ICICS
Director's Corner

In this issue of FOCUS, my final as ICICS director, I reflect upon the challenges and rewards of guiding ICICS over the last ten years. I have promoted a collaborative, interdisciplinary approach to human-centered research during my time as director. In this spirit, I wish to thank my colleagues, whose enthusiasm and creative ideas over the years have made my job much easier. They are a fun, infinitely resourceful group, and I will miss working with them on a daily basis.

ICICS has grown from 60 to over 160 members in the last decade. We profile in this issue some of the innovative work emerging from the new lab space we have built to accommodate them.

ICICS researchers in the Microsystems and Nanotechnology (MiNa) research group are investigating and developing novel micro- and nano-scale devices and systems for applications such as nano-computing, printing of circuitry, neural implants for prosthetic control, and cellular-level imaging.

Civil Engineering professor Sheryl Staub-French is looking at collaborative computer systems that will make it easier for construction professionals to share information across distance and time.

Please join me in welcoming Nimal Rajapakse as ICICS director effective July 1, 2007. As head of Mechanical Engineering at UBC since 2000 and a deeply committed ICICS member and advisor, Nimal is well acquainted with the inner workings of ICICS, and has a clear vision for its future. I know that ICICS will flourish under his direction.

Rabab Ward, ICICS Director

Ward: ***Continued from page 1***

Today, these partners include BC Hydro, Boeing, General Motors, Hewlett-Packard, IBM, Motorola, Nortel Networks, Nissan, Powertech Labs, Shaw Communications, Sierra Wireless, Sony, Weyerhaeuser Inc., and Xerox.

"I had a lot of help and expertise to rely upon," emphasizes Ward, acknowledging KD Srivastava and Jim Varah, who were involved in the early stages, as well as Kellogg Booth, Sid Fels and a host of others integral to the ICICS vision.

Crafting Consensus

"One of the biggest challenges was to build a consensus among the group, particularly with respect to office space, labs and equipment," admits Ward. "We involved the researchers themselves and I tried to ensure that everyone was well-represented on various committees." With the number of faculty snowballing, meeting the needs of all stakeholders was a formidable task, requiring considerable interpersonal skills—and the ability to counsel, coax and craft consensus among such a large and disparate group. "I believe in personal contact," she says. "Discussing issues over the phone or in meetings is very important." Under her warm, soft-spoken exterior, Ward clearly has the power of persuasion.

The new ICICS building—one of several facilities now used by ICICS researchers across campus—opened in 2005 and houses 30,000 sq. ft. of cutting-edge equipment and 25 dedicated research labs. In addition, common labs are available to all researchers. These include an observation studio, interactive workrooms, physical simulation and measurement lab, sound studio, digital media studio, and human measurement lab. "The common labs were designed to facilitate collaborative research, which is one of the major aspirations of ICICS," states Ward.

Infrastructure Inspires Innovation and Collaboration

The scope of study now undertaken at ICICS is staggering, and collaborations involve leading researchers from across UBC, Canada and around the world. Nationally, ICICS members are key players in the Joint Infrastructure Interdependencies Research Program (JIIRP), funded by the Natural Sciences and Engineering Research Council and Public Safety and Emergency Preparedness Canada. JIIRP involves six partner projects at universities across Canada. ICICS researchers lead the largest project—a $1.1 million initiative that involves BC Hydro, BC Transportation Commission, TELUS, and the Greater Vancouver Regional District. ICICS members from ECE, CS, ME, Commerce, Psychology, and Geography are working to develop real-time simulation tools for the continent-spanning infrastructure systems that would be called into play—or compromised—by catastrophic events (*FOCUS* Fall 2005).

International collaborations under Ward's directorship include eight research projects in the applied sciences funded by the National University of Singapore, with ICICS providing the lab space and much of the equipment. In another international collaboration, ICICS members worked with Shanghai Jiaotong University, Shanghai Post & Telecom, BCT, TELUS, and Nortel China to investigate ways of improving China's telecommunications sector.

More specific projects include the computer vision software for AIBO, the Robotic Dog, developed by ICICS researchers in the Lab for Computational Intelligence, and licensed by Sony. The technology can also be used in robotic vacuum cleaners, lawn mowers, etc., and to help elderly people with security-type applications, cooking, and cleaning. Other projects include image analysis for biomedical applications; data mining to improve lung cancer treatment; a technique for finding the mechanical parameters of tissue that can be used in the diagnosis, prognosis, and treatment of prostate cancer; and a daily planner program for people with aphasia (who have lost the ability to recognize words) that will allow them to record meetings and appointments using images and sounds.

Continued on page 8

Toward Digital Environments for Design and Construction Coordination

Civil Engineering professor Sheryl Staub-French is working on digital environments that will allow construction professionals to coordinate designs in 3D, and collaborate across distance and time.

- **Design Coordination**
- **3D Modelling**
- **Digital Collaboration**

> **"Our goal is to better understand how digital environments can support the design and construction process."**

Collaboration is bred in the bone for a civil engineer. While working on her PhD at Stanford, ICICS member Sheryl Staub-French collaborated with a company on 3D modelling to support design coordination, cost estimating and scheduling in building construction. When UBC Properties Trust learned of her experience in this area, they approached her to model some of the building systems in the Chemical and Biological Engineering building then being constructed. The 3D computer-aided design (CAD) model her student created from schematic drawings identified over 50 potential conflicts before construction, saving many thousands of dollars.

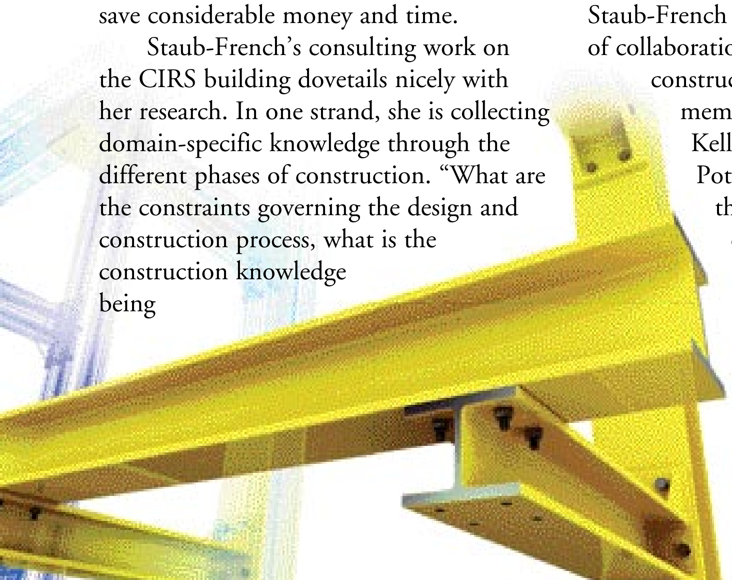
Impressed, UBC Properties Trust bid out the Centre for Interactive Research on Sustainability (CIRS) building as a 3D project, and brought Staub-French in to facilitate the 3D modelling process. "It's a different way of working for everyone when you move to 3D," she says. "It requires a coordinated effort around how you develop your designs, because now you're collaborating electronically and trying to leverage the integrated models for a variety of purposes." The "what-if" scenarios this approach permits will likely save considerable money and time.

Staub-French's consulting work on the CIRS building dovetails nicely with her research. In one strand, she is collecting domain-specific knowledge through the different phases of construction. "What are the constraints governing the design and construction process, what is the construction knowledge being considered, how do different design decisions impact construction cost?" Staub-French aims to build this reasoning into her models.

In the other strand of her research, Staub-French is looking at the nature of collaboration during the design and construction process. Fellow ICICS members and computer scientists Kellogg Booth and Rachel Pottinger are contributing their respective expertise in collaborative technology and information integration, through a 3-year NSERC Strategic Projects grant with Staub-French as Principal Investigator. Melanie Tory of the University of Victoria is working on information visualization aspects of the project.

The researchers are observing the interactions that take place during design and construction meetings—annotations made to drawings, group and side conversations, note-passing, etc.—with a view to understanding how digital environments might better support the process. For example, annotations to a 3D model made on a tablet computer during a meeting could be reviewed at a later date, or in real time at a different location.

Continued on page 8



Ingenuity + Infrastructure = Innovation

Aided by a new suite of laboratories opened in the summer of 2005, ICICS researchers are making more breakthroughs than ever before.

Engaging the Technology of Touch

Most current technological devices make only rudimentary use of our sense of touch—or haptics. The Sensory Perception and Interaction (SPIN) research group, led by Karon MacLean, uses a host of ICICS facilities to explore how haptic feedback can enhance and improve our interaction with—and use of—technology. MacLean and her group are interested in learning how haptics can facilitate the communication of both abstract information and emotion, and how this can be incorporated into information applications.

The smaller devices such as cell phones, PDAs and portable media players become, the more difficult they are to control and navigate. In addition, user notification, such as a phone ringing during a meeting or movie, can be intrusive and annoying. In collaboration with colleagues at McGill, SPIN researchers have developed haptic technology to improve navigation and notification in handheld mobile devices. They have developed a prototype that uses piezoelectric actuators (crystals that generate an electric charge in response to mechanical stress) to produce a series of different skin-stretching sensations. "The McGill team led the hardware evolution and our ICICS team handled the perceptually-driven application and design," says MacLean. "We conducted a series of studies to learn how people can use these novel sensations to get detailed information from a handheld display." **Contact: maclean@cs.ubc.ca or visit www.cs.ubc.ca/labs/spin**

Playing in Sync

ICICS member Keith Hamel from UBC's School of Music is developing a software environment that facilitates interactive music and video performance. Live performances by instrumentalists trigger various electronic sounds, real-time processing effects and video images. Hamel's software allows musicians to synchronize their performances with the computer-generated sound and video. "Once the ICICS Open Media Environment (OME) is fully functioning, it will be an ideal space for presenting multimedia works like these," says Hamel. The OME is designed to be a focal point for interactive multimedia performances involving ICICS faculty and students, and artists from all over the world. **Contact: hamel@interchange.ubc.ca**

Understanding Unwanted Effects of Parkinson's Disease Medication

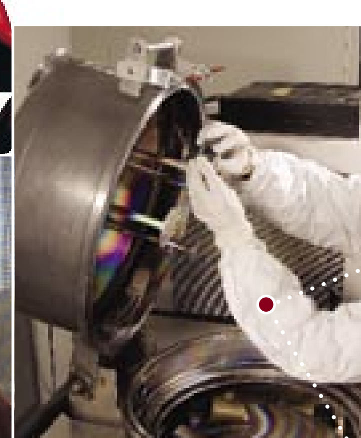
Parkinson's disease (PD), the second most common neurological disease after Alzheimer's, is characterized by slowness of movement, stiffness and tremor. Dr. Martin McKeown, member of the Pacific Parkinson's Research Centre and of ICICS, is studying the effects of medication on Parkinson's disease patients. Some brain chemicals such as dopamine—the one deficient in PD—are released from brain cells that have two modes of activity. "Steady-state" or "tonic" activity refers to activity that is sustained at the same level over long periods of time. "Transient" or "phasic" modes refer to abrupt bursts of activity.

Dopamine normally has complex, incompletely understood effects in the brain, but the steady-state activity appears more related to motor performance and the transient activity more related to reward-seeking behaviour. The drugs used to replace the deficient levels of dopamine in PD attempt to increase the steady-state activity to within normal levels, but this may result in unintended consequences on transient activity. For example, PD patients taking dopamine-replacement therapy to improve their motor performance occasionally develop problems with impulsive behaviour, such as pathological gambling or hypersexuality.

Medical researchers measure transient brain activity with electroencephalography (EEG) and muscle activity with electromyography (EMG). Dr. McKeown's lab is using ICICS' high-resolution projection screens to observe the effects of visual stimuli on EEG and EMG activity and to study various aspects of movement in PD patients, including frequency, force production, visual guidance, and task ordering and timing. ICICS members Jane Wang and Victor Leung are assisting with the wireless and sensor hardware used in the acquisition of the data and in the analysis of the acquired data. **Contact: mmckeown@interchange.ubc.ca**

Pioneering Tiny, Powerful Technology

The fifteen researchers in ICICS' young, dynamic Microsystems and Nanotechnology Group are making quantum leaps in the development and fabrication of these emerging technologies.



The prefixes micro and nano have become buzzwords for powerful technology so small that it seems to belong to the realm of science fiction, not science (one nanometre is one-billionth, or 10^{-9} of a metre). Yet, the devices under development by ICICS' Microsystems and Nanotechnology (MiNa) group promise a host of real-world applications. "In the next five to fifteen years this will be the dominant technology, so our goal is to be leaders in the design and fabrication of future systems," says ECE's Lukas Chrostowski. The group currently has six main research foci: biomedical devices, nano-devices and computing, energy, optical communications, sensors and actuators, and micro- and nano-fabrication technology development.

Nanotubes, Nanowires and Nano-electronics

Carbon nanotubes are single molecules of carbon rolled up to form tubes, which have unique electronic and mechanical properties. Alireza Nojeh and MiNa colleagues are working on both single-walled and multiple-walled nanotubes (layers of cylinders inside each other) to better understand their intriguing properties in order to apply them to an array of potential industrial uses.

One potential application for single-walled nanotubes is electron emitters for flat-panel displays, which combine high quality visuals with long product lifetime and low cost. "It's the best of both worlds," says Nojeh. "This technology provides the high brightness and wide viewing angle of old cathode ray tubes with the thinner and lighter structure of the flat-panel technology." Other applications include high-resolution electron microscopes, electron beam lithography, high frequency transistors, and chemical and biological sensors.

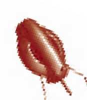
Nanowires are similar to carbon nanotubes, in that they are very long only in one dimension. However, nanowires can be fabricated from both organic materials, such as carbon and DNA, and inorganic materials, such as metal oxides. One of the main attractions of nanowires, and nanotechnology in general, is that their electrons are confined in two dimensions, and the tighter the confinement, the more marked the quantum-mechanical properties. Nanowires of silicon and other inorganic composites have applications in integrated circuits, photonics, solar cells, and displays. ECE professor Peyman Servati has fabricated photo detectors from silicon composite nanowires that exhibit extremely promising light sensitivity, and which could be used for developing future solar cells.

Advances in Nano-computing

In current computer hardware, logic gates and wires a fraction of a micron wide are fabricated onto a silicon chip. However, as these components become smaller—the size of a few atoms—the laws of classical physics break down and the rules of quantum mechanics take over. Group members are working on several aspects of nano-computing, including device simulation (ECE/ICICS' Nojeh, Konrad Walus, David Pulfrey), device fabrication (Nojeh, Servati) and nano-device circuit and systems simulation (Walus). In another complementary and essential area, Walus and ECE/ICICS colleague André Ivanov are researching the design and testability of nanoelectronic circuits. "Many of these nanoscale devices have relatively poor reliability and exact fabrication and connection of the 100 million or more components that are in current computers may not be possible," notes Walus. "It is imperative that we develop new methodologies to design and test these future circuits."

Inkjet Technology "Prints" Bio-materials

One exciting research direction in the MiNa group is the application of inkjet



Continued on Page 7