation," Battlefield Biomedical Technologies Conference, SPIE AeroSense Symposium, Marriott World Center (Orlando, FL, April 24-28, 2000).

**L. B. Levitin**, "Distribution of Paralogs in Prokaryotic Genoms," Institute for Theoretical Biology, Humboldt University (Berlin, Germany, July 2000).

**L. B. Levitin**, "Information and Conditional Entropy in Quantum Systems," Institute for Algorithms and Cognitive Systems, University of Karlsruhe (Germany, August 2000).

**L. B. Levitin**, "On Distinguishability of Quantum States," Institute of Physics, Polish Academy of Sciences (Warsaw, Poland, August 2000).

**T. F. Morse**, Solid State and Diode Laser Technology Review (SDLTR), Phillips Laboratory (Albuquerque, NM, June 5, 2000).

**T. D. Moustakas**, "Phase Separation and Long Range Order in InGaN Alloys grown by MBE," Centennial American Physical Society Meeting (Atlanta, March 20, 1999).

**T. D. Moustakas**, "Wide Band Gap Materials Overview," 26th Annual Symposium of International Microelectronics and Packaging Society (Andover, MA, May 13, 1999).

**T. D. Moustakas**, "Opto-electronic Applications of III-V Nitrides," Materials Physics School, Aristotle University (Thessaloniki, Greece, November 12, 1999).

**H. M. Ng, T. D. Moustakas**, "Group III Nitride VCSEL structures grown by Molecular Beam Epitaxy," presented in the Symposium - *Physics and Simulation of Optoelectronic Devices* of The SPIE Photonics West Meeting (San Jose, CA, January 24, 2000).

**T. D. Moustakas**, "Growth and Device Applications of III-V Nitrides by MBE," 5<sup>th</sup> International Workshop on Expert Evaluation and Control of Compound Semiconductor Materials and Technologies (Heraklion, Crete, Greece, May 21, 2000).

**M. Ruane**, "Curricular Reforms in Client Disciplines: Implications for Post-Calculus Mathematics," The Mathematical Association of America Joint Meetings (Washington, DC, January 21, 2000).

**B. E. A. Saleh**, "Optics in the electrical engineering curriculum: Should it be more than an appendix," Forum on Education, 1999 Annual Meeting of the Optical Society of America (Santa Clara, CA, September 30, 1999).

**B. E. A. Saleh**, "Entangled-photon imaging," Army Research Laboratory (January 12, 2000).

**E. F. Schubert**, "GaN-based white-light-emitting diodes with high luminous performance," *Optical Physics Seminar Series*, Boston University (October 7, 1999).

**E. F. Schubert**, "GaN-based white-light-emitting diodes with high luminous performance," *Optics and Quantum Electronics Seminar Series*, Massachusetts Institute of Technology (MIT) (Cambridge, MA, November 10, 1999).

**X. Y. Guo, J. Graff, and E. F. Schubert**, "Photon-recycling semiconductor white light emitting diodes," *International Electron Devices Meeting (IEDM)* (Washington, DC, 1999).

**I. D. Goepfert, E. F. Schubert, A. Osinski, and P. E. Norris**, "Superlattice doping p-type GaN to efficiently activate the deep acceptor magnesium," *Fall meeting of the Materials Research Society (MRS)* (Boston, MA, November 29, 1999).

**X. Y. Guo, J. Graff, and E. F. Schubert**, "Photon-recycling semiconductor white light emitting diodes," *SPIE Photonics West* (San Jose, CA, January 25 - 27, 2000).

**E. F. Schubert**, "Light-emitting diodes: Device physics and applications" Short course given at the *SPIE Photonics West* (San Jose, CA, January 25 - 27, 2000).

**E. L. Waldron, J. Graff, E. F. Schubert, A. Osinsky, W. J. Schaff, and L. F. Eastman**, "P-doped AlGaIn/GaN superlattices: Physical properties and device applications," *6<sup>th</sup> Annual Wide Bandgap III-Nitride Workshop* (Richmond, VA, March 12 - 15, 2000).

**A. Osinsky, L. Chernyak, L. Zhou, I. Adesida, J. Graff, and E. F. Schubert**, "Characterization of Diodes Based on AlGaIn/GaN Heterostructures and Superlattices for Bipolar Transistor Applications," *6<sup>th</sup> Annual Wide Bandgap III-Nitride Workshop* (Richmond, VA, March 12 - 15, 2000).

**E. L. Waldron, E. F. Schubert, J. Graff, and W. J. Schaff**, "Polarization effects in AlGaIn/GaN superlattices," *Connecticut Microelectronics and Optoelectronics Symposium* (Hartford, CT, March 14, 2000).

**E. F. Schubert, E. L. Waldron, J. Graff, A. Osinsky, W. J. Schaff, and L. F. Eastman**, "Current results and future potential of doped AlGaIn/GaN superlattices," *ONR/TMS Workshop on Doping and Dopants in GaN* (Copper Mountain, April 2-6, 2000).

**A. Osinsky, L. Chernyak, V. Fuflyigin, J. Graff, and E. F. Schubert**, "P-type superlattice doping: Material characteristics pertaining to bipolar devices," *ONR/TMS Workshop on Doping and Dopants in GaN* (Copper Mountain, April 2-6, 2000).

**E. F. Schubert**, "Quantum Metrology and Nondemolition Measurement," "Enrico Fermi" Summer School, "Recent Advances in Metrology and Fundamental Constants" (Varenna, Italy, July 25-August 4, 2000).

**E. F. Schubert**, "Quantum Cryptography with Polarized Entangled Photons," Boston Chapter of the IEEE Communications Society (Boston, MA, April 13, 2000).

**E. F. Schubert**, "Hyper-Entangled States and Femtosecond Parametric Down Conversion," Harvard-Smithsonian Center for Astrophysics, Harvard University (February 23, 2000).

**Eric L. Schwartz**, "Recent progress in space-variant active vision," Naval Research Lab (June 26, 2000).

**Eric L. Schwartz**, "An Overview of Spatial Structure in Visual Cortex," Harvard MGH Brain Imaging Center (November 9, 1999).

**Eric L. Schwartz**, "Allometry and the scaling of neo-cortex in vertebrates," Harvard MGH Brain Imaging Center (June 7, 2000).

**J. G. Smits**, "An integrated double bimorph optical scanner with PZT piezoelectric bimorphs," American Vacuum Society (Burlington, MA, June 12, 2000).

**M. C. Teich**, "Nonlinear Cellular Dynamics and Routes to Chaos in the Cochlea," Invited Joint Colloquium, Department of Aerospace & Mechanical Engineering and Hearing Research Center, Boston University (Boston, MA, December 1999).

**M. C. Teich**, "Entangled-Photon Microscopy," Seminar, Microcosm, Inc. (Columbia, MD, January 2000).

**M. C. Teich**, "Entangled-Photon Absorption, Spectroscopy, and Microscopy," Solid-State Seminar, Yale University (New Haven, CT, March 2000).

**M. C. Teich**, "Entangled-Photon Microscopy," Zeiss GmbH (Jena, Germany, June 2000).

**M. S. Ünlü**, "Near-field Spectroscopy of Guided and Propagating Waves: A comparison of Coated vs. Uncoated Tips," Seminar at the Department of Biomaterials, Universität Ulm (Ulm, Germany, February 2000).

**M. S. Ünlü**, "High-speed High-efficiency RCE Photodetectors," Seminar at the Department of Optoelectronics, Universität Ulm (Ulm, Germany, April 2000).

**M. S. Ünlü**, "Multi-spectral Integrated Photodetectors," presentation at the Office of Naval Research Annual Gathering (Washington, D.C., April 2000).

**M. S. Ünlü**, "Near-field Imaging of GRIN Lasers for EDFA Pumping," JDS Uniphase Laser Enterprise Seminar (Zürich, Switzerland, April 2000).

**M. S. Ünlü**, "Near-field Spectroscopy of Guided and Propagating Waves," Applied Physics Seminar, Ludwig Maximilian University (München, Germany, May 2000).

**M. S. Ünlü**, "Near-field Spectroscopy of Guided and Propagating Waves," Electro-Technik Colloquium, Universität Ulm (Ulm, Germany, May 2000).

**M. S. Ünlü**, "Near-field Spectroscopy of Guided and Propagating Waves," Applied Optics Colloquium, MESA, University of Twente (Enschede, Netherlands, June 2000).

**M. S. Ünlü**, "Time and Spatially Resolved Studies of Recombination Mechanisms in GaN Films," GaN Group Seminar, Universität Ulm (Ulm, Germany, June 2000).

## Technical Reports and Other Publications

Oscar Garcia and **Roscoe Giles**, "Research Foundations on Successful Participation of Underrepresented Minorities in Information Technology: A Cyberconference," NSF report published online at the NSF site, <http://www.cise.nsf.gov/itminorities.html>

**D. Perreault**, "Logical to physical S-Record Conversion Utility," Distributed Free by P&E Microcomputer (2000).

**D. Perreault**, "Programming to Debugger Conversion Utility," Distributed Free by P&E Microcomputer (2000).

**D. Perreault**, "PCI BGDM Accelerator," Distributed by P&E Microcomputer (2000).

**D. Perreault**, "Compact PCI BGDM Accelerator," Distributed by P&E Microcomputer (2000).

## 5.3 Research Labs

### Advanced Electronic Materials & Device Processing Research Laboratory

This laboratory is primarily concerned with the science of electronic materials processing and the effect of such processing on device characteristics. Devices of interests include: high temperature, high frequency and/or high power switching devices and photonic devices. Research activities include: 1) investigation of high density plasma-based processes including etching, passivation, implantation, and growth; 2) application of photolithographic and high density plasma processing techniques to realize novel devices; and 3) characterization of such devices. This group works in close collaboration with Prof. Theodore Moustakas in the area of materials growth and device application and Prof. Scott Dunham in the area of process and device modeling. *Eddy*

### Applied Electromagnetics Laboratory

Work focuses on experimental problems in electromagnetics with emphasis on industrial processes, sensing and measurement, and micro-electromechanical systems (MEMS). Applications include MEMS sensors and activators for adaptive optics, microvalve arrays, and bio-mems' of electrostatics materials and ESD protection. *Horenstein*

### Biological Information Processing Laboratory

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

### Broadband Wireless Communications Laboratory

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

### Computational Electromagnetics Laboratory

This laboratory is devoted to the application of high performance computing and advanced mathematics to the solution of problems in engineering electromagnetics. Algorithmic issues in the calculation of three-dimensional electromagnetic fields are investigated and new methods for finite-element modeling are pursued. Applications range from magnetic materials and electric machines to biological systems. *Brower, Giles, Eisenberg, and Kotiuga*

### Imaging Science Laboratory (ISL)

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

### Integrated Circuit Fabrication Laboratory

This lab contains basic equipment for silicon integrated circuit fabrication. Research efforts are aimed at investigating fabrication processes and fabricating innovative device structures. *Dunham, Smits*

### Integrated DSP Environments and Architectures Laboratory (IDEA)

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

### Liquid Crystal Display (LCD) Laboratory

Liquid Crystal Display devices are fabricated and their optical characteristics are studied in this laboratory. Novel techniques for enhancing the angle of view and the color rendition of LCDs are investigated. New methods for characterization of such devices are developed, and applications of LCDs as spatial light modulators in optical image processing systems are pursued. *Saleh*

### Lightwave Technology Laboratory

This lab is one of the few university laboratories capable of designing, fabricating, and characterizing silica optical fibers. The research activities of this laboratory focus on new processing techniques for optical fibers and planar waveguides, high power optical fiber lasers, and a variety of optical fiber sensors. The components of this facility consist of a fabrication laboratory with three glass lathes including a new state-of-the-art Nextrom MCVD system, an optical laboratory with numerous pump lasers for fiber lasers, five isolation tables, and an 8 m optical fiber draw tower, newly outfitted with Nextrom winding and control equipment. In



addition, there is a CVD laboratory for studies of thin films. *Morse*

### Magnetic and Optical Devices Laboratory (MODL)

Properties and applications of magnetic and magento-optical materials are studied using optical, electrical, and computational methods in the MODL. Recent work has included photoresist studies for CD stamper manufacturing, deposition of magnetic films on patterned substrates, investigation of X-Ray mirror materials, 3-D computational studies of GMR memory devices and eddy current losses in thin films, and development of extremely low cost, low-density optical disks and players. *Ruane, Humphrey*

### Microprocessor Laboratory

In this lab, techniques for the rapid development, testing, and performance evaluation of microprocessor-based systems, including communication systems, are developed. *Perreault*

### Multi-Dimensional Signal Processing (MDSP) Laboratory

The MDSP Lab conducts research in the general 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 multimedia applications. Research includes investigation of distributed modes of group interaction; communication systems for continuous media; conceptual and physical database organizations; indexing schemes to support content specific queries and fast browsing; user interfaces; and applications. The laboratory is equipped with tools for real-time digital video capture, storage, conversion and playback. *Little*

### Near-Field Spectroscopy Laboratory

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

### Network Computing Laboratory

The Network Computing Laboratory currently conducts research in the following fields: routing algorithms, performance evaluation, dependability of network-based computing systems, protocol verification and testing, and implementation complexity. *Avresky*

### Picosecond Spectroscopy Laboratory (PSL)

This state-of-the-art optical characterization facility was recently established. The Picosecond

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

### Quantum Imaging Laboratory

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

### Radio Communications and Plasma Research Laboratories

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

### Reliable Computing Laboratory

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

### Semiconductor Device Research Laboratory

This laboratory fabricates prototypes of next-generation optoelectronic devices such as semiconductor lasers and light-emitting diodes. Activities include photolithographic fabrication, optical and electrical characterization, and modeling of device and systems properties.

*Schubert*

### Sensors, Actuators, and Micromechanics Laboratory

Clean-room fabrication facilities in this lab are used to develop silicon sensors and actuators with integrated electronics. Silicon machining and piezoelectric sensor materials are integrated to create tactile sensors, strain gauges, optical scanners for helmet mounted displays or optical disk drives, micro-pumps for drug delivery and for gas pumps to be used in gas chromatographs for flights to Mars, and autonomous mobile "silicon ants" (micro-robots).

*Smits*

### Signal Processing and Interpretation (SPI) Laboratory

The SPI Lab supports several research projects involving stochastic modeling of signals for synthesis and recognition/ understanding applications. Research currently focuses on speech processing, including acoustic and language modeling for spontaneous speech recognition, as well as computational modeling of prosody. The lab is equipped with a network of several workstations with audio recording and playback facilities, and is supported by several government and industrial grants.

*Ostendorf*

### 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 SEL provides students with state-of-the-art development tools for the design, implementation, and testing of significant software systems. *Vidale*

### Speech Communication Laboratory

The Speech Communication Laboratory is concerned with understanding speech communication, including speech recognition, speech perception, speech production, and acoustic phonetics. *Espy-Wilson*

### 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*

### VLSI Process Modeling and Characterization Laboratory

Efforts in this lab focus on obtaining a basic understanding of integrated circuit fabrication processes and applying that knowledge to produce better models and simulators. Research is applied mainly to bulk processes, such as diffusion, activation, extended defect kinetics, and film growth. *Dunham*

### Wide Band Gap Semiconductors Laboratory

In this laboratory we investigate the optoelectronic properties and device applications of III-Nitride materials. The materials are grown by Molecular Beam Epitaxy (MBE) and Vapor Phase Epitaxy. Device applications include emitters (lasers and LEDs), UV-solar blind detectors and transistors for high power and high temperature applications. The laboratory is equipped with clean room facilities for materials growth (MBE and VPE) and device fabrication (electron beam evaporator and sputtering units) as well as facilities for material and device characterization. This group collaborates closely with Professor C. Eddy in the area of device processing and Professor S. Dunham in the area of device modeling. *Moustakas*

## 5.4 Centers and Interdisciplinary Activities

### Center for Computational Science (CCS)

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

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

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

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

### Center for Space Physics

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

The mission of the Center is to promote and foster space physics research and to provide a central base for that research and for the teaching of space physics, es-

pecially 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

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

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

In 1997, the University completed the nine-story, 235,000 square-foot Photonics Building to house this ambitious initiative. The \$80 million facility includes a full complement of state-of-the-art laboratories as well as meeting rooms, lecture halls, and an entire floor devoted to incubator space for start-up companies that complements its existing incubator at 1106 Commonwealth Avenue. Faculty affiliated with the Center have

in-depth expertise in all aspects of photonics technology, including the core areas of opto-electronics, photonic materials, data storage, imaging systems, medical applications, and sensors.

Resources available to industry partners, government, faculty, and students through the Photonics Center support development and testing of ideas and products. These resources include several research and development laboratories: Scanning Infrared Near-Field Microscopy Laboratory, Optoelectronic Device Characterization Laboratory, Femtosecond Laser Facility, Photo-

chemical 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.

## 5.5 New Grants and Contracts

The table on the next four pages delineates the new grants awarded over the 1999/00 fiscal year. The funding level for new grants where an ECE faculty member is the Principal Investigator (PI) is approximately \$5,064k. ECE faculty members were also Co-PI's on grants with PI's from other departments, as noted in the table. Their share of the funding for new grants awarded is approximately \$670k. The total of new grants is therefore approximately \$5.7m.

### New Grants with ECE Principal Investigators

FACULTY	TITLE OF AWARD	SOURCE	BEGIN	END	AMOUNT
Avresky, Dimiter	Analysis of TNET: A Reliable System Area Network for I/O and IPC	Tandem Computers	1/1/00	12/31/00	\$60,000
Brackett, John	A Language and an Authoring Tool for the Creation of Clinical Guidelines (J. Choi) (Subcontract via Brigham and Women's Hospital)	HHS/NIH/NLM	9/1/99	08/31/00	\$19,688
Castañon, David Karl, W. Clement (Co-PI)	Sensor Management and Information Fusion for Detection, Localization and Classification of Mines (Subcontract via Northeastern University)	DOD/Army	12/01/99	11/30/00	\$50,000 (PI) \$50,000 (Co-PI)
Castañon, David	MURI95-A Comprehensive and Integrated Approach to Reduced Signature Target Recognition	DOD/Air Force	12/01/99	11/30/00	\$1,500,000
Espy-Wilson, Carol	Device for Enhancing Artificial Larynx Speech (Subcontract via Speech Technology and Applied Research (STAR), Inc.)	HHS/NIH/NINDS	08/01/99	07/31/00	\$81,331

FACULTY	TITLE OF AWARD	SOURCE	BEGIN	END	AMOUNT
Espy-Wilson, Carol	Studies of Speech Communication	HHS/NIH/NIDCD	06/01/00	05/31/01	\$66,636
Espy-Wilson, Carol	A Knowledge-Based Speech Signal Representation	NSF	07/01/00	06/30/01	\$69,025
Horenstein, Mark Hubbard, Allyn (Co-PI)	CMOS VLSI Driver for Low- VoltageMEMS Array (Sub-contract via Boston Micromachines Corp.)	DOD/Air Force	12/16/99	06/16/00	\$12,735 (PI) \$12,735 (Co-PI)
Karl, W. Clement	Anatomic Morphological Analysis of MR Brain Images (Sub contract via Massachusetts General Hospital)	HHS/NIH/NINDS	09/01/99	08/31/00	\$75,295
Little, Thomas	Research in IP Streaming	EMC Corp.	09/01/99	04/30/00	\$27,710
Morse, Theodore	Miniature Photoacoustic Detector for TraceChemical and Biological Warfare Agents (in conjunction with Photonics Center)	DOD/Navy	09/01/99	10/01/01	\$150,000
Morse, Theodore	Photonics Research and Technology	DOD/Army	08/01/99	09/30/00	\$100,000
Morse, Theodore	Advances in Fiber Lasers (in conjunction with Photonics Center)	DOD/Air Force	10/01/99	12/31/00	\$240,000
Morse, Theodore	NSF STTR Phase II: A Fiber-Optic Probe for In-situ Measurement of Thin Film Deposition (in conjunction with Photonics Center) (Subcontract via Ion Optics, Inc.)	NSF	09/01/99	12/31/00	\$150,000
Morse, Theodore	Advances in Fiber Lasers (Subcontract via Brown Univ.) (in conjunction with Photonics Center)	DOD/Air Force	10/01/99	11/30/99	\$52,596
Morse, Theodore	Miniature Photoacoustic Detector for Trace Chemical and Biological Warfare Agents (in conjunction with the Photonics Center)	DOD/Navy	09/01/99	10/01/01	\$210,000
Morse, Theodore	SGER: Processing of Multi-Mode Optical Fiber Preferences (in conjunction with the Photonics Center)	NSF	10/01/99	07/31/00	\$10,179

FACULTY	TITLE OF AWARD	SOURCE	BEGIN	END	AMOUNT
Moustakas, Theodore	AIGaN Ultraviolet Detectors Subcontract via BlueLight, Inc.)	DOD/DARPA/ Lockheed Martin, Inc.	01/02/97	12/31/98	\$66,467
Moustakas, Theodore	III-V Nitride UV Detector Arrays Fabricated by Combining HVPE Lateral Epitaxial Overgrowth and MBE Methods	DOD/Navy	01/01/99	01/31/00	\$100,000
Moustakas, Theodore	STRR Phase 1: Micromachined Harsh Environment Quantum-Well Nitride Sensors (Subcontract via Boston MicroSystems, Inc.)	NSF	07/01/99	06/30/00	\$45,000
Moustakas, Theodore	Photonics Research and Technology Insertion/Task 7: Gallium Nitride Vertical Cavity Surface-Emitting Lasers (in conjunction with the Photonics Center)	DOD/Army	08/01/99	09/30/00	\$109,999
Moustakas, Theodore	Photonics Research and Technology Insertion Task 7: Gallium Nitride Modulators (in conjunction with the Photonics Center)	DOD/Army	08/01/99	09/30/00	\$50,000
Moustakas, Theodore	Investigation of Atomic Long- Range Order in AIGaN Films)	DOD/Navy	12/01/99	09/30/02	\$104,517
Nguyen, Truong	Wavelet Design for Discrimination and Target Recognition (Subcontract via Brown University)	DOD/Navy	05/01/98	04/30/00	\$80,000
Nguyen, Truong	A Novel Video Compression Technique Using Wavelets for Distributed Command and Control Applications (Subcontract via Intelligent Automation, Inc.)	DOD/Air Force	07/01/99	03/31/00	\$10,750
Oliver, William	Rough N Ready System Development (Subcontract via GTE/BBN, Inc.)	DOD/Air Force	01/01/00	06/30/00	\$11,813
Perreault, David	Communications Reduction Study	P&E Microcomputer Systems, Inc.	9/01/99	08/31/00	\$40,750
Perreault, David	Communications Reduction Study - Continuation Systems	P&E Microcomputer Systems, Inc.	05/01/00	08/31/00	\$10,595
Saleh, Bahaa	Interactive Spoken Language Understanding Systems (C.Liu) (Subcontract via GTE-BBN Corp.)	DOD/Navy	10/01/99	12/31/99	\$9,450

FACULTY	TITLE OF AWARD	SOURCE	BEGIN	END	AMOUNT
Saleh, Bahaa	Interactive Spoken Language Understanding Systems (C.Liu) (Subcontract via GTE-BBN Corp.)	DOD/Navy	10/01/99	03/31/00	\$9,450
Saleh, Bahaa Teich, Malvin (Co-PI) Sergienko, Alexander (Co-PI)	Imaging and Optical Information Processing with Entangled Photons	NSF	05/01/99	04/30/01	\$33,334 (PI) \$33,333 (Co-PI) \$33,333 (Co-PI)
Schubert, E. Frederick	Enhancement of Deep Acceptor Activation in Semiconductors by Superlattice Doping	DOD/Navy	12/01/98	11/30/00	\$110,000
Sergienko, Alexander Teich, Malvin (Co-PI) Saleh, Bahaa (Co-PI)	Quantum Ellipsometry	NSF	10/01/99	09/30/00	\$26,667 (PI) \$26,666 (Co-PI) \$26,666 (Co-PI)
Smits, J.G.	Very Large Angle Optical Scanner	GSI-Lumonics, Inc.	09/01/99	08/31/01	\$22,000
Smits, J.G.	Design Study for LIG Scroll Pump (Subcontract via Jet Propulsion Laboratory)	NASA	08/01/99	10/01/99	\$5,000
Suri, Neeraj	USER/OS Transparent Fault Recovery Using Caches	NSF	06/01/00	04/30/02	\$50,000
Teich, Malvin Saleh, Bahaa (Co-PI) Sergienko, Alexander (Co-PI)	Entangled-Photon Absorption and Spectroscopy	NSF	06/01/99	05/31/01	\$43,334 (PI) \$43,333 (Co-PI) \$43,333 (Co-PI)
Teich, Malvin Saleh, Bahaa (Co-PI) Sergienko, Alexander (Co-PI)	Collaborative Research Agreement in Entangled-Photon Microscopy	Carl Zeiss Jena GmbH	07/01/00	12/31/01	\$69,889 (PI) \$69,889 (Co-PI) \$69,888 (Co-PI)
Toffoli, Tommaso	Programmable Matter Methods (in conjunction with Center for Computational Science)	Department of Energy	09/01/99	08/31/00	\$105,867
Toffoli, Tommaso	Personal Knowledge Structuring	Startup Institute for Scientific Interchange Foundation (Italy)	09/01/99	08/31/00	\$12,500
Ünlü, M. Selim	REU: US-Turkey Cooperative Research/ High Performance RCE Photodetectors	NSF	07/01/99	12/31/00	\$10,000
Ünlü, Selim Goldberg, Bennett (Co-PI) Lutchen, Kenneth (Co-PI)	Large Volume Production of Hyper-polarized Noble Gas for Biological Magnetic Resonance Research (in conjunction with Photonics Center) (Subcontract via Brigham and Women's Hospital)	NSF	07/01/99	08/31/00	\$36,142 (PI) \$36,142 (Co-PI) \$36,141 (Co-PI)

FACULTY	TITLE OF AWARD	SOURCE	BEGIN	END	AMOUNT
Ünlü , M. Selim	Monolithically Integrated Thermoelectric Coolers for Mid-IR Lasers/High Resolution Thermal Imaging (in conjunction with Photonics Center)	DOD/DARPA	06/21/99	11/30/99	\$35,600
Ünlü , M. Selim	Photonics Research and Technology Insertion/Task 4: Vertical Cavity Polarization Detectors for Mid Infrared (in conjunction with the Photonics Center)	DOD/Army	08/01/99	09/30/00	\$126,299
Ünlü , M. Selim Goldberg, Bennett (Co-PI)	REU: PRIDE—Photonics Research in Interdisciplinary Education (in conjunction with Photonics Center)	NSF	06/01/96	09/30/00	\$5,000 (PI) \$5,000 (Co-PI)
Ünlü , M. Selim Goldberg, Bennett (Co-PI)	Monolithically Integrated Thermoelectric Coolers for Mid-IR Lasers/High Resolution Thermal Imaging (in conjunction with Photonics Center) (Subcontract via NASA/Jet Propulsion Laboratory/Caltech)	DOD/DARPA	12/01/99	11/30/01	\$168,550 (PI) \$168,550 (Co-PI)
Ünlü , M. Selim	Career: Development in Innovative Opto-Electronic Devices and Techniques	NSF	09/01/96	08/31/00	\$25,000
<b>Total Awards</b>					<b>\$5,064,178</b>



## New Grants with ECE Co-PI's

FACULTY	TITLE OF AWARD	SOURCE	BEGIN	END	AMOUNT
Giles, Roscoe	PACI: Education, Outreach and Training (EOT) (Subcontract via Univ. of Illinois)	N.S.F.	10/01/99	09/30/00	\$135,000
Rebbi, Claudio Bresnahan, Glenn Giles, Roscoe Porter, John	PACI: MARINER/ A Mid-Level Alliance Resource in the North East Region (Subcontract via Univ. of Illinois)	N.S.F.	10/01/99	09/30/00	\$395,000
Goldberg, Bennett Ünlü , Selim (Physics)	Optical Biosensors for Food-Borne Pathogens (Subcontract via University of Rhode Island) (in conjunction with Photonics Center)	Dept. of Agriculture	09/15/99	09/14/01	\$69,243
Goldberg, Bennett Ünlü , Selim (Physics)	An Ultrasensitive Optical Biosensor for Food Safety ( In conjunction with the Photonics Center) (Subcontract via SatCon Technology Corp.)	DOD/Army	01/20/00	06/30/00	\$16,698
Grossberg, Stephen Hubbard, Allyn	A MURI Center for Automated Vision and Sensing Systems (Cognitive and Neural Systems)	DOD/Navy	06/01/98	05/30/00	\$370,000
Mountain, David Hubbard, Allyn	Active Filtering in the Cochlea (in conjunction with the Hearing Research Center)	HHS/NIH/ NIDCD	06/01/98	05/30/00	\$16,191
<b>SUBTOTAL</b>	<b>Grants with ECE Co-PI's</b>				<b>\$ 671,260</b>
<b>GRAND TOTAL</b>					<b>\$ 5,735,438</b>

## 5.6 Continuing Grants and Contracts

The following table delineates grants in which research has continued during 1999/2000.

FACULTY	TITLE OF AWARD	SOURCE	BEGIN	END
Carruthers	CAREER: High Bit Rate Wireless Infrared Communications	NSF	04/01/99	03/31/03
Castañon	Coordination and Optimization of Quality of Service End-to-End Resources for Adaptive Information Flows	Honeywell, Inc.	01/15/99	12/31/99
Eddy Moustakas	Gallium Nitride static Induction Power Transistors	Dept. Of Defense /Navy	03/01/99	12/31/99
Espy-Wilson	Studies of Speech Communication	PHS/NIH/ NIDCD	06/01/98	05/31/01
Espy-Wilson	Knowledge-Based Speech Signal Representation	NSF	07/01/98	06/30/00
Hubbard	Design, construction and testing of a rotary device for automated drug and chemical analysis	Alexion Pharmaceuticals, Inc.	04/01/98	03/31/01
Hubbard	A MURI Center for Automated Vision and Sensing Systems	Office of Naval Research	06/01/98	08/31/01
Karl	Multiresolution Information Fusion	Alphatech, Inc.	11/01/97	10/31/99
Karpovsky	REU Supplement: Software Implemented Fault Tolerance in Multiprocessors	NSF	01/01/97	07/31/00
Karpovsky	Software Implemented Fault Tolerance in Multiprocessors	NSF	08/01/96	07/31/00
Lee	University Resident Research Program: Controlled Experiments on Whistlers	US Air Force Phillips Laboratory	10/15/98	12/31/99
Little	Dynamic Service Aggregation for Interactive Information Delivery	NSF	09/01/98	08/31/00
Nawab	Application-Specific Development of IPUS	Syracuse University	10/01/98	12/31/99
Nawab	AASERT: Segment-Based Acoustic Models for Continuous Speech Recognition	NSF	03/15/94	08/31/99
Nguyen	Multiresolution-Based Watermarking Algorithms	A&T Engineering Technologies Group	09/01/98	12/31/99
Nguyen	Multiresolution Analysis of Epileptic Signals	Flint Hills Scientific, L.L.C.	08/24/98	08/24/99
Ostendorf	Speech Generation for Human- Computer Interaction	NSF	05/01/96	01/31/00
Ostendorf	STIMULATE: Modeling Structure in Speech above the Segment for Spontaneous Speech Recovery	NSF	03/01/97	08/31/99
Ostendorf	Use of Multi-Domain Data in Dialog- Act Mixture Language Modeling for Conversational Speech Recognition	BBN Technologies	10/22/98	12/31/99

FACULTY	TITLE OF AWARD	SOURCE	BEGIN DATE	END DATE
	Interactive Spoken Language Understanding Systems	BBN Corporation	01/01/98	09/30/99
	Imaging and Optical Processing with Entangled Photons	NSF	05/01/99	04/30/01
Schubert	Enhancement of Deep Acceptor Activation in Semiconductors by Superlattice Doping	NSF	08/15/97	09/30/00
Schubert	Doping Engineering for High Conductivity in GaN and Related Compounds	Cornell University	04/01/99	03/30/00
Sergienko	CAREER: Quantum Cryptography with Entangled Photons	NSF	02/15/99	01/31/03
	CAREER Program: User/OS Transparent Fault Recovery Using Caches	NSF	09/01/98	05/31/00
	Verification and Validation of Dependable Real-Time Protocols	University of Pittsburgh	09/01/98	09/30/99
Teich	Entangled-Photon Fluorescence Microscopy	NSF	05/01/98	12/31/00
	Entangled-Photon Absorption and Spectroscopy	NSF	06/01/99	05/31/01
	Functional Imaging of Synapses by Entangled-Photon Microscopy	The David and Lucile Packard Foundation	08/01/99	08/31/04
	CAREER: Development in Innovative Optoelectronic Devices and Optical Characterization Techniques	NSF	09/01/97	08/31/00
	Photonics Research in Interdisciplinary Education—REU Supplement	NSF	06/01/96	09/30/00

# 6. Outlook

The last decade has witnessed the maturation of the ECE department from a primarily undergraduate program to a more balanced department with quality instruction, a substantial research program, and an increasingly distinguished faculty. Key statistics of enrollment, degrees awarded, faculty size, and grant funding in the last 10 years are exhibited in the following tables and charts.

## 6-1 Enrollment

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

- A demographic decline in enrollment occurred mid-decade, followed by a slow steady increase.
- Enrollment shifted from EE to CSE, such that 64% of students now pursue CSE (see Chart 6-2).
- A deliberate restriction on enrollment was implemented to attain a higher quality student body, as part of a college-wide effort.

	'89	'90	'91	'92	'93	'94	'95	'96	'97	'98	'99
<b>BS</b>	498	441	384	338	334	358	381	390	398	410	410
<b>MS</b>	276	281	247	201	171	135	103	68	70	83	80
<b>Ph.D.</b>	29	39	44	49	50	55	64	78	83	80	72
<b>Total</b>	<b>803</b>	<b>761</b>	<b>675</b>	<b>588</b>	<b>555</b>	<b>548</b>	<b>548</b>	<b>536</b>	<b>551</b>	<b>573</b>	<b>562</b>

Table 6-1: Enrollment

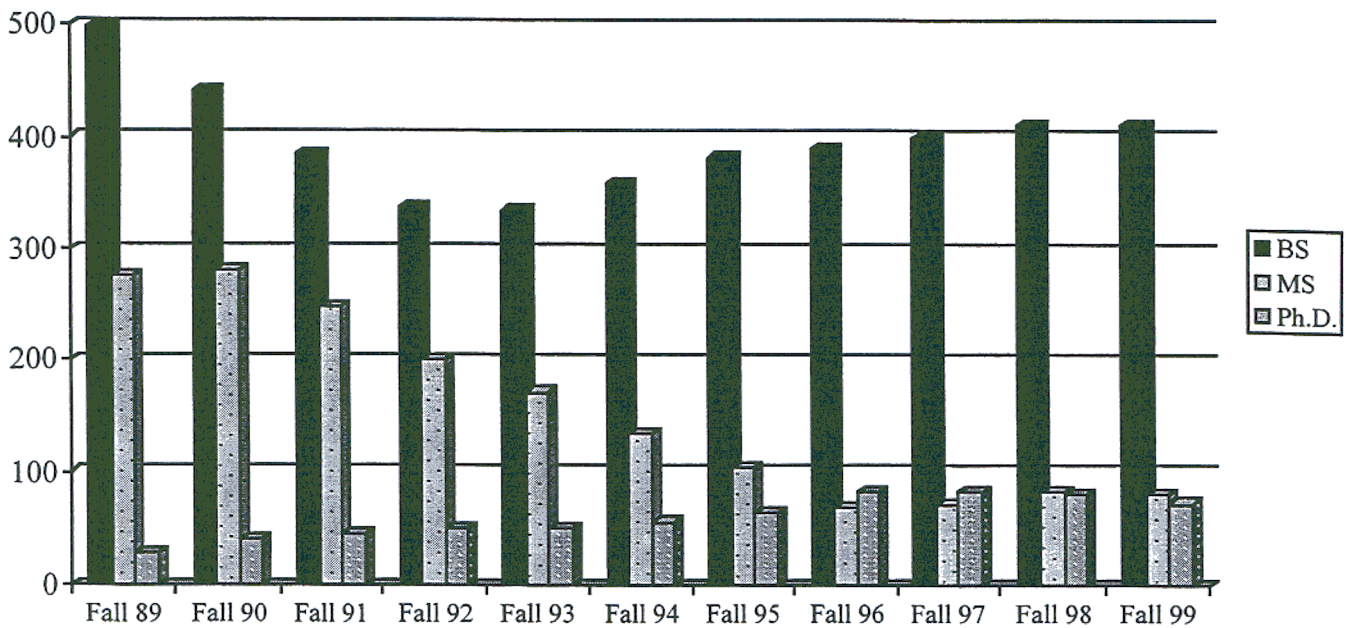
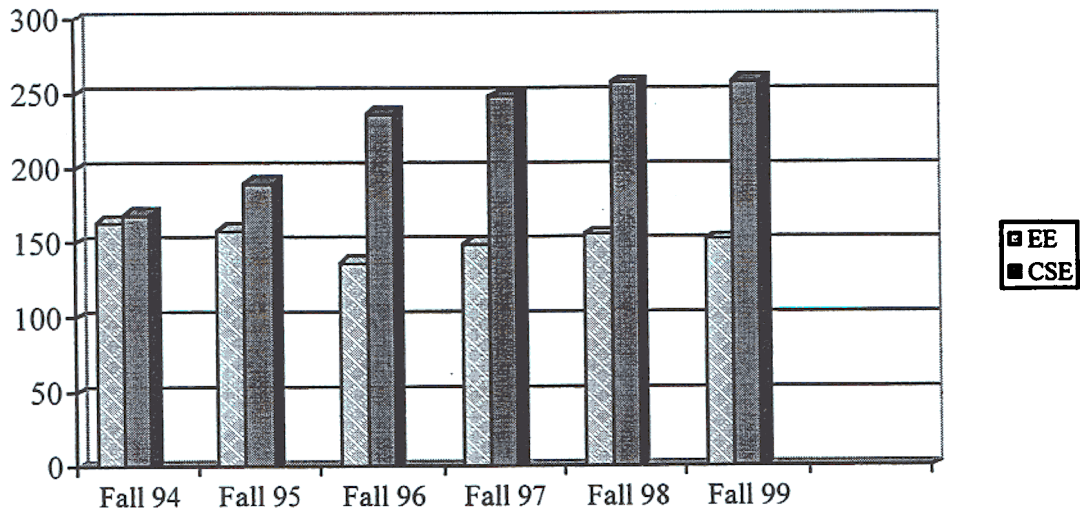


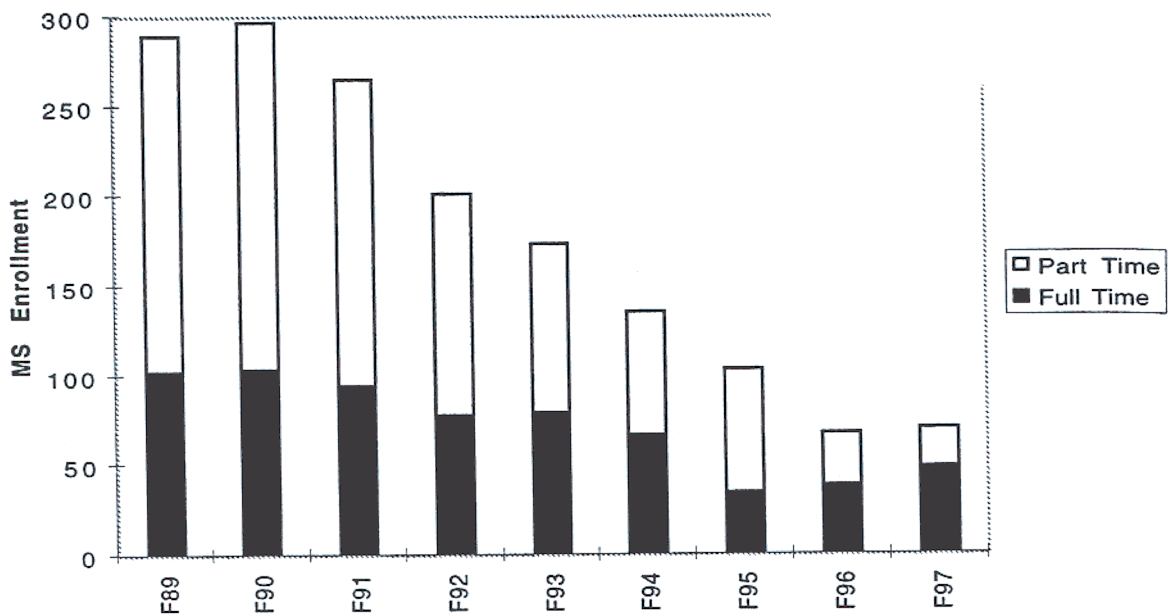
Chart 6-1: Undergraduate and Graduate Student Enrollment



**Chart 6-2: EE and CSE Enrollment in BS Program**

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

- MS degree enrollments dropped sharply, mainly with the demise of the Corporate Classroom program. Few part-time or self-funded MS students remain.
- Ph.D. enrollment has risen substantially, along with the number of applications, but domestic candidates remain difficult to recruit.
- Graduate fellowship resources have remained fixed, while RA support grew modestly with grant funding.



**Chart 6-3: MS Enrollment**

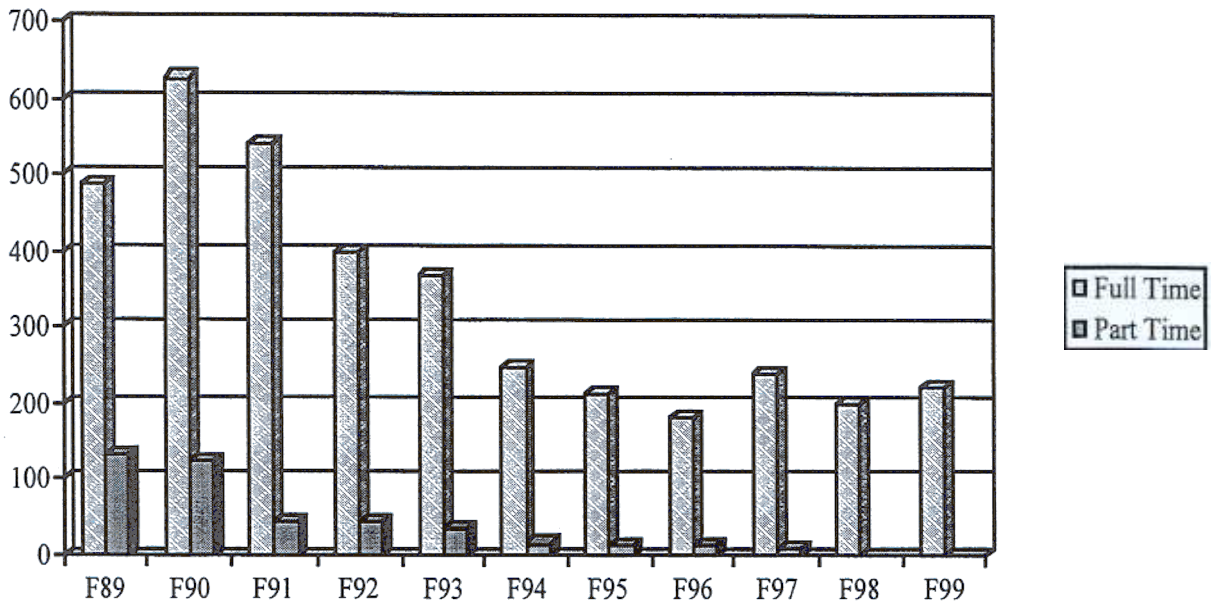


Chart 6-4: M: Applications

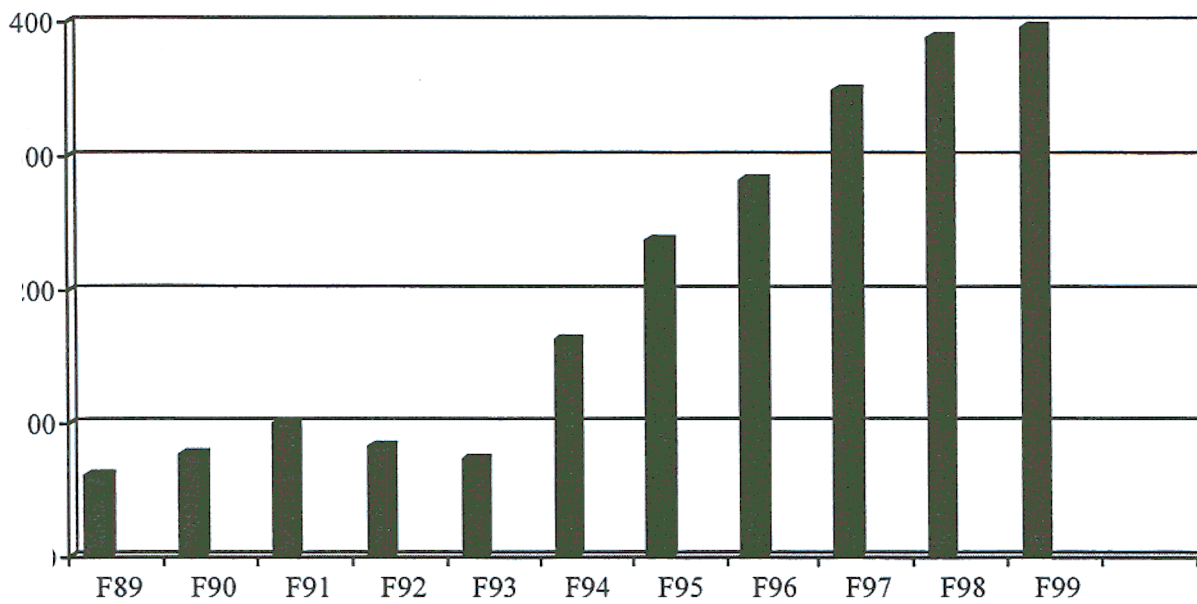


Chart 6-5: Ph.D. Applications

## 6.2 Degrees Granted

Data on the degrees granted by the department in the last twelve years are shown in Table 6-2 and Charts 6-6 to 6-8.

	'89	'90	'91	'92	'93	'94	'95	'96	'97	'98	'99	'00
BS	172	186	130	115	88	78	85	90	88	96	98	99
MS	111	133	130	136	109	91	92	70	52	28	43	38
Ph.D.	2	2	4	6	4	6	10	4	10	15	4	10
<b>Total</b>	<b>285</b>	<b>321</b>	<b>264</b>	<b>257</b>	<b>201</b>	<b>175</b>	<b>187</b>	<b>164</b>	<b>150</b>	<b>139</b>	<b>145</b>	<b>147</b>

Table 6-2: Degrees Granted

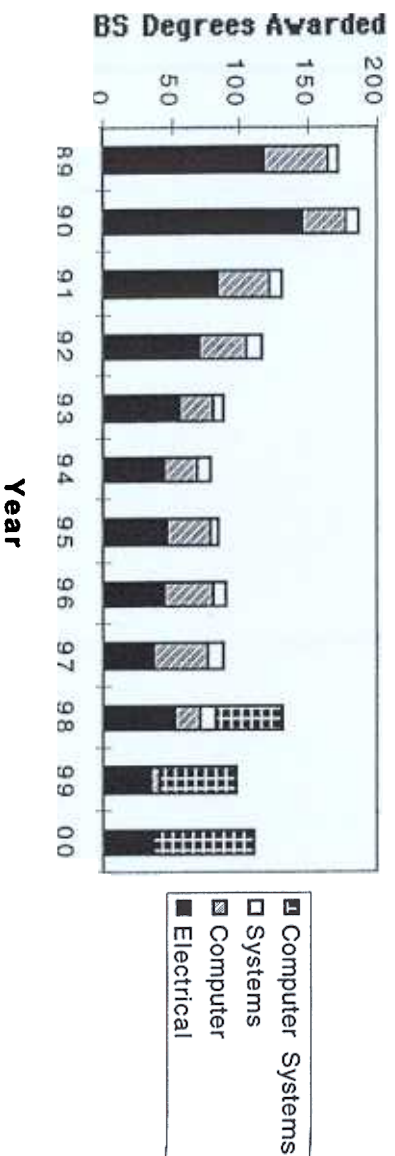


Chart 6-6: BS Degrees Awarded

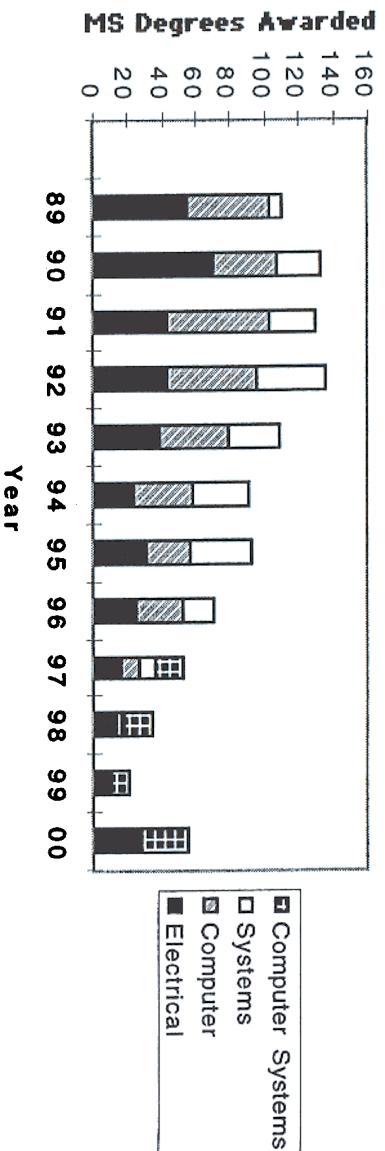


Chart 6-7: MS Degrees Awarded

The small number of Ph.D. degrees awarded last year proved to be an anomaly inconsistent with the total enrollment in the doctoral program (80), and with the numbers in the previous two years. Slight growth is expected for 2000-2001.

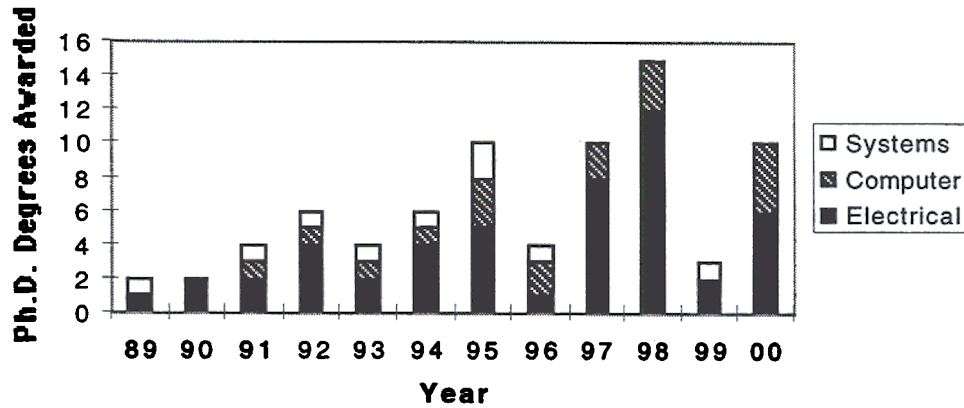
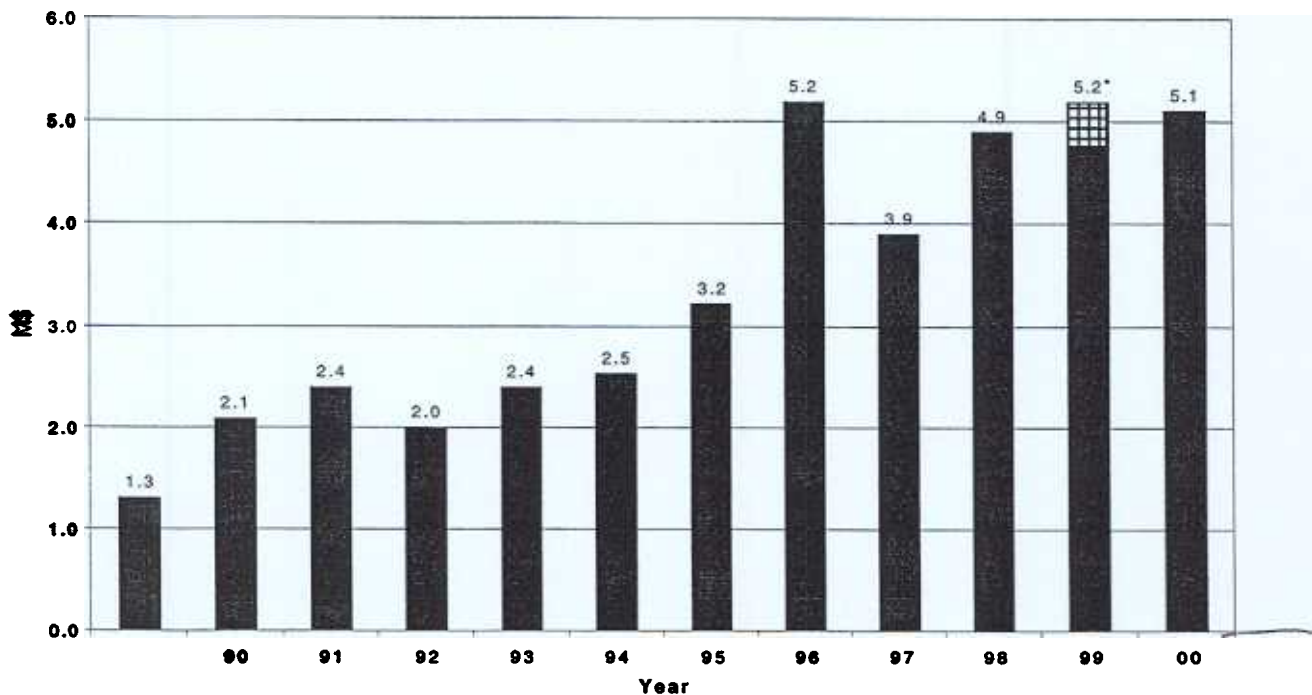


Chart 6-8: Ph.D Degrees Awarded

### 6.3 Research Funding

Research funding has grown significantly in the last ten years. The last three years have been similar, reflecting a fixed department faculty and more competitive grant processes. This effort needs to be even more aggressive in 2000-2001:

- New grant awards for 1999/2000 totaled \$5.1M.
- Funding per faculty totaled approximately \$160k.



**Chart 6-9: New Research Grants and Contracts** These figures include only grants and contracts for which the Principal Investigators (PI) were ECE faculty. The share of grants for which ECE faculty were Co-PIs totaled approximately \$0.7M in 1999/00, so that the total funding is approximately \$5.7M.

\* The 1998/1999 Annual Report indicated a new funding total of \$4.8M. This figure was later adjusted to reflect a \$480k grant from The David and Lucille Packard Foundation for Professors Teich and Saleh. The new total for 1998/99 is \$5.2M.



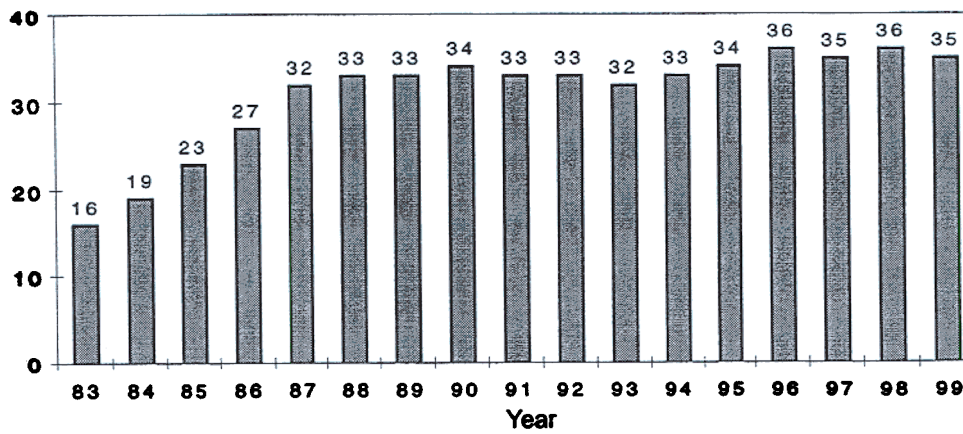
## 6.4 Faculty and Staff

Faculty hiring has largely replaced departures, with small net growth:

- Department growth has been only two positions in the last five years.
- 13 of the current faculty joined the department in the last five years.
- New hires have been directed both to strategic research thrusts and to address shifting enrollments.

Staff development has lagged behind the faculty and programmatic changes:

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



**Chart 6-10: Faculty Growth and Turnover Since 1983** Affiliate faculty and research faculty with no teaching responsibilities are not included in this chart.

## 6.5 Targeted Growth

The ECE faculty have held extensive discussions at various meetings and annual retreats in recent years to determine strategic areas for targeted growth. Plans for faculty growth have been motivated by the need to strengthen existing research areas to make them more competitive at a national level, develop expertise in areas of ECE where important new technologies are expected to grow, and respond to shifting and growing student enrollments at both undergraduate and graduate levels. As described in Section 5, the department has three main divisions: *electrophysics* (which includes photonics, solid state materials and devices, and electromagnetics), *signals* (which includes speech and image processing, and control and communication systems), and *computer engineering* (which includes reliable computing, high performance computing, networks, VLSI, and multimedia). These areas overlap and are mutually supportive, and our growth must exploit synergies between these areas, as well as links with other departments and centers.

The following areas have been selected for growth:

### Computer Systems Engineering

Our most urgent need for growth is in computer systems engineering. This is immediately dictated by increasing undergraduate enrollment, reflecting the robust market for our graduates. Enrollment in CSE has surpassed that in EE, yet the number of faculty capable of teaching computer engineering courses, particularly in software engineering is alarmingly inadequate. Significant teaching is done by non-research active faculty and CSE research is weak.

Failure to add new faculty in this area could cause severe course staffing problems and frustrate research growth. To achieve greater national visibility, CSE must keep up with the changing face of our profession, information revolution, and play a leading role in shaping future technological advances. Research funding in ECE is dominated by EE-related grants. This is not conducive to maintaining a balanced department and hurts CSE recruiting. Recruiting in CSE is not easy under the best of circumstances. The scarcity of qualified people and the strong competition with industry and other universities means that most ECE departments in the U.S. are facing the same difficulty, and makes vigorous recruiting in computer engineering a necessity. We plan to coordinate this growth in computer systems engineering with the BU Department of Computer Science to benefit from synergies and to enhance our competitiveness in attracting new faculty members. Additionally, we need to establish stronger links with the Center for Computational Science. Another link offering particularly strong synergistic possibilities is that between the ECE High Performance Computing group and the Center for Space Physics (CSP). CSP is a BU research center with strong links to ECE (40% of its graduate students are from ECE).

**Telecommunication and computer networks**

Another area of high student demand and important research is telecommunication and computer networks. Telecommunications and networking have dramatically changed society and their economic impact will continue to grow. They drive much of the recent technology growth in computers and VLSI. We must enhance therefore enhance the curriculum at both the undergraduate and graduate levels and increase the size of our research effort. Computer-network specialists would also help us in meeting some of our urgent teaching needs in the general computer systems engineering program. The Computer Science Department at BU has also targeted computer networks for growth, and our combined effort can foster a strong BU effort in this very important area.

**Analog and digital VLSI electronics**

Analog and digital VLSI electronics continues to be an area of fundamental importance. 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. The application of VLSI electronics to biological sensors is an area of great potential, and interests both the ECE and the Biomedical Engineering (BME) departments. The addition of more faculty is essential to meet increased teaching needs and to give this re-

search area the critical mass needed to gain national recognition and competitiveness for research funds.

**Photonics**

When BU established the Photonics Center, it made a strategic commitment to become a national center of excellence in photonics. Senior and junior ECE faculty have been added in photonic materials and devices, quantum optics, and fiber-optic sensors. There is need to maintain the momentum and to continue to strengthen this program with new faculty. This will of course enrich the scientific base of the Photonics Center and its technical vitality. While we have outstanding research in photonic materials and devices and their applications, we lack strength in the systems area, particularly in high-speed optical communication, switching, and networks. Growth in these areas would also strengthen our effort in telecommunication and computer networks. Another area of importance in photonics and also solid state devices is micro-electromechanical systems (MEMS) and their optical applications in sensors, scanners, and actuators. MEMS is a thrust area for other engineering departments, and MEMS efforts will benefit from a well coordinated faculty recruiting campaign and a large research group in this important area. One of our early goals has been the establishment of a new MS degree program (or option) in photonics. Another goal has been to offer a program of short courses (including courses offered via distance learning). The addition of new faculty is necessary to acquire the critical mass for creating such programs.

**Signal, speech, and image processing**

ECE has an outstanding, and well-funded, group of faculty in signal, speech, and image processing. This group has established an excellent reputation and enjoys an unusually strong graduate student interest. The group includes leaders of a multi-university multi-million dollar MURI AFOSR grant, and a new proposal to establish a large four-university NSF Engineering Research Center for Subsurface Imaging and Sensing (with participants from other ECE groups and other departments of the College). It is essential to maintain the strength of this group and to seek opportunities to make it even stronger by enhancing its ties with other BU groups. The speech processing work is also linked to other activities within the college, such as the Hearing Research Center, the Center for BioDynamics, and the acoustics group in the AME Department.