FACULTY OF ENGINEERING
RESEARCH
The Faculty of Engineering’s research excellence is built upon strong comprehensive Computer Science, Electrical and Computer Engineering, and Mechanical Engineering Departments, as well as on Research Centres that bring together faculty and graduate students to pursue joint endeavours in research and development. UVic has demonstrated leadership in emerging fields such as alternative energies, human-computer interaction, biomedical and information sciences, and ocean engineering to name a few. Our researchers individually and collaboratively investigate a vast array of disciplinary and interdisciplinary research subjects at the cutting edge of science and engineering. The research programs are devoted to finding tomorrow’s knowledge, methods, and approaches and integrating evolving computer and engineering science with the constantly expanding spectrum of novel applications and processes. The three faculty highlighted in this issue’s Spotlight Series are young researchers with an excellent research history and promising potential. Also, the Ocean Engineering Research Group is highlighted. The Group intends to advance ocean engineering research, promote interaction amongst researchers and industry, foster an innovative research climate, and participate in shaping policies in ocean technology.

Our faculty members’ excellence in research is demonstrated by the quality of their published articles and conference presentations, and the education of highly qualified personnel. This naturally has led to our participation in several provincial and federal Centers of Excellence as well as research partnerships with government laboratories, industry and other universities in Canada and worldwide. In 2007, the Engineering faculty was successful in obtaining over $20M in external grants, including a $10M CFI/BCKDF grant to build a state of the art microscope, research contracts and funding for research chairs. Additionally, graduate students are an essential part of our research program and it is noteworthy that the annual Graduate Innovation Forum is steered by students to showcase their graduate theses research.

The Office of Associate Dean Research supports the research efforts of all faculty members in the Faculty of Engineering, provides mentoring for our new research faculty, facilitates and fosters industrial collaboration and research programming, and identifies and disseminates research opportunities and collaborations.
Spotlight on Computer Science

Geographically Distributed Software Development

Daniela Damian is an Associate Professor in the Department of Computer Science, where she leads the research in the Software Engineering Global interAction Laboratory (SEGAL, segal.uvic.ca). Her broad research interests include Software Engineering, Computer-supported Cooperative Work and Human-Computer Interaction. Daniela held an NSERC UFA Award (2002-2007) and is an IBM Visiting Research Fellow.

Daniela and her research team are interested in designing and evaluating methodological and technological support for collaborative tasks in software engineering. Drawing on existing research as well as insights from industry practice, SEGAL projects address issues of requirements engineering, knowledge management, and communication and coordination in software development, with a special focus on the collaborative work of geographically distributed software teams.

Global software development is increasingly becoming common practice in the software industry. However, the rapidly increasing globalization of software industry creates software engineering challenges due to the impact of temporal, geographical and cultural differences, and requires development of methodologies, techniques and technologies to address these issues.

Collaborations with industry partners such as IBM, Siemens, Dell and Unisys are providing SEGAL researchers with insights into current software development practice such that to develop theories and collaboration tools for global software development.

Our current projects developed a number of Team Awareness and Coordination Mechanisms.

For example, the Feature Awareness Team Explorer (FATE) prototype builds upon the IBM’s Jazz platform to expose and visualize software artifact clusters and social interactions across artifact clusters, aiming at providing awareness and supporting coordination in teams who are actively managing work and social dependencies in their workspace. Similarly, the Related Contributors prototype leverages the implicit and explicit relationships among work items in a project to identify coordination needs among contributors and provide a ranked list of people who are most related to one’s work. Further, we are conducting in-depth observational case studies of practices of communication and awareness in large development teams at IBM and Dell. Our research methodology uses social network analysis to unveil patterns of communication, collaboration and awareness in groups working on same or inter-related software features, and to inform the design of mechanisms that would overcome the challenges of distributed communication in software teams. Finally, a large longitudinal study of patterns of distributed software development practice evolution within offshore wholly-owned subsidiaries aims to understand the differences between offshore outsourcing and internal offshoring, and then to propose a model that encompasses the evolution of software development activities within and among several subsidiaries owned by an organization.

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As seventy percent of our planet is covered by water, understanding the ocean is vitally important for the future of our mother planet. Motivated by this, people have been developing sensing technologies and underwater transportation systems, and we are now ready to exploit the underwater world. However, there are very limited communication solutions possible underwater. Due to the severe environment and transmission medium, there are as many opportunities as there are challenges for underwater communications. This beckons for innovations and major breakthroughs.

The University of Victoria (UVic) is considered one of the best places for underwater communications and networking research and development, because not only is it located on an island surrounded by the Pacific, but it also owns two revolutionary cabled seafloor observatories.

The world-leading cabled infrastructure can provide high speed connectivity from the seafloor to the ground. Sensor nodes and unmanned vehicles can further exploit the wide-area, three-dimensional underwater space using new wireless technologies tailored for underwater environment.

The UVic research group led by Dr. Lin Cai will investigate three areas critical to the design, deployment, and operation of underwater wireless networks:

a) Resource management schemes, medium access control and routing protocols to efficiently utilize the premium wireless resources and preserve energy consumption;

b) Self-deployed and self-configured underwater network services; and

c) Understanding network performance limits and trade-offs.

It is anticipated that the underwater ubiquitous networking solutions proposed by the UVic researchers will enable real-time oceanographic data collection on pollution, weather, and disaster monitoring, interaction and real time control of unmanned/autonomous underwater vehicles, and other navigation and surveillance applications.

For more information please contact: Lin Cai - cai@ece.uvic.ca.
Researchers of the Subsea Robotics Lab work to advance undersea technologies that are the means for offshore exploration, science, and economic development occurring off Canada’s Pacific coast. Dr. Buckham’s research team focuses on Remotely Operated Vehicles (ROVs) and moored offshore structures including domestically developed Wave Energy Converters (WECs). In each of these areas, the Subsea Lab personnel and its industrial partners blend expertise in computer dynamics simulation and hardware design and operation to improve the ability of Canadians to interact with the undersea environment and extract energy from the sea surface.

**Remotely Operated Vehicle Technology**
Underwater tethered ROVs are versatile and reliable platforms with which it is possible to explore and interact with the submerged world. To exploit the full capabilities of the ROV and its robotic limbs, a guiding human presence is necessary and so the communication provided by the tether is vital. However the long tether complicates ROV operation as the drag and weight of the tether significantly disturb the ROV motion, and in some cases make operation of the vehicle impossible. The Subsea Robotics Lab has developed a state-of-the-art dynamics simulator that can be adapted for the particulars of any ROV platform. Simulations have been used to redesign ROV systems as well as to evaluate new navigation and control algorithms for ROVs. Recent developments include the modeling of cabled systems with rapidly varying scope and vortex induced vibration.

The Subsea Robotics Lab partners with Suboceanic Sciences Ltd. to implement the navigation and control work. The experimental platform is a Seaeye Falcon ROV equipped with a 5-function Hydrolek manipulator and three positioning devices: sonar, a Doppler velocity log, and an inertial measurement unit. Currently, a spatial joystick is being integrated into the human-machine interface which will allow for advanced redundancy resolution algorithms to be implemented on the Falcon which coordinate the ROV and manipulator motions. Together, the spatial joystick and the redundancy resolution algorithms make detailed undersea interventions possible using an inexpensive, portable platform such as the Falcon. Dr. Buckham collaborates with Dr. Podhorodeski and Dr. Constantinescu on the Falcon development.

**Wave Energy Conversion**
Over the past two years Dr. Buckham has worked closely with SyncWave Energy Inc. in the development of a new floating wave energy converter (WEC). This work has included conceptual analyses of early pneumatic systems and analysis of test data acquired from a proof-of-concept prototype built and tested in 2006. The current prototype uses an internal tuning mechanism that is isolated from the harsh ocean environment, and affords easy adjustment of the natural frequencies of the floating components. Dr. Buckham’s involvement with Syncwave has produced a US provisional patent application in 2006 and 2007.

For further information please contact:
Brad Buckham - bbuckham@me.uvic.ca.
Ocean Engineering Research is vital to the long-term well being of the entire planet. At the University of Victoria, in the Faculty of Engineering, the Ocean Engineering Research Group (OERG) is focused on innovative ocean technology development and leadership within the global academic community.

The OER Group develops advanced technologies for studying, working in, and exploring all facets of the world’s oceans, lakes and rivers. Faculty and students within the group share a keen interest in the aquatic environment and have a wide range of academic and engineering expertise in subsea technology research and development. In addition to being a strong supporter of both graduate and undergraduate student led technology developments and initiatives (e.g. the AUVIC program), the OER Group also facilitates academic and industrial collaborations across the disciplines of engineering, science and the humanities.

In addition to students, we are also keen to meet and work with other researchers and industrial partners who share our passion for oceans and lakes and who are looking for opportunities to participate in innovative ocean technology research. The objectives of the group include:

1 - To develop advanced technologies for studying, working in, and exploring all facets of the world’s oceans, lakes and rivers.
2 - To foster the development of ocean centered academic and industrial collaborations across the disciplines of engineering, science and the humanities.
3 - To attract academically strong students with a passion for the aquatic environment and to substantially advance their education and opportunities for future academic and/or industrial contributions through classroom, laboratory and field research participation.
4 - To disseminate information about Ocean Technology research and development taking place within the Faculty of Engineering at UVIC by providing a centre for information seekers.

Research at the OER Group covers a broad spectrum of activities both above and below water. Research interest and activities; Autonomous and Remotely Operated Underwater Vehicles, Manipulator Control, Biomimetic Propulsion, Undersea Real-time Networked Observatories, High Resolution Acoustic Imaging and Mapping, Image Processing, Acoustical Oceanography, Acoustic Communications, Subsea Navigation, Ocean Power Generation, Marine Mammal Tracking, and Benthic Monitoring. For more information please see our website www.oer. engr. uvic. ca

The OERG Group Members: Dr. Lin Cai (ECE) Dr. Paul Kraeutner (Adjunct, ECE), Dr. Colin Bradley (ME), Dr. Adam Zielinski (ECE), Dr. Brad Buckham (ME), Dr. Curran Crawford (ME), Dr. Afzal Suleman (ME) and Dr. Alexandra Branzan Albu (ECE)
The Faculty of Engineering is proud to welcome its newest faculty

Computer Science

Dr. Brian Wyvill
Professor and Canada Chair, Tier 1
Implicit Modelling and Non-Photorealistic Rendering (NPR), Modelling and Animation for Computer Graphics

Mechanical Engineering

Dr. Curran Crawford
Assistant Professor
Wind & Tidal Turbines, Multidisciplinary Optimization, Design of Sustainable Energy Systems

Dr. Martin Byung-Guk Jun
Assistant Professor
Miniature or Micro-Scale Machine Tools, Manufacturing Processes and Systems
Research Interests

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Advanced Materials and Related Technology
Aerospace Engineering
Applied Electromagnetics
Approximation Algorithms
Autonomic Computing
Bioinformatics
Biomedical Technology
Coding Theory
Combinatorial Algorithms
Communications
Computational and Continuum Mechanics
Computational Complexity
Computational Electromagnetics
Computer Architecture
Computer Communications and Networks
Computer Graphics
Computer Supported Collaborative Work
Computer Vision
Computer-Aided Design, Engineering and Manufacturing
Cryogenics
Cryptography
Data Mining
Database Systems
Digital Signal Processing
Digital System Design
Embedded Systems
Fuel Cell and Electric Hybrid Vehicles
Global Software Development and Interaction
Graph Algorithms
Grid Computing
Human Computer Interaction (HCI)
Hydrogen Fuel Cell Technology
Implicit Modelling and Non-Photorealistic Rendering (NPR)
Information Security and Object Technology
Integrated Circuits and Devices
Integrated Energy Systems
Manufacturing Processes and Systems
Mechatronics Systems
Medical Imaging and Informatics
Micro Mechanical Systems
Microfluidics
Microscale Machine Tools
Microwave Systems
Microwave, Millimeter Wave Theory and Applications
Middleware Engineering
Modelling and Animation for Computer Graphics
Modelling and Verification of Software Systems
Multidisciplinary Optimization
Music Information and Sound Technology
Nano-electronics and Nanotechnology
Network Protocols
Network Security
Neural Networks
Numerical Analysis
Optical Systems and Technology
Parallel and Distributed Computing
Parallel and Intelligent Systems
Parameterized Complexity
Pervasive Systems
Power and Energy Aware Computer Architecture
Power Electronics and Drives
Program Comprehension
Pulp and Paper Technology
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Requirements Engineering
Robotics, Mechanisms and Mechatronics
Security Engineering
Sensor Networks
Signal Processing in Communications
Software Architecture
Software Engineering
Software Evolution
Software Repositories
Software Reverse Engineering
Software Visualization
Sustainable Energy Systems
System Dynamics and Control
Thermo-fluids and Transport Phenomena
Ultra-Wide Band Communications
Underwater Acoustics
Video Signal Processing
VLSI Design and Test
Wind & Tidal Turbines
Wireless Communications and Networks

Research Centres

IESVIC
www.iesvic.uvic.ca

LACIR
web.uvic.ca/~lacir

CAMTEC
camtec.uvic.ca

Engineering Website Directory

Faculty of Engineering
www.engr.uvic.ca

Computer Science
www.csc.uvic.ca

Electrical and Computer Engineering
www.ece.uvic.ca

Applying to the Faculty of Engineering
www.engr.uvic.ca/prospective.html

University of Victoria
www.uvic.ca

Software Engineering
www.bseng.uvic.ca

Mechanical Engineering
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Faculty of Engineering Degree Programs
www.engr.uvic.ca/degrees.html