

Section 9b-BSOE

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Reviewed and approved by:

## **Baskin School of Engineering (BSOE) Research Centers and Institutes**

### **Center for Games and Playable Media**

This center focuses on research in computer games, interactive fiction, and playable media, broadly construed. The center houses the school's five games-related research labs: Expressive Intelligence Studio, Computational Cinematics Studio, Natural Language and Dialog Systems, Augmented Design Laboratory, and Software Introspection Laboratory. There is a great diversity in the faculty's topics of research. Projects range from work on artificial intelligence and interactive storytelling, to natural language dialogue systems, cinematic communication, procedural content generation, human computer interaction, rehabilitation games, computational photography, and level design. Members of the group have published in some of the most respected journals in the fields of game studies, game AI, and game culture. Web:

<http://games.soe.ucsc.edu/games-and-playable-media>

### **Center for Maximizing Abilities Through Technology, Education and Research**

#### **(MATTER)**

The MATTER Center (Maximizing Abilities Through Technology, Education and Research) is formed by an eclectic combination of faculty members in Engineering, Psychology, Nursing, and Rehabilitation from UC Santa Cruz, UC San Francisco, and UC Davis. The Center covers a broad spectrum of research areas, under the common denominator of technologies to help persons with special needs in their activities of daily living. Web: <http://matter.ucsc.edu/>

### **Center for Research in Intelligent Storage (CRIS)**

The Center for Research in Intelligent Storage (CRIS) is a partnership between universities and industry, featuring high quality, industrially relevant fundamental research, strong industrial support of collaboration in research and education, and direct transfer of university developed ideas, research results, and technology to U.S. industry to improve its competitive posture in world markets. Through innovative education of talented graduate and undergraduate students, CRIS is providing the next generation of scientists and engineers with a broad, industrially oriented perspective on engineering research and practice. Web: <http://www.cris.soe.ucsc.edu/>

### **Center for Stock Assessment Research (CSTAR)**

CSTAR is a collaboration between the Fisheries Ecology Division, NOAA Fisheries (FED), Santa Cruz, and UCSC to provide training in for undergraduate and graduate students and postdoctoral colleagues in the quantitative population biology needed to improve the sustainability of fisheries. CSTAR members work closely with FED staff, and participate in stock assessments, cruises, data workshops, and other management-oriented activities. Members of CSTAR have gone on to positions at NOAA Fisheries across the country, to academia, and to other kinds of non-academic positions including the Malaria Atlas and high-tech companies. A CSTAR alumna founded FishWise, which trains point of sale individuals about sustainability of fisheries and includes Safeway and Target as customers. Web:

<http://ugr.ue.ucsc.edu/CSTAR>

### **Center for Sustainable Energy and Power Systems (CenSEPS)**

The Center for Sustainable Energy and Power Systems (CenSEPS) is poised to become a major hub for innovation in emerging clean energy technologies and tackling the challenges of energy sustainability. The Center explores the societal implications of new renewable energy technologies as well as prepares a new generation of 21st century engineers and scientists to address the problem of more efficient energy use with minimal carbon footprint. We promote and integrate the use of renewable energy technology to create sustainable communities and renewable energy districts. The center partners with other energy research institutes, both within the United States and abroad, to develop an international approach to solving the critical problems that delay deployment of renewable energy resources. Web: <http://censeps.soe.ucsc.edu/>

## **Information Technologies Institute (ITI)**

The Information Technologies Institute (ITI) is a focused research activity (FRA) founded in 2001 and housed at the Baskin School of Engineering. ITI's objective is to provide an environment in which its members can attract large-scale projects that bridge technology research from concept to prototype and solve problems in social and commercial sectors nationally.

In ITI, advanced Internet applications provide the impetus and focus that bring together the components of research related to the rapidly expanding world of networks, distributed computing, "smart" sensors, and Internet appliances. As electronics and packaging developments lead to powerful low-cost sensors, resulting in a broad array of instruments, these become Internet devices, bringing a significant increase in the data captured, transmitted, stored, managed, and displayed.

Through its research centers, ITI focuses on interrelated areas in computer science, computer engineering, and electrical engineering as well as physics, chemistry, and applied mathematics. Areas of emphasis follow:

- Design and development of complex networked systems and software technologies
- Storage systems and databases
- Assistive Technologies
- Sensors, sensor systems and Internet appliances
- Multimedia systems and applications in education and business management
- Communications
- VLSI design, packaging, testing
- Visualization and computer graphics
- Knowledge management / data mining
- Decision support tools

Directed by Computer Engineering Professor Patrick Mantey, ITI has faculty throughout the School of Engineering and manages the participation with other research partnerships including the activities in the Center for Information Technology Research in the Interest of Society (CITRIS), with UC Berkeley, UC Davis, and UC Merced; and also has participation from the Division of Physical and Biological Science, the Division of Social Sciences, and the Arts. Web: [www.iti.ucsc.edu](http://www.iti.ucsc.edu)

## **Institute for Scalable Scientific Data Management (ISSDM)**

ISSDM is a collaboration between Los Alamos National Laboratory (LANL) and UC Santa Cruz. The ISSDM promotes and sponsors LANL/UCSC research collaborations and fosters long-term relationships with collaborators at LANL and UCSC. The current focus of these collaborations is on research in storage systems, data and knowledge management, human computation, and visual exploration and analysis of cosmology. Web: <http://issdm.soe.ucsc.edu/>

## **Storage Systems Research Center (SSRC)**

This center is composed of faculty from the Computer Science, Computer Engineering, and Electrical Engineering departments and the Technology and Information Management Program. It is funded by the NSF, Department of Energy, and companies such as NetApp, Symantec, HP, LSI, Data Domain, and Agami. Current research topics include long-term archival storage, scalable indexing and metadata, petabyte-scale storage systems, and file systems for next-generation storage technologies such as non-volatile memories and probe-based storage. Issues of particular concern include performance and scalability, reliability, and security. The SSRC's resources include several computing clusters, the largest with more than 80 processor-disk nodes, as well as over 10 terabytes of dedicated storage. In addition, there are several hardware-software testbeds for projects such as self-managing archival storage and large-scale distributed file systems. The SSRC also maintains a PlanetLab site at UC Santa Cruz, allowing researchers to run experiments on the PlanetLab global-scale distributed testbed. Web: [www.ssrc.ucsc.edu](http://www.ssrc.ucsc.edu)

## **W. M. Keck Center for Adaptive Optical Microscopy**

This interdisciplinary center's objectives are to develop enabling adaptive optical technologies and critical procedures to overcome longstanding barriers and vastly improve in vivo deep tissue biological imaging. The approach is inspired by the highly successful use of adaptive optics in the W. M. Keck Telescopes, which allows astronomers to see much more clearly and deeply into space. This center was made possible through the generous support of the W.M. Keck Foundation. Web: <http://cfaom.soe.ucsc.edu/>

## **W. M. Keck Center for Nanoscale Optofluidics**

The mission of this multidisciplinary center is the development of optofluidic devices and their application to single-particle studies in molecular biology and biomedical diagnostics. Facilities include a dedicated nanofabrication facility housing a FEI Quanta 3D FEG dual beam SEM/FIB nanofabrication instrument for fabrication, imaging, and characterization of nanoscale devices. Web: <http://cfno.soe.ucsc.edu/index.htm>

## **UCSC Genome Sequencing Center**

The center features state-of-the-art equipment including the GS FLX Titanium Series sequencing platform from 454 Life Sciences and the SOLiD sequencing platform from Applied Biosystems. Applications include whole-genome and targeted sequencing; resequencing; RNA sequencing; micro-RNA and small-RNA sequencing; chromatin immunoprecipitation (ChIP) sequencing (to identify binding sites of DNA-associated proteins); and metagenomics (also called environmental genomics, involving the analysis of genetic material recovered directly from environmental samples). Web: <http://sequencing.soe.ucsc.edu/>

## **Baskin School of Engineering (BSOE) Facilities**

BSOE occupies principally the Jack Baskin Engineering and Engineering 2 buildings. Some laboratories and offices are also in the new Biomedical Sciences and Engineering Building (completed in 2012), the Physical and Biological Sciences Building, and the Sinsheimer Laboratory Building. Outside of the main campus and on the west side of Santa Cruz, BSOE has a set of advanced material sciences laboratories at 2300 Delaware Ave. (formally a Texas Instruments semiconductor fabrication plant). Several BSOE faculty also work closely with colleagues at the adjacent UCSC Long Marine Laboratory and Marine Sciences Campus.

“Over the hill,” BSOE has created a strong presence at the UCSC Silicon Valley Campus (SVC) located at 2505 Augustine Drive in Santa Clara across the 101 Freeway from Intel, and has joint laboratory facilities at NASA Ames Research Center in Mountain View, California. Many BSOE faculty members maintain offices and teach classes at the SVC and have joint research agreements with NASA through its University Affiliated Research Center (UARC) and with a large number of companies. Many BSOE faculty are also members of the joint NASA/UCSC Advanced Studies Laboratories (ASL), which is located at NASA Ames Research Center. Web: <http://asl.ucsc.edu/>

BSOE is working to develop additional locations off the main campus often in interdisciplinary partnerships. Web: [www.soe.ucsc.edu](http://www.soe.ucsc.edu)

### **BSOE Computing Infrastructure**

Most current details regarding BSOE computing infrastructure can be found at [support.soe.ucsc.edu](http://support.soe.ucsc.edu). BSOE operates a computing network of several hundred Unix, Windows, and Macintosh computers and several computer laboratories. These labs support research and graduate instruction in applied mathematics and statistics, biomolecular engineering, computer engineering, computer science, electrical engineering and technology and information management. Undergraduate computing is supported by a combination of BSOE Undergraduate Laboratories (also known as the BELS Labs) and the campus's Instructional Computing Laboratories (IC Labs).

For graduate and research computing, the ITS/BSOE computing support team operates a high-speed 100/1000 megabit-per-second network with 1/10 gigabit-per-second fiber optic backbones and redundant core routers and paths. Most areas of BSOE buildings are covered by wireless networking of various types (802.11g/n). The BSOE computing network has redundant connections to the main campus network.

UCSC and BSOE have connections to the Corporation for Education Network Initiatives in California (CENIC) via CENIC-managed “dark-fiber,” which provides direct connections to CENIC High Performance Research Network, to activities at NASA Ames, and to the BSOE research labs located at 2300 Delaware Ave. Web: <http://www.cenic.org/pressroom/releases/2010/FibertotheFuture.pdf>

BSOE Computing also operates four separate Tier 1+ data centers, all with UPS and air-conditioning support. Two of the data centers have backup power generation and the other two use a campus cogeneration facility for backup power. In addition, BSOE uses the main UCSC data center (Tier 2) for some redundancy and for web sites and copies and/or mirrors data to distant Universities (such as the San Diego Supercomputer Center). For graduate and research computing, BSOE supports the following:

- Central file servers for core services such as mail, name service, file sharing, and backup
- Several general-access Unix systems

- Multiple compute servers
- Research computing clusters
- Several general-use research computing clusters, in addition to the clusters used by individual research groups. These clusters are available to all faculty and graduate students for general-purpose computations:
- Several graduate student computer labs with a mix of Windows, Linux, and Apple workstations and network printers
- A variety of software purchased in cooperation with UCSC central computing, BSOE computing, and individual faculty members
- A variety of computer-aided-design software, including Altera, Agilent Advanced Design System, AutoCAD, Cadence, Maple, Matlab, Mentor Graphics, National Instruments Labview, Qualnet, Synopsys, and Xilinx.

**Baskin Engineering Wireless Networking.** BSOE has an installed wireless computer (Wi-Fi) network that covers nearly all interior building spaces of the Baskin Engineering, Engineering 2, Physical Sciences Building, and Biomedical Sciences Building. The Wi-Fi network uses “eduroam,” a wireless authentication system that allows members of other confederated universities to use the UCSC wireless ~~network~~[network and BSOE personnel to use Wi-Fi networks at other Universities who participate in eduroam.](#)

**Undergraduate Engineering Laboratories (Baskin Engineering Lab Support–BELS).** BSOE operates the following special instructional laboratories for the exclusive use of engineering students. These laboratories are typically open 24 hours a day, seven days a week, during instructional quarters. The instructional labs available in 2012 are listed below. Please check the web site for updates as new instructional laboratories are being added:

- Digital Logic Design Laboratory
- Controls, Signals, and Instrumentation Laboratory
- Analog Circuits Laboratory
- Electrical Engineering Senior Projects Laboratory
- Optics and Laser Laboratory
- Computer Engineering Projects Laboratory
- Electromagnetic and Radio Frequency Laboratory
- Physical Electronics Laboratory
- Computer Networking Laboratory
- Computer Game Design Laboratory
- [Tau Beta Pi](#), Engineering Honor Society Hardware Laboratory
- Biomolecular Engineering Instructional Laboratory
- Fabrication Laboratory
- Flexible Instructional Laboratory

[A number of additional laboratory spaces are setup for three quarter sequence senior project for Electrical Engineering, Computer Engineering and Computer Science. These labs are often used by project groups whom are being sponsored by various industry partners, many of whom have headquarters or operaitons in Silicon Valley and the Monterey Bay Area.](#)

Detailed information about these labs can be found at [bels.soe.ucsc.edu/](http://bels.soe.ucsc.edu/).

**UCSC Instructional Computing Laboratories.** In addition to the facilities provided by the Jack Baskin School of Engineering, students have access to the computing facilities of the UCSC Instructional Computing (IC) Labs. These include several labs located around the campus consisting of Unix, Mac, and Windows workstations. There are two large IC Labs located in the Baskin Engineering Building. Check the UCSC Instructional Computing web site for details on these labs and hours of operation: [ic.ucsc.edu](http://ic.ucsc.edu).

### Research Laboratories

BSOE operates and supports the following research laboratories. Current information about BSOE Research Labs can be found at [www.soe.ucsc.edu/research/labs](http://www.soe.ucsc.edu/research/labs).

**Applied and Nano-optics Group.** The Applied and Nano-optics group covers a wide range of optical research with an emphasis on experimental nanoscale optics. New methods and devices are developed for optical studies of single particles such as molecules, photons, or nanomagnets. A variety of optical and nanoscale characterization techniques such as time-correlated single-photon counting, ultrafast laser

spectroscopy, or scanning-probe microscopy are used and investigated. Applications include integrated biomedical sensors, high-density magnetic memory, single-photon light sources and detectors. Web: <http://photon.soe.ucsc.edu/>

**Biomolecular Engineering Research Facilities.** BSOE supports a broad range of biomolecular-engineering (BME) research activities through the use of more than seven state-of-the-art research labs in the department. Areas of research include systems biology, comparative genomics, HIV vaccine development, stem-cell research, nano-device fabrication and DNA-sequencing-device development. BME departmental laboratory facilities include a variety of equipment used for molecular biology, cell biology, protein chemistry, immunology, virology and computational biology. Specific equipment includes high- and low-speed centrifuges, PCR machines, CO<sub>2</sub> incubators, bacterial shakers, microtiter plate readers, microtiter plate washers, microscopes (inverted, upright, fluorescence), spectrophotometers, protein-chromatography equipment, a variety of gel electrophoresis equipment including power supplies, gel dryers, gel-imaging equipment, vacuum concentrators, and cryopreservation equipment. Recently acquired and planned equipment purchases to be shared with other investigators include a Fluorescence Activated Cell Sorter (FACS), and next-generation DNA sequencing devices. Shared equipment rooms contain a variety of common equipment including freezers, glass-washing equipment, autoclaves, and refrigerators. Most labs are supplied with basic utilities such as air, gas, vacuum and reverse-osmosis de-ionized (RODI) water. The BME research groups have several computer clusters, one with more than 1,000 CPUs. There is additional access to BSOE laboratories and facilities within other departments. Many of the BME research groups cooperate closely with the Electrical Engineering Department, which operates a clean room, a scanning electron microscope and semiconductor fabrication facilities. Collaborative research with faculty from the Physical and Biological Sciences Division is frequent with routine access to a wide range of biology and chemistry laboratory facilities. Web: [www.soe.ucsc.edu/research/labs/](http://www.soe.ucsc.edu/research/labs/)

**Clean Room.** The Electrical Engineering Department operates a shared Class 1,000 clean room for use by researchers in Electrical Engineering. The Biomolecular Engineering Department also uses this facility. Web: [www.soe.ucsc.edu/research/labs/](http://www.soe.ucsc.edu/research/labs/)

**Computer Communication Research Group (CCRG).** This group is dedicated to basic and applied research in computer communication. CCRG research focuses on new algorithms, protocols, and architectures for wireless networks based on packet switching (packet-radio networks), Internetworking, multipoint communication, and the control of resources by multiple administrative authorities. Web: [www.cse.ucsc.edu/labs/ccrg](http://www.cse.ucsc.edu/labs/ccrg)

**Design and Verification Laboratory.** This lab facilitates research in software and system design methods, embedded software design, software and system verification, game theory, formal methods. Web: [dvlab.cse.ucsc.edu/](http://dvlab.cse.ucsc.edu/)

**Geospatial Visualization Laboratory.** This lab creates a consistent four-dimensional space-time visualization of geospatial data and intelligence associated with the environment. This task requires intelligent collection of data using various sensors, including a variety of cameras, LIDAR data, and multispectral imagery in all kinds of frequency bands. The spatiotemporal GIS (geographic information systems) visualization will bring together several layers of information including terrain data, street maps, buildings, environment data, aerial images, and mobile-objects data. Web: <http://www.soe.ucsc.edu/research/labs/>

**High-Speed Network Laboratory.** Members of this lab explore and expand the field of high-speed computer networking and communication. Current areas of research include high-speed switching, traffic-scheduling algorithms for providing quality-of-service (QoS) guarantees in packet networks, ATM congestion control, and optical networks. Projects are funded by NSF, ARPA, and private industry.

**Image Processing and Multimedia Laboratory (IPMML).** This lab is the central venue for ongoing research into topics in image processing and multimedia. Areas of interest include wireless digital video; virtual scene and panorama generation; natural and machine-generated image compression; video capture, processing, and editing techniques; color printing technology; image libraries; and combinations of the above.

**Information Retrieval and Knowledge Management Lab (IRKM).** This lab conducts basic and applied research in information retrieval and data mining. Projects include developing a proactive personalized information-retrieval system (funded by NSF), adaptive information filtering (funded by AFOSR), and collaborative personalized search, recommendation and advertising (with industry funding from Yahoo, Microsoft, Google, NEC, Nokia, Bosch).

**Internetworking Research Group (i-NRG).** This group conducts research in the design, experimental evaluation, and implementation of network protocols for both wired and wireless internetworks. Research activities include a number of areas in computer networks and distributed systems. Web: [inrg.cse.ucsc.edu](http://inrg.cse.ucsc.edu)

**Materials Synthesis and Characterization Research Lab.** This laboratory has recently been commissioned at our 2300 Delaware Ave. location. Formally a Texas Instruments semiconductor fabrication plant, the building has infrastructure to support very large clean rooms. At present, synthesis capability exists in metal-organic chemical vapor deposition (MOCVD) and rf-magnetron sputtering. The Materials Synthesis and Characterization Research Lab capability includes semiconductor test equipment, bulk magneto-thermal properties, and atomic force microscopy. Much of the work involves properties of materials at very low temperatures, nearly 0 degrees Kelvin. At these temperatures, materials behave very differently than at room temperature, a notable example being superconductors. Web: [www.soe.ucsc.edu/research/labs](http://www.soe.ucsc.edu/research/labs)

**Micro-Architecture at Santa Cruz (MASC).** MASC's focus is on computer-architecture research, with emphasis on energy/performance trade-offs, thread-level speculation, simulation tools, FPGAs, and design complexity. Web: [masc.soe.ucsc.edu](http://masc.soe.ucsc.edu)

**Multidimensional Signal Processing Research Group (MDSP).** This group's interests are in the area of inverse problems in imaging, statistical detection and estimation, and associated numerical methods. Current projects include image-resolution enhancement and superresolution, computationally efficient image-motion estimation, shape reconstruction from local and global geometric data, multiscale modeling and analysis of signals and images, radon transform-based algorithms for deformation analysis and dynamic imaging, image processing and inverse problems in remote sensing, and automatic target detection and recognition. The group is also associated with the Image Processing and Multimedia Lab. Web: [www.users.soe.ucsc.edu/%7emilanfar/](http://www.users.soe.ucsc.edu/%7emilanfar/)

**Network Management and Operations Lab.** BSOE, in partnership with Cisco Systems, has established this lab to serve as a "network-systems teaching hospital" where real-world problems and projects are addressed by students and faculty. Projects range from the routine (e.g., quality-assurance and release testing of new products) to the advanced (e.g., research into new architectures for network systems). Students employed as interns work with faculty researchers on these projects in BSOE facilities equipped for the specific needs of the projects. Web: [nmo.soe.ucsc.edu](http://nmo.soe.ucsc.edu)

**Quantum Electronics Group.** This group's interests are in the mutual interaction of heat, light and electricity in nano- and microscale materials and devices. Studies and experiments are done in which this mutual interaction is used to improve device or circuit performance for communication, computing or energy conversion applications. Examples include microrefrigerators on a chip that could be used to remove hot spots in microprocessor chips and internally cooled semiconductor lasers. The group has developed novel thermal-imaging techniques that can provide transient temperature maps of active devices with submicron spatial resolution. The group is also investigating optoelectronic and thermoelectric properties of quantum wire and quantum dot materials and the design of low chirp, narrow line width and widely tunable passive micro-ring-coupled lasers. The group maintains several electrooptics labs with femtosecond lasers, cryogenic and high temperature setups, confocal and Raman microscopy and houses an on-site molecular beam epitaxy thin film growth facility. Web: [quantum.soe.ucsc.edu](http://quantum.soe.ucsc.edu)

**Santa Cruz Laboratory for Visualization and Graphics.** Recent research at this lab includes animal modeling and animation, environmental visualization, isosurfaces, d.v.r., hierarchies, irregular grids, massively parallel volume rendering through the net, uncertainty visualization, virtual reality in scientific visualization, nomadic collaborative visualization, tensor visualization, and flow visualization. Web: <http://slvg.soe.ucsc.edu>

**Thin Films Research Lab.** This laboratory is located at our 2300 Delaware Ave. location. Formally a Texas Instruments semiconductor fabrication plant, the building has infrastructure to support very large clean rooms. The Thin Films laboratory operates several advanced metal organic chemical vapor deposition (MOCVD) systems to fabricate and study thin film semiconductors. Applications include advanced solar cells, memory systems, and biosensors. The Thin Films laboratory in April 2010 received an in-kind donation from Phillips LumiLEDs of Santa Clara of an AIXTRON Nitride MOCVD Reactor (AIX 200RF).

**UCSC Broadband Communications Research Group.** The members of this group investigate the fundamental limits and performance analysis of protocols in wireless ad hoc networks, space-time signal processing, and development of signal processing and coding techniques for wireless communication systems. Web: <http://www.soe.ucsc.edu/%7Ehamid/ucbc/index2.html>

**UCSC Scientific Visualization Laboratory.** This lab provides the means for creating visualizations from scientific data. Projects include a simulation of an “extensive air shower” striking the Milagro detector at Los Alamos National Lab, representing a subsonic flow over a delta-wing aircraft, a demonstration of direct volume rendering on a multiple-gridded space-shuttle launch vehicle, an N-body simulation of large-scale structure in the universe, and a representation of a diving whale based on location data from a Monterey Bay tagging experiment. Web: [www.soe.ucsc.edu/research/labs/](http://www.soe.ucsc.edu/research/labs/)

**UCSC Visual Computing Laboratory.** This lab explores visual tracking, stereo and sparse IBR, facial modeling and analysis, and image and video processing. Web: [soe.ucsc.edu/research/labs](http://soe.ucsc.edu/research/labs)  
For additional information regarding BSOE, please check the web site: [www.soe.ucsc.edu](http://www.soe.ucsc.edu).