DEPARTMENT OF ELECTRICAL, COMPUTER, AND SYSTEMS ENGINEERING

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More Information: https://engineering.case.edu/electrical-computer-and-systems-engineering

Effective as of June 1, 2019, the Electrical Engineering and Computer Science Department in the Case School of Engineering has been renamed to be the Department of Electrical, Computer, and Systems Engineering (ECSE).

The ECSE Department spans a spectrum of topics from (i) materials, devices, circuits, and processors through (ii) control, signal processing, and systems analysis to (iii) human-machine interfaces, computation, computer systems, embedded systems and networking. The ECSE Department at Case Western Reserve supports three synergistic degree programs: Electrical Engineering, Computer Engineering, and Systems & Control Engineering. Each degree program leads to the Bachelor of Science degree at the undergraduate level. At the graduate level, the department offers the Master of Science and Doctor of Philosophy degrees in Electrical Engineering, Computer Engineering, and Systems & Control Engineering. We offer minors in Electrical Engineering, Computer Engineering, Systems & Control Engineering, and also in Computer Gaming, and Electronics. For supplemental information to this bulletin as well as the latest updates, please visit the ECSE Department website at https://engineering.case.edu/electrical-computer-and-systems-engineering.

ECSE is at the heart of modern technology. ECSE disciplines are responsible for the devices and microprocessors powering our computers and embedded into everyday devices, from cell phones and tablets to automobiles and airplanes. Healthcare is increasingly building on ECSE technologies: micro/nano-systems, electronics/instrumentation, implantable systems, embedded microprocessors, wireless medical devices, surgical robots, imaging, system biology, and visualization. The future of energy will be profoundly impacted by ECSE technologies, from smart appliances connected to the Internet, smart buildings that incorporate distributed sensing and control, to the envisioned smart grid that must be controlled, stabilized, and kept secure over an immense network. ECSE drives job creation and starting salaries in our fields are consistently ranked at the top of all college majors. Our graduates work in cutting-edge companies--from giants to start-ups, in a variety of technology sectors, including computer and internet, healthcare and medical devices, manufacturing and automation, automotive and aerospace, defense, finance, energy, and consulting.

Educational Philosophy

The ECSE department is dedicated to developing high-quality graduates who will take positions of leadership as their careers advance. We recognize that the increasing role of technology in virtually every facet of our society, life, and culture makes it vital that our students have access to progressive and cutting-edge higher education programs. The core values for all of the degree programs in the department are:

- mastery of fundamentals
- creativity
- social awareness
- leadership skills
- professionalism

Stressing excellence in these core values helps to ensure that our graduates are valued and contributing members of our global society and that they will carry on the tradition of engineering leadership established by our alumni.

Our goal is to graduate students who have fundamental technical knowledge of their profession and the requisite technical breadth and communications skills to become leaders in creating the new techniques and technologies which will advance their fields. To achieve this goal, the department offers a wide range of technical specialties consistent with the breadth of electrical engineering, computer engineering, and systems & control engineering, including recent developments in the fields. Because of the rapid pace of advancement in these fields, our degree programs emphasize a broad and foundational science and technology background that equips students for future developments. Our programs include a wide range of electives and our students are encouraged to develop individualized programs which can combine many aspects of electrical engineering, computer engineering, and systems & control engineering.

Research

The research thrusts of the Electrical, Computer, and Systems Engineering department include:

a. Micro/Nano Systems
b. Electronics and Instrumentation
c. Robotics and Human-Machine Interfaces
d. Embedded Systems, including VLSI and FPGA design
e. Hardware Algorithms, Hardware Security, Testing/Verification
f. Systems Biology
g. Machine Learning and Data Mining
h. Computer Networks and Distributed Systems
i. Energy Systems, including Wind and Power Grid Management/Control
j. Gaming, Simulation, Optimization
k. Medical Informatics and Wireless Health

ECSE participates in a number of groundbreaking collaborative research and educational programs, including the Microelectromechanical Systems Research Program, the Center for Computational Genomics, graduate program in Systems Biology and Bioinformatics, the Clinical & Translational Science Collaborative, the Great Lakes Energy Institute, and the VA Center for Advanced Platform Technology.

Faculty

M. Cenk Cavusoglu, PhD
(University of California, Berkeley)
Nord Professor of Engineering
Robotics, systems and control theory, and human-machine interfaces; with emphasis on medical robotics, haptics, virtual environments, surgical simulation, and bio-system modeling and simulation

Vira Chankong, PhD
(Case Western Reserve University)
Associate Professor
Large-scale optimization; logic-based optimization; multi-objective optimization; optimization applications in radiation therapy treatment planning, medical imaging, manufacturing and production systems, and engineering design problems

Zonghe Chua, PhD
(Stanford University)
Assistant Professor
Intelligent robotic teleoperator systems capable of sensing, understanding, and delivering multisensory feedback to the user to improve performance

Michael Fu, PhD
(Case Western Reserve University)
Timothy E. and Allison L. Schroeder Assistant Professor
Neuro-rehabilitation and motor-relearning, with emphasis on virtual environments, neuromuscular electrical stimulation, and haptic interfaces

Mario Garcia-Sanz, DrEng
(University of Navarra, Spain)
Professor
Robust and nonlinear control, quantitative feedback theory, multivariable control, dynamic systems, systems modeling and identification; energy innovation, wind energy, spacecraft, electrical, mechanical, environmental and industrial applications

Evren Gurkan-Cavusoglu, PhD
(Middle East Technical University)
Associate Professor
Systems and control theory, systems biology, computational biology, biological system modeling, signal processing applied to biological systems, signal processing

Hossein Miri Lavasani, PhD
(The Georgia Institute of Technology)
Assistant Professor
High performance integrated circuits and systems, Low power interface circuits for MEMS and sensors

Gregory S. Lee, PhD
(University of Washington)
Assistant Professor
Haptic devices, including low-power design and effects on perception; applications to robotic surgery and telesurgery; secure teleoperation

Pan Li, PhD
(University of Florida)
Associate Professor
Networks, Cybersecurity, Big data, Cyber-physical systems, Bioinformatics

Wei Lin, PhD
(Washington University in St. Louis)
Professor
Nonlinear control, dynamic systems and homogeneous systems theory, H-infinity and robust control, adaptive control, system parameter estimation and fault detection, nonlinear control applications to under-actuated mechanical systems, biologically-inspired systems and systems biology

Steve Majerus, PhD
(Case Western Reserve University)
Assistant Professor
New medical treatments and diagnostic tools by integrating low-power interface circuits, signal-processing algorithms, and flexible sensors

Behnam Malakooti, PhD, PE
(Purdue University)
Professor
Risk analysis and prediction, design and multiple-objective optimization of manufacturing/production/operations systems, NASA intelligent internet protocol systems and networks, feed-forward artificial neural networks, intelligent decision making

Pedram Mohseni, PhD
(University of Michigan)
Goodrich Professor of Engineering Innovation and Chair
Biomedical microsystems, bioelectronics, wireless neural interfaces, CMOS interface circuits for MEMS, low-power wireless sensing/actuating microsystems

Christos Papachristou, PhD
(Johns Hopkins University)
Professor
VLSI design and CAD, computer architecture and parallel processing, design automation, embedded system design

Daniel Saab, PhD
(University of Illinois at Urbana-Champaign)
Associate Professor
Computer architecture, VLSI system design and test, CAD design automation

Sree N. Sreenath, PhD
(University of Maryland)
Professor
Systems biology complexity research (modeling, structural issues, and simulation); cell signaling, population behavior, and large-scale behavior; global issues and sustainable development

Christian A. Zorman, PhD
(Case Western Reserve University)
F. Alex Nason Professor
Materials and processing techniques for MEMS and NEMS, wide bandgap semiconductors, development of materials and fabrication techniques for polymer-based MEMS and bioMEMS

Secondary Faculty Appointments

Vipin Chaudhary, PhD
(University of Texas at Austin)
Professor, Computer and Data Sciences

Kathryn Daltorio, PhD
(Case Western Reserve University)
Assistant Professor, Mechanical & Aerospace Engineering

Dominique Durand, Ph.D.
(University of Toronto)
Professor, Biomedical Engineering

Mark Griswold, PhD
(University of Würzburg, Germany)
Professor, Radiology

Roger D. Quinn, PhD
(Virginia Polytechnic Institute and State University)
Professor, Mechanical and Aerospace Engineering

Satya S. Sahoo, PhD
(Wright State University)
Associate Professor, Dept of Population & Quantitative Health Sciences

Peter Thomas, PhD
(University of Chicago)
Associate Professor, Mathematics, Applied Mathematics, and Statistics

Dustin Tyler, PhD
(Case Western Reserve University)
Professor, Biomedical Engineering

Satish Viswanath, PhD
(Rutgers University)
Assistant Professor, Biomedical Engineering

Xiong (Bill) Yu, PhD, PE
(Purdue University)
Professor, Civil and Environmental Engineering

Chris Yingchun Yuan, PhD
(University of California, Berkeley)
Professor, EMAE

Research Faculty

Mahdi Bayat, PhD
(University of Minnesota)
Research Assistant Professor
Signal processing, biomedical imaging, machine learning

Michael A. Suster, Ph.D.
(Case Western Reserve University)
Research Assistant Professor
Point-of-care diagnostic platforms, sensors, circuits, and microsystems

Adjunct Faculty Appointments

Hanieh Agharazi, PhD
(Case Western Reserve University)
Adjunct Assistant Professor

Nicholas Barendt, MSEE
(Case Western Reserve University)
Adjunct Sr. Instructor

Michael S. Branicky, ScD, PE
(Massachusetts Institute of Technology)
Adjunct Professor

Philip Feng, Ph.D.
(California Institute of Technology)
Adjunct Professor

Roberto Galan, PhD
(Humboldt Universität zu Berlin, Germany)
Adjunct Associate Professor

Allison Hess-Dunning, PhD
(Case Western Reserve University)
Adjunct Assistant Professor

Suparerk Janjarasjitt, PhD
(Case Western Reserve University)
Adjunct Assistant Professor

David Kazdan, Ph.D.
(Case Western Reserve University)
Adjunct Assistant Professor

Madison Kretzler, PhD
(Case Western Reserve University)
Adjunct Instructor

Soumyajit Mandal, Ph.D.
(Massachusetts Institute of Technology)
Adjunct Associate Professor

Maximilian Scardelletti, PhD
(Case Western Reserve University)
Adjunct Assistant Professor

Lawrence Sears
(Case Western Reserve University)
Adjunct Instructor

Nicole Seiberlich, PhD
(Universitaet Wuerzburg, Wuerzburg)
Adjunct Associate Professor

Amit Sinha, PhD
(Case Western Reserve University)
Adjunct Assistant Professor

Benjamin Vandendriessche, PhD
(Ghent University)
Adjunct Assistant Professor

Daniel Weyer, PhD
(Case Western Reserve University)
Adjunct Assistant Professor

Francis G. Wolff, Ph.D.
(Case Western Reserve University)
Adjunct Associate Professor

Jackie Wu, PhD
(Mayo Graduate School)
Adjunct Professor

Emeritus Faculty

Marc Buchner, PhD
(Michigan State University)
Emeritus Associate Professor
Computer gaming and simulation, virtual reality, software-defined radio, wavelets, joint time-frequency analysis

Sheldon Gruber, PhD
Emeritus Professor
Electrical Engineering and Applied Physics

Kenneth A. Loparo, PhD
(Case Western Reserve University)
Emeritus Professor
Stability and control of nonlinear and stochastic systems; fault detection, diagnosis, and prognosis; recent applications work in advanced control and failure detection of rotating machines, signal processing for the monitoring and diagnostics of physiological systems, and modeling, analysis, and control of power and energy systems

Francis "Frank" L. Merat, PhD, PE
(Case Western Reserve University)
Emeritus Associate Professor
Computer and robot vision, digital image processing, sensors, titanium capacitors and power electronics; RF and wireless systems; optical sensors; engineering education

Wyatt S. Newman, PhD, PE
(Massachusetts Institute of Technology)
Emeritus Professor
Mechatronics, high-speed robot design, force- and vision-based machine control, artificial reflexes for autonomous machines, rapid prototyping, agile manufacturing, mobile robotic platforms

Programs

- Computer Engineering, BSE
- Computer Engineering, Minor
- Computer Engineering, MS
- Computer Engineering, PhD
- Computer Gaming, Minor
- Electrical Engineering, BSE
- Electrical Engineering, Minor
- Electrical Engineering, MS
- Electrical Engineering, PhD
- Electronics, Minor
- Systems and Control Engineering, BSE
- Systems and Control Engineering, Minor
- Systems and Control Engineering, MS
- Systems and Control Engineering, MS (Online)
- Systems and Control Engineering, PhD

Dual Degrees

- Undergraduate Programs toward Graduate or Professional Degrees

Related Minors in Other Departments

- Artificial Intelligence, Minor (administered by the Department of Computer and Data Sciences)

Facilities

Computer Facilities

The department computer facilities incorporate both Unix (primarily Linux) and Microsoft Windows-based operating systems on high-end computing workstations for education and research. A number of file, printing, database and authentication servers support these workstations, as well as the administrative functions of the department. Labs are primarily located in the Olin and Glennan buildings, but include Nord Hall, and are networked via the Case network.

The Case network is a state-of-the-art, high-speed fiber optic campus-wide computer network that interconnects laboratories, faculty and student offices, classrooms, and student residence halls. It is one of the largest fiber-to-desktop networks anywhere in the world. Every desktop has a 1 Gbps (gigabit per second) connection to a fault-tolerant 10 Gbps backbone. To complement the wired network, over 1,200 wireless access points (WAPs) are also deployed allowing anyone with a laptop or wireless enabled PDA to access resources from practically anywhere on campus.

Off-campus users, through the use of virtual private network (VPN) servers, can use their broadband connections to access many on-campus resources, as well as software, as if they were physically connected to the Case network. The department and the university participate in the Internet2 and National Lambda Rail projects, which provide high-speed, inter-university network infrastructure allowing for enhanced collaboration between institutions. The Internet2 infrastructure allows students, faculty and staff alike the ability to enjoy extremely high-performance connections to other Internet2 member institutions.

Aside from services provided through a commodity Internet connection, Case network users can take advantage of numerous online databases such as EUCLIDplus, the University Libraries' circulation and public access catalog, as well as Lexus-Nexus™ and various CD-ROM based dictionaries, thesauri, encyclopedias, and research databases. Many regional and national institutional library catalogs are accessible over the network, as well.

ECSE faculty are active users of the Microfabrication Laboratory and participants in the Advanced Platform Technology Center described under Interdisciplinary Research Centers.

Additional Department Facilities

Sally & Larry Sears Undergraduate Design Laboratory

This laboratory supports all departmental courses in circuits and includes a state-of-the-art lecture hall, a modernistic glass-walled lab, an electronics "store", and a student lounge and meeting area. Specialized lab space is available for senior projects and sponsored undergraduate programs. The lab is open to all undergraduates, and components are provided free of charge, so students can “play and tinker” with electronics and foster innovation and creativity. The laboratory provides access to PCs, oscilloscopes, signal generators, logic analyzers, and specialized equipment such as RF analyzers and generators. In addition, the lab includes full-time staff dedicated to the education, guidance and mentoring of undergraduates in the “art and practice” of hands-on engineering.
This is the central educational resource for students taking analog, digital, and mixed-signal courses in electronics, and has been supported by various corporations in addition to alumnus Larry Sears, a successful engineer and entrepreneur. Basic workstations consist of Windows-based computers equipped with LabView software, as well as Agilent 546xx oscilloscopes, 33120A Waveform Generators, 34401A Digital Multimeters, and E3631A power supplies. Advanced workstations are similarly configured, but with a wider variety of high-performance test equipment.

ECSE Undergraduate Computer Lab

This laboratory (recently renovated with major funding provided by Rockwell Automation) on the 8th floor of the Olin building is accompanied by a suite of instructor/TA offices and supports the freshman computing classes: ENGR 131 Elementary Computer Programming and ECSE 132 Programming in Java. Thirty student Macintosh workstations with underlying UNIX operating systems are available for hands-on instruction and support the study of introductory programming at the university.

Nord Computer Laboratory

This is a general-purpose computer facility that is open 24 hours a day, to all students. The lab contains 50 PCs running Windows and four Apple Macintosh computers. Facilities for color printing, faxing, copying and scanning are provided. Special software includes PRO/Engineer, ChemCAD and Visual Studio. Blank CDs, floppy disks, transparencies and other supplies are available for purchase. Visit the website for more information.

Kevin Kranzusch Virtual Worlds (Gaming and Simulation) Laboratory

The Kevin Kranzusch Virtual Worlds Gaming and Simulation Laboratory provides software and hardware to support education and research in computer gaming and simulation activities within the Electrical, Computer, and Systems Engineering Department and the University at large. The lab has been leveraged to provide students with extensive game play opportunities and excellent, strongly experiential simulation and game development educational opportunities – primarily targeted to the ECSE undergraduate population.

The lab also stimulates large amounts of cross-disciplinary collaboration in both education and research. Simulation and visualization techniques are of great value in all science and engineering fields, and the lab is capable of supporting advanced applications of these techniques in real-time applications. In addition, interactive technologies and video games require substantial artistic resources, which has resulted in excellent opportunities for educational and research collaboration with the Cleveland Institute of Art (CIA), the School of Nursing, the Medical School, and the Psychology Department. Of particular note has been the Advanced Game Project course (ECSE 390 and ECSE 487 Advanced Game Development Project) taught jointly by CWRU and CIA for juniors and seniors. This course has been very popular and has provided truly excellent student game design and production experiences while receiving industrial and popular recognition and acclaim. In addition, an entry-level computer game programming course (ECSE 290 Introduction to Computer Game Design and Implementation) is available for students who have taken both a Java-based programming course and a data structures course to provide an introduction to many of the technical aspects of computer game development. Many other courses in the department also use the lab as an important part of their curriculum including courses on computer graphics, artificial intelligence, simulation, digital signal processing, and control systems. The lab also supports research in the department requiring significant computational resources, e.g. GPU acceleration, VLSI simulation, etc.

A recent large donation for the lab has allowed for the update and renovation of the entire lab including the physical infrastructure (carpeting, furniture, etc.), the gaming PCs, and the gaming consoles. In addition, a new VR and AR room has been added to represent this new area connected strongly to computer gaming. The lab is now structured into a PC gaming area and an adjacent gaming console area, a VR/AR room, a portable gaming development room, and a team collaboration room.

The renovated lab includes the following primary equipment:

- 24 New Alienware PCs with Dell 27" 4K monitors
- 4 Sony Bravia Television monitors 75" 3DTV
- 2 Microsoft HoloLens AR headsets
- 3 Oculus Quest VR headsets
- A 3D projector (and large wall screen) with 3D capability for common presentations
- 4 Xbox One Units with Xbox One controllers
- 4 PS4 Sony PlayStation units with controllers

Intelligent Networks & Systems Architecting (INSA) Research Laboratory

The Intelligent Networks & Systems Architecting (INSA) Research Laboratory is a state-of-the-art research facility dedicated to intelligent computer networks, systems engineering, design, and architecting. It includes optimization, simulation, artificial intelligence, visualization, and emulation. This lab has been partially supported by NASA's Space Exploration programs for Human and Robotic Technology (H&RT). The INSA Lab is equipped with 10 high-performance workstations and 2 servers in a mixed Windows and Linux environment, with over 40 installed network interface cards providing connectivity to its wired and wireless research networks. It includes software packages such as GINO and LINDO, Arena simulation, ns2 and OPNET, as well as the STK satellite toolkit, artificial neural network, systems architecting and modeling, and statistical analysis and data management packages such as SPSS. The INSA Lab is also used for research in heterogeneous, sensor web, and mobile ad-hoc networks with space and battlefield applications.

VLSI/CAD Design Laboratory

This lab has been supported by the Semiconductor Research Corporation, NSF, AFRL, NASA, Synopsys, Mentor, and Sun Microsystems. This laboratory has a number of advanced UNIX/Linux workstations that run commercial CAD software tools for VLSI ASIC and microchip design, simulation and testing. The lab is currently being used to develop design and testing techniques for embedded system-on-chip (SoC).

Embedded Systems Laboratory

The Embedded Systems Laboratory is equipped with several Sun Blade Workstations running Solaris and Intel PCs running Linux. This lab has been recently equipped with advanced FPGA Virtex II prototype boards from Xilinx, including many Xilinx Virtex II FPGAs and Xilinx CAD tools for development work. A grant-in-aid from Synopsys has provided the Synopsys commercial CAD tools for software development and simulation. More recently, the lab has been equipped with many modern embedded platforms based on Raspberry Pi 3 and 4 models with numerous sensor devices. The lab has been also equipped with advanced embedded FPGA/ARM boards based on the Xilinx Zynq platform. This lab is also equipped with NIOS FPGA boards from Altera, including software tools. Together with software CAD EDK tools, these modern equipment and tools will be of great help to students' education and research work.

Mixed-Signal Integrated Circuit Laboratory

This research laboratory includes a cluster of Windows workstations and a UNIX server with integrated circuit design software (Cadence Custom IC Bundle), as well as a variety of equipment used in the characterization of mixed-signal (analog and digital) integrated circuits, which are typically fabricated using the MOSIS foundry service. Test equipment includes an

IC probe station, surface-mount soldering equipment, logic and network/spectrum analyzers, an assortment of digital oscilloscopes with sample rates up to 1 GHz, and a variety of function generators, multi-meters, and power supplies.

Microelectromechanical Systems (MEMS) Research Laboratory

The MEMS Research Laboratory is equipped for microfabrication processes that do not require a clean room environment. These include chemical-mechanical polishing (two systems), bulk silicon etching, aqueous chemical release of free-standing micromechanical components, and supercritical point drying. In addition to the fabrication capabilities, the lab is also well equipped for testing and evaluation of MEMS components as it houses wafer-scale probe stations, a vacuum probe station, a multipurpose vacuum chamber, and an interferometric load-deflection station. Two large (8 x 2 ft2) vibration isolated air tables are available for custom testing setups. The laboratory has a wide variety of electronic testing instruments, including a complete IV-CV testing setup.

BioMicroSystems Laboratory

This research laboratory focuses on developing wireless integrated circuits and microsystems for a variety of applications in biomedical and neural engineering. The laboratory contains several PC computers, software packages for design, simulation, and layout of high-performance, low-noise, analog/mixed-signal/RF circuits and systems, and testing/measurement equipment such as dc power supply, arbitrary function generator, multichannel mixed-signal oscilloscope, data acquisition hardware, spectrum analyzer, potentiostat, and current source meter. Visit the website for more information.

Emerging Materials Development and Evaluation Laboratory

The EMDE Laboratory is equipped with tooling useful in characterizing materials for MEMS applications. The laboratory contains a PC-based apparatus for load-deflection and burst testing of micromachined membranes, a custom-built test chamber for evaluation and reliability testing of MEMS-based pressure transducers and other membrane-based devices, a probe station for electrical characterization of micro-devices, a fume hood configured for wet chemical etching of Si, polymers, and a wide variety of metals, tooling for electroplating, an optical reflectometer, and a supercritical-point dryer for release of surface micromachined devices. The lab also has a PC with layout and finite element modeling software for device design, fabrication process design, and analysis of testing data.

Control and Energy Systems Center (CESC)

The Control and Energy Systems Center (CESC) looks for new transformational research and engineering breakthroughs to build a better world, improving our industry, economy, energy, environment, water resources and society, all with sustainability and within an international collaboration framework. With an interdisciplinary and concurrent engineering approach, the CESC focuses on bridging the gap between fundamental and applied research in advanced control and systems engineering, with special emphasis on energy innovation, wind energy, power systems, water treatment plants, sustainability, spacecraft, environmental and industrial applications. Fundamental research foci are to gain knowledge and understanding on multi-input-multi-output physical worlds, nonlinear plants, distributed parameter systems, plants with non-minimum phase, time delay and/or uncertainty, etc., and to develop new methodologies to design quantitative robust controllers to improve the efficiency and reliability of such systems. Applied research aims to develop advanced solutions with industrial partners, for practical control engineering problems in energy systems, multi-megawatt wind turbines, renewable energy plants, power system dynamics and control, grid integration, energy storage, power electronics, wastewater treatment plants, desalination systems, formation flying spacecraft, satellites with flexible appendages, heating systems, robotics, parallel kinematics, telescope control, etc. The Center was established in 2009 with the support of the Milton and Tamar Maltz Family Foundation and the Cleveland Foundation.

Process Control Laboratory

This laboratory contains process control pilot plants and computerized hardware for data acquisition and process control that is used for demonstrations, teaching, and research. This laboratory also has access to steam and compressed air for use in the pilot processes that include systems for flow and temperature control, level and temperature control, pH control, and pressure control plants.

Dynamics and Control Laboratory

This laboratory contains data acquisition and control devices, PLCs, electromechanical systems, and mechanical, pneumatic, and electrical laboratory experiments for demonstrations, teaching, and research. Particular systems include: AC/DC servo systems, multi-degree-of-freedom robotic systems, rectilinear and torsional multi-degree-of-freedom vibration systems, inverted pendulum, magnetic levitation system, and a PLC-controlled low-voltage AC smart grid demonstration system that includes conventional and renewable (wind and solar) generation, battery and compressed air energy storage, residential, commercial and industry loads, a capacitor bank for real-time power factor correction, and advanced sensing and controls implemented through an interconnected system of intelligent software agents.

Medical Robotics and Computer Integrated Surgery (MeRCIS) Laboratory

The Medical Robotics and Computer Integrated Surgical Systems Laboratory (MeRCIS) is equipped for research on medical robotics, advanced control systems, haptics, and human-machine interfaces. Specifically, the MeRCIS laboratory houses major equipment, computational resources, and software infrastructure to support: i) design, modeling, and simulation of robotic systems, specifically milli- and micro-robotic tools for medical applications, ii) design, modeling and simulation of high performance control systems, iii) design and analysis of haptic systems, iv) development of virtual environment-based medical training simulators, and v) modeling and simulation of complex biological systems.

The laboratory is equipped with state-of-the-art sensing, electronic measurement, and data acquisition equipment, as well as, some rare and unique resources available to support research on robotics and intelligent systems, with specific emphasis on medical robotics. The laboratory has an Intuitive Surgical daVinci™ IS1200 robotic surgical system. The system has been upgraded with an open interface electronics kit that converted the system into a ROS compatible open research platform (dVRK).