



## Graduate Program

### *Electrical Engineering*

The Graduate Program in Electrical Engineering (EE) at the University of Massachusetts Amherst offers both M.S. and Ph.D. degrees. The Program is part of our Department of Electrical and Computer Engineering, which is actively engaged in teaching, research, and service across a wide spectrum of technical areas. The Department boasts one of the most prestigious new national research centers in the country in CASA, the Engineering Research Center for Collaborative Adaptive Sensing of the Atmosphere, which promises to transform the way human beings monitor weather and track storms. Beyond CASA, our Microwave Remote Sensing Laboratory (MIRSL) is the nation's leading university research laboratory in microwave remote sensing of the global environment. Last year, the Department formed a new Antenna Research Center to develop technology for national defense, air traffic control, homeland security, and other needs. Half of our faculty members are fellows of the Institute of Electrical & Electronics Engineers. EE was recently ranked in the top quartile in the country by the National Research Council and 26th in the nation by US News & World Report.

## Facilities

The department is equipped with several state-of-the-art research laboratories available to graduate students in EE. They include: the Antennas and Propagation Lab, featuring an antenna anechoic chamber and electronic test instrumentation for measuring radiation pattern, impedance, and propagation parameters; a Device Fabrication Lab, featuring a clean room that provides hands-on experience in micro/nano electronic device fabrication; an Emerging Electronics Device Simulation Lab, training students in the design of modern electronic devices; a Lab for Millimeter Wave Devices and Applications, featuring a Cascade probe station and test instrumentation for the design and testing of microwave and millimeter wave integrated circuits; the Microwave Remote Sensing Laboratory, which deals with the design, assembly, and testing of various radar systems and radiometers; and a Thin Films Lab, with special facilities for the engineering of thin films. In addition, CASA's first DCAS radar node is installed on the test bed tower on campus.

## Research

Below are representative examples of the many kinds of research available to graduate students in EE:

**The Antennas and Propagation Lab:** Students design, fabricate, test, and analyze printed circuit antennas and arrays, develop electromagnetic models for the propagation of radio waves in several environments, and devise computational techniques for solving practical electromagnetic problems.

**CASA:** This \$40 million center brings together a multidisciplinary group to conduct fundamental research, develop enabling technology, and deploy prototype engineering systems that help scientists observe, understand, and predict weather hazards.

**Emerging Electronic Device Simulation Lab:** This group is concerned with the numerical simulation of nano-scale semiconductor devices, nanostructures such as nanowires, carbon nanotubes, and MOSFETs, and transport in these structures.

**Information Systems Lab:** This laboratory deals with the development of statistical and physical models for imaging systems and the development of signal processing algorithms for various applications.

**MIRSL:** This lab has been developing a wide range of microwave sensors for the remote sensing of many geophysical processes, including cloud data that have a direct effect on the



earth's energy budget, surface winds over the ocean, the scattering and radiating characteristics of vegetation (particularly leaves), soils that are highly responsive to changes in water content, and soil moisture that is a primary factor in crop yield.

**Terahertz Lab:** This laboratory is dedicated to the development of low noise THz receivers and detectors, emphasizing Hot Electron Bolometric (HEB) mixer receivers at terahertz frequencies. In the austral summer of 2002-2003, our research group successfully deployed a heterodyne terahertz receiver on the AST/RO Telescope at the U.S. South Pole Station, Antarctica.

**Thin Films Lab:** This group develops materials and processes for thin-film-based devices and components.

**Wireless Systems Laboratory:** Researchers in this lab study the theory and implementation of solutions to systems-level problems in communications. The emphasis is on the design and analysis of coding, modulation, and equalization schemes for wireless communications.

**Feedback Control Lab:** Students study topics such as active noise control, adaptive optics, reset control, distributed and robust control, and complex system modeling.

## Financial Assistance

It is the goal of the Electrical and Computer Engineering Department to provide assistantships and/or fellowships to any graduate student whose degree will culminate in the completion of a research project, thesis, or dissertation. The Department will also make every effort to provide funding for those involved with specific projects. Though limited in number, teaching assistant positions may be available for those either interested in teaching as a career, or involved in research projects that don't have funding. Typically, tuition waivers are part of the assistantship contract.

## Employment

Our graduates find jobs in the fields of radio, television, telephone, radar, personal computers, consumer electronics, wireless communications, weather prediction, transportation, drug discovery, human genomics, bioengineering, nanotechnology, space exploration, global economy, and electrical power generation and transmission, to mention just a few. Our alumni are sought by leading companies such as General Electric, Microsoft, Intel, Raytheon, MIT Lincoln Labs, and many more. EE alumni have also founded many successful start-up companies.

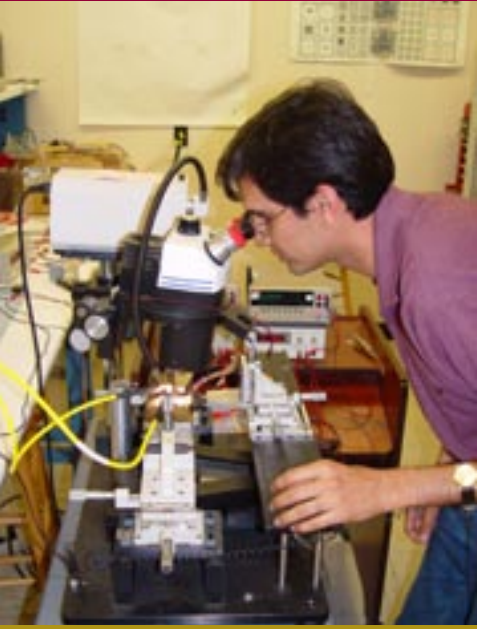
## Location

The University of Massachusetts is the state university of the Commonwealth. It was founded in 1863 under the provisions of the Morrill Land Grant Act, which was passed by the United States Congress one year earlier. Situated in one of the most picturesque sections of the state, UMass Amherst joins with its academic neighbors – Amherst, Smith, Mount Holyoke, and Hampshire colleges – in the Five College Consortium, which helps maintain the rich tradition of educational benefits (including cross-registration for coursework) and cultural activity (numerous concerts, Broadway shows, plays, readings, entertainers of every kind, and dance performances) associated with the Connecticut Valley. Amherst is also located within easy access to New York, Boston, and Montreal, and has a reputation throughout New England for its numerous outdoor activities, which can all be easily accessed through the UMass Amherst Outing Club.

### Contact

For more information on graduate studies in EE contact  
Professor Ramakrishna Janaswamy, *Graduate Program Director*, [ecegrad@ecs.umass.edu](mailto:ecegrad@ecs.umass.edu)  
or consult the Program Website at: <http://www.ecs.umass.edu/ece/dept/grad/index.html>

**List of Faculty:** N. G. Anderson, A. P. DeFonzo, S. B. Desu, T. E. Djaferis, B. Doshi,  
M. V. Fischetti, Frasier, D. Goeckel, W. Gong, C. V. Hollot, R. W. Jackson, R. Janaswamy,  
P. A. Kelly, D. P. Looze, D. McLaughlin, O. Oliaei, H. Pishro-Nik, E. Polizzi,  
D. H. Schaubert, P. Siqueira, T. W. Tang, M. Vouvakis, K. S. Yngvesson



## Graduate Program

### Computer Systems Engineering

The Department of Electrical and Computer Engineering at UMass Amherst offers both M.S. and Ph.D. degrees with a concentration in the area of Computer Systems Engineering (CSE). Three of CSE's faculty have received National Science Foundation (NSF) CAREER Awards, one an ARO Young Investigator Award, and one a Research Excellence Award. The faculty and students also play a key role in designing the computer infrastructure for the innovative radars being built by the Engineering Research Center for Collaborative Adaptive Sensing of the Atmosphere (CASA). Other key research areas are systems, VLSI and CAD, computer networks, and biocomputing. CSE enjoys an excellent reputation worldwide and is ranked highly by the National Research Council and US News & World Report.

## Facilities and Research

The following laboratories of the CSE are housed in the third floor of the Knowles Engineering Building: the Architecture and Real-time Systems Laboratory, the Reconfigurable Computing Laboratory, the VLSI CAD Lab, and the Networking Lab. Facilities include a network of computers running on Intel IXP processors, servers, a router test lab with CISCO routers, and emulators and CAD tools from Cadence, Synopsis, and Mentor. Circuit and technology libraries and fabrication facilities down to 90nm CMOS are available from the MOSIS program.

Research within the Program can be broadly classified into: Systems; VLSI and CAD; and Networks.

### Systems Research

**Real-time Systems:** Real-time systems must execute computational tasks to meet deadlines imposed on them by the application. Such systems – typically computers in the control of some process – are becoming ever more prevalent. Members of the CSE faculty are working on ways to make such systems more reliable and power-efficient, which is mainly done at the systems software and middleware layers.

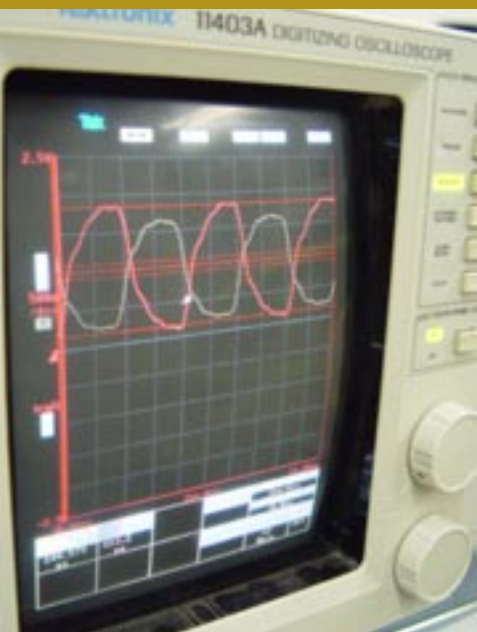
**Power-aware Computing:** Power consumption is a major design issue in today's processors. Modern high-end processors can generate more heat per square inch of surface area than a kitchen hotplate. Effectively dissipating this heat before it harms the processor is a technical challenge. Also, processors are increasingly being used in mobile battery-powered applications, where there are constraints on the total energy available between recharges. Faculty are looking at ways of controlling such power consumption at the VLSI, architecture, and operating system levels.

**Reconfigurable Systems:** Reconfigurable computing involves the design and use of circuits that can be reconfigured to suit changes in the needs of the application. Faculty are designing reconfigurable architectures as well as computer-aided design tools and test techniques for them.

**Nanotechnology:** Nanotechnology involves using devices many times smaller than the smallest conventional transistors. This field is in its very early stages, and much foundational work remains to be done before computers can be built out of nanowires or nanotubes. CSE faculty are involved in designing and evaluating basic nanotechnology architectures and understanding their performance and reliability characteristics. An important part of the work involves introducing fault-tolerance into nanoarchitectures to increase the manufacturing yield of such systems.

### VLSI & CAD Design Research

Research within this group is supported by NSF, SRC, Intel, IBM, Altera, KLA-Tencor, and other semiconductor and CAD companies. VLSI Research involves collaborations with industry and researchers in analog, RF, radar, physics, computer science, polymer science, and math. Topics of research include nano-scale circuits and architectures; reconfigurable computing (FPGA) circuits,



architectures and applications; CAD for synthesis and verification, computer arithmetic; VLSI for signal processing, communications, 3D graphics, cryptography, security, radar, robotics, and networking applications; VLSI circuits for long interconnects and memories; and low-power design techniques.

### *Networking Research*

Research within this group is carried out across various layers and includes both wireless and wired networks.

**The Multimedia Networks Group:** This team advances the science of computer networks, especially as they pertain to the future wireless networks and their need to transport a maze of multimedia, voice, and data applications across the globe. The group adds value mainly in the data, network, and transport layers, while understanding, modifying, and integrating third-party solutions in other layers. The solutions are validated by a combination of analytical, simulation, and prototyping tools.

**The Network Systems Lab:** This lab looks at novel router designs and how they can be used in future network architectures. In particular, network processors are used to prototype such systems and measure their performance in high-speed networks. The group is also collaborating with the Computer Science Department to develop a measurement platform that can collect real packet traces from the UMass Amherst Internet link. Such work is extremely useful for studying network behavior.

**Multimedia Networking and Internet Lab:** This research focuses on enhancing the reliability and security of the Internet, including research on wired and wireless networks as well as Internet backbone networks. In collaboration with Internet service providers, the lab develops real-time network diagnosis tools and analyzes backbone network traffic traces as well as routing data.

## Financial Assistance

It is the goal of the Electrical and Computer Engineering Department to provide assistantships and/or fellowships to most graduate students whose degrees will culminate in the completion of a research project, thesis, or dissertation. The Department will also make every effort to provide funding for those involved with specific projects. Though limited in number, teaching assistant positions may be available for those either interested in teaching as a career, or involved in research projects that don't have funding. Typically, tuition waivers are part of the assistantship contract.

## Employment

Recent graduates have accepted positions at Oracle, Qualcomm, Samsung, Opnet, Cisco, EMC Corporation, National Electronics and Computer Technology Center in Thailand, Microsoft, Motorola, Verizon, the Hellenic Air Force, Kasersart University, Chung-Ang University, Lucent Technologies, Meyer/Glass Interactive, and Hong Kong University of Science and Technology.

## Location

The University of Massachusetts is the state university of the Commonwealth. It was founded in 1863 under the provisions of the Morrill Land Grant Act, which was passed by the United States Congress one year earlier. Situated in one of the most picturesque sections of the state, UMass Amherst joins with its academic neighbors – Amherst, Smith, Mount Holyoke, and Hampshire colleges – in the Five College Consortium, which helps maintain the rich tradition of educational benefits (including cross-registration for coursework) and cultural activity (numerous concerts, Broadway shows, plays, readings, entertainers of every kind, and dance performances) associated with the Connecticut Valley. Amherst is also located within easy access to New York, Boston, and Montreal, and has a reputation throughout New England for its numerous outdoor activities, which can all be easily accessed through the UMass Amherst Outing Club.

### Contact

For more information on graduate studies in CSE contact

**Professor Ramakrishna Janaswamy**, Graduate Program Director, [ecegrad@ecs.umass.edu](mailto:ecegrad@ecs.umass.edu)  
or consult the Program Website at <http://www.ecs.umass.edu/ece/dept/grad/index.html>

Other CSE faculty: W. Burleson, VLSI and CAD; M. Ciesielski, VLSI and CAD; A. Ganz, Networking; L. Gao, Networking; W. Gong, Networking; I. Koren, Systems; M. Krishna, Systems; S. Kundu, VLSI and CAD; R. Mettu, Biocomputing; A. Moritz, Systems; R. Tessier, VLSI and CAD; T. Wolf, Networking