INSTITUTE FOR COMPUTING, INFORMATION AND COGNITIVE SYSTEMS •I•C•I•C•S•

FOCUS

SPRING 2009 | VOL.20 | NO.1

Modelling the Behaviour of Complex Fluids

Mechanical Engineering Professor Dana Grecov takes a three-pronged approach to characterizing complex fluids. Pg.02

P2P: Peer-to-Peer
Back Page

UBC
THE UNIVERSITY OF BRITISH COLUMBIA

DIRECTOR'S CORNER

IN THIS REDESIGNED ISSUE OF FOCUS, we take you from the nanoscale of carbon nanotubes to the macroscale of earthquake engineering.

Dana Grecov (ME), featured in our cover article, characterizes the properties of complex fluids such as joint fluid and biolubricants.

Alireza Nojeh (ECE) investigates the electron-emission properties of carbon nanotubes for a variety of applications, including electron microscopy.

Earthquake engineer **Carlos Ventura** (CIVIL) brings 30 years of experience to bear on his seismic assessments of structures and regions.

Karen Cheung (ECE) designs biomedical microdevices, including neural implants and lab-on-a-chip devices for culturing and characterizing cancer cells.

We also introduce you to **Tyseer Aboulnasr**, the new dean of Applied Science at UBC, and give you an update on ICICS' Master of Software Systems program, now in its tenth year. Our planned partnership with the Peter Wall Institute for Advanced Studies is now a reality, and we outline the programs jointly funded by our two institutes. **Clarence de Silva** (ME) has been elected a Fellow of the Royal Society of Canada, the highest honour a researcher working in Canada can achieve. We touch on his work in a short article.

We hope you like the new look of FOCUS. As always, we welcome your feedback.

Nimal Rajapakse, ICICS Director

COVER ARTICLE

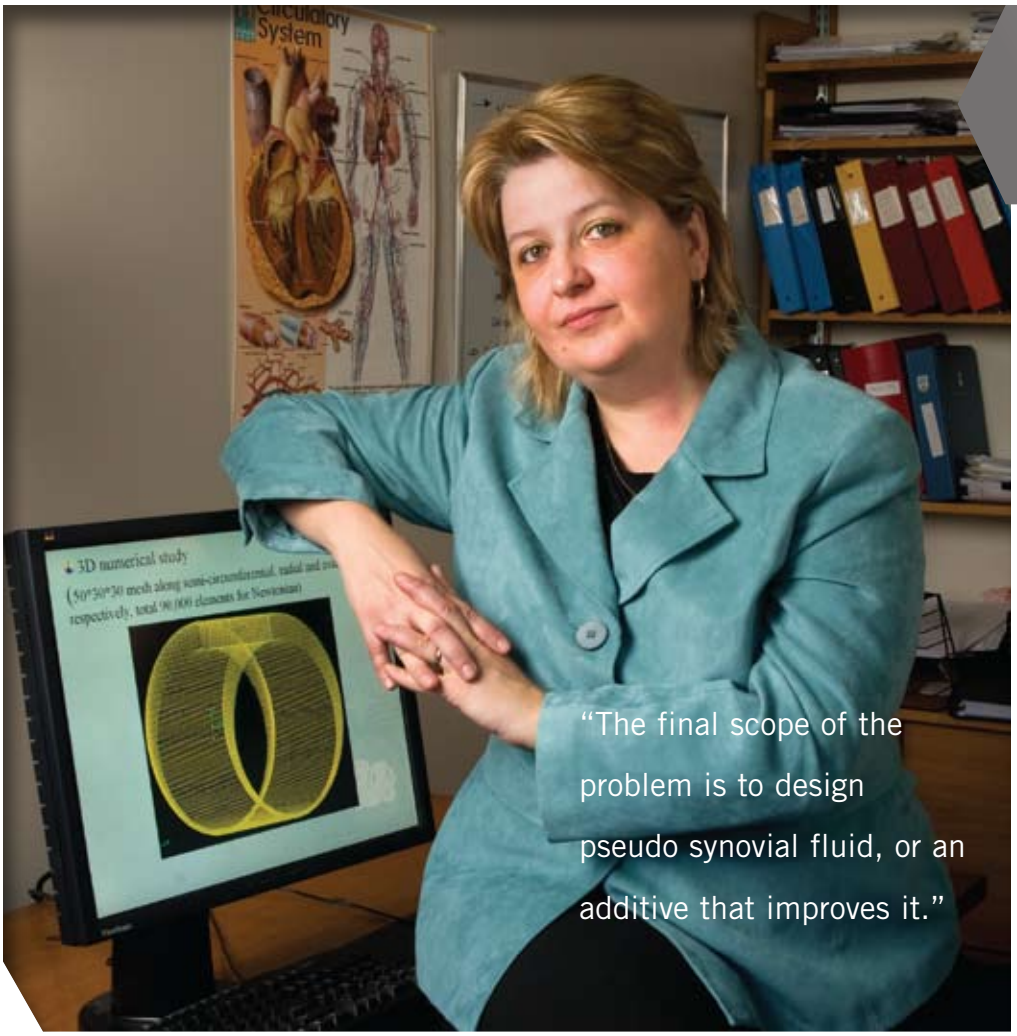
Modelling the Behaviour of Complex Fluids

MECHANICAL ENGINEERING PROFESSOR DANA GRECOV TAKES A THREE-PRONGED APPROACH TO CHARACTERIZING COMPLEX FLUIDS.

IN THE MID-1960S, Heinz ketchup was billed as "The slowest ketchup in the West," and sales soared. But scientifically characterizing non-Newtonian fluids like ketchup—or joint fluid—is much more difficult, because their viscosity is not constant. Dana Grecov, a Peter Wall Institute Early Career Scholar from 2007–08 and a member of UBC's Laboratory for Complex and Non-Newtonian Fluid Flow, uses mathematical modelling, numerical simulation, and experimentation to characterize and optimize complex fluids.

SYNOVIAL FLUID AND OSTEOARTHRITIS

Lubricants such as synovial (joint) fluid support loads through their viscous properties, while their elasticity keeps the lubricant in place after being deformed by applied forces—walking, for instance, in the case of a knee joint. The load-bearing capacity of a joint diminishes as the viscoelasticity of its fluid decreases, making it more likely that cartilage will contact bone. In osteoarthritis (OA), the most common joint disorder associated with aging, the breakdown of cartilage causes pain and stiffness. Grecov, in collaboration with Drs. Pierre Guy (Orthopaedics/BioMed Eng) and Ezra Kwok (BioMed Eng/ChemBio Eng), is developing complex mathematical models and numerical simulations of the rheological properties of synovial fluid, such as viscosity, viscoelasticity, and pressure gradients under stress. She plans to validate her models and compare healthy and diseased synovial fluid using an advanced rheometer, which measures flow response to applied forces. She will then correlate her results with radiological findings. "The final scope of the problem," Grecov says, "is to design pseudo synovial fluid, or an additive that improves it." She will also look at the microstructure of synovial fluid, to determine whether its molecules align in a load-bearing way when subjected to flow, or an electric or magnetic field. Her work in this area may help establish a scientific basis for future therapeutic devices.



"The final scope of the problem is to design pseudo synovial fluid, or an additive that improves it."

- Numerical Simulation
- Synovial Fluid
- Biolubricants

BIOLUBRICANTS FOR BEARINGS

Liquid crystals, which lie somewhere between a liquid and a solid, are known to have a structure that aligns under flow conditions, making them a good lubricant candidate. Liquid-crystal biolubricants based on vegetable oils have been shown to perform better than petroleum-based lubricants in chainsaws. Grecov, supported by Calgary-based Greenland Corp, is characterizing and correlating the structural and rheological properties of a canola-based biolubricant for use in journal bearings such as door hinges and wheel bearings. She has already established through numerical simulations that increased viscoelasticity increases the biolubricant's ability to reduce friction. By adding dynamic measurements to her model, including the effects of torque and cessation of flow, Grecov hopes to develop a predictive tool for designing inexpensive, biodegradable alternatives to petroleum-based lubricants. Given the ubiquity of journal bearings, a biolubricant for them that is more efficient, cheaper to produce, and more environmentally friendly than conventional petroleum-based lubricants would be a significant advance.

IMPROVING INDUSTRIAL PROCESS FLOWS

Many industrial processes are refined by trial and error, based on the experience of plant personnel. The ability to predict, even roughly, the effect of parameter adjustments on output would save an enormous amount of time and money in large-scale processes. Grecov, together with ICICS member Martha Salcudean (ME), has helped Syncrude Canada Ltd. achieve such savings. She simulated the multiphase flows involved when bitumen, the heavy crude oil extracted from the Alberta oil sands, is diluted with naphtha for transmission through pipelines. By combining different mathematical models and developing appropriate numerical solutions, she was able to provide a package Syncrude can use to optimize transport of their product. "These simulations may not be perfect," she concedes, "but they do lead to more focused trials, based not just on past practice." In another industrial flow project, she and Salcudean are modelling the production of clinker, the basic ingredient in cement, for Lafarge North America.

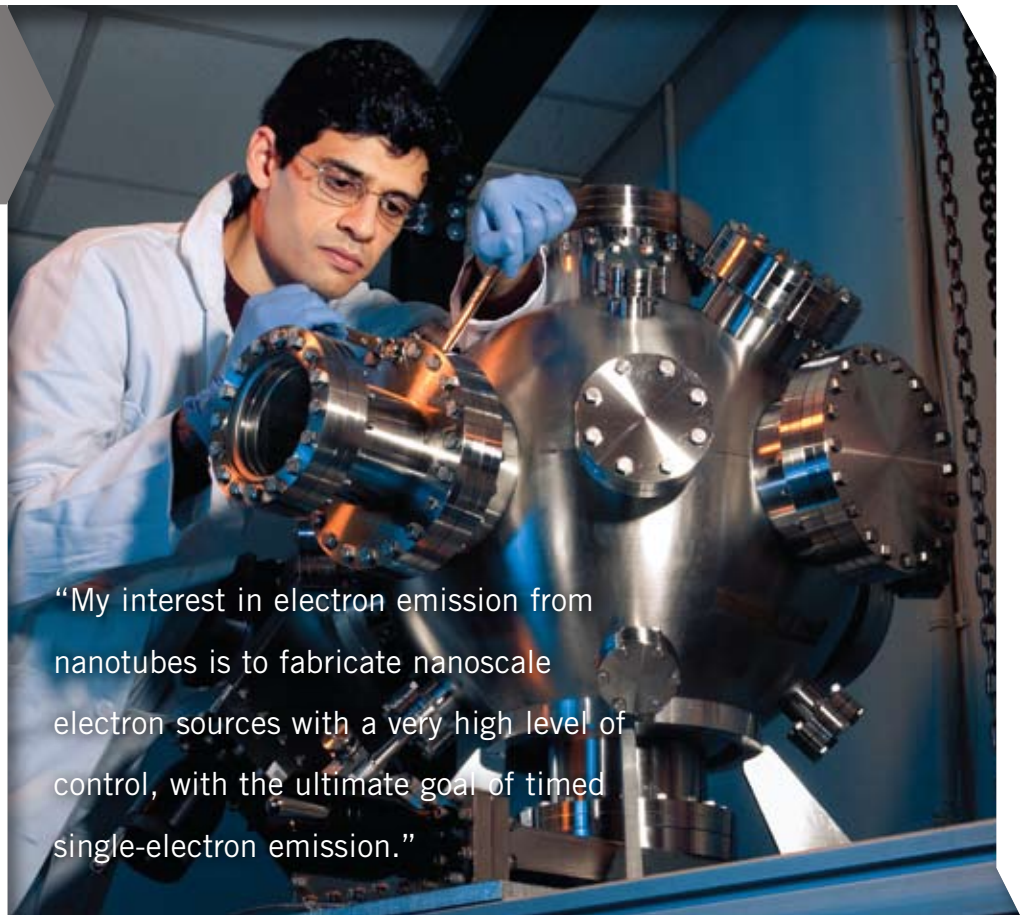
The strength of Grecov's simulations lies in their comprehensiveness. By squarely addressing complexity, she is providing solutions to some of the more difficult problems in her field.

Dana Grecov can be reached at 604-822-6710 or dgrecov@mech.ubc.ca

Harnessing the Properties of Carbon Nanotubes

ELECTRICAL AND COMPUTER ENGINEERING PROFESSOR ALIREZA NOJEH STUDIES THE ELECTRON-EMISSION PROPERTIES OF CARBON NANOTUBES FOR DIVERSE APPLICATIONS.

- Carbon Nanotubes
- Controlled Electron Emission
- Vacuum Nanoelectronics



CARBON NANOTUBES (CNTs) are carbon molecules in the form of single or multi-walled tubes a few nanometres in diameter and up to several centimetres in length. At these small diameters, quantum mechanical properties become important—electrons when excited can travel only along the tube, and are far less subject to scattering than, for example, in traditional semiconductors, where they travel in many directions. Alireza Nojeh sees great potential for nanoelectronic devices in this key property of CNTs: "In a nanotube," he says, "an electron can move microns without hitting anything, which potentially could lead to very high-speed operation." There is, however, significant randomness in the fabrication of nanotube devices, which Nojeh is working to overcome to help pave the way for practical applications.

BUILDING A BETTER NANODEVICE

Nojeh, part of ICICS' Microsystems and Nanotechnology research group, works with single-walled nanotubes because of their unique electron-emission properties. In the chemical vapour deposition (CVD) process he uses to manufacture nanodevices, catalyst nanoparticles such as nickel or iron are placed on a substrate where nanotube formation is desired, a microelectrode in the case of CNT transistor fabrication. Carbon feedstock in the form of methane or ethylene gas is fed into the CVD reactor and heated. If the conditions are right, nanotubes will grow at the catalyst site, connecting with an adjacent microelectrode in perhaps one out of twenty instances. For commercial production of CNT-based circuits, however, this process must be vastly improved.

Nojeh is looking at the effect of electric fields and the flow of the feedstock gases in aligning the nanotubes and creating more complex nanotube structures. "We are trying to harness these factors in a more efficient way," he says, "so we end up getting more of the devices we want."

SOURCING ELECTRONS

During his PhD work at Stanford, Nojeh demonstrated electron-stimulated electron emission from the tip of single-walled carbon nanotubes into a vacuum. He observed that for every electron hitting the tip, many electrons were emitted, establishing CNTs as a high-gain electron source and also explaining why they can easily be seen in an electron microscope. He provided a possible explanation of these phenomena through quantum mechanical modelling, and continues to work on characterizing electron emission from CNTs using a variety of mechanisms such as field-emission and photo-emission. "My interest in electron emission from nanotubes," Nojeh says "is to fabricate nanoscale electron sources with a very high level of control,

Continued on Pg. 10 »

The Art and Science of Earthquake Engineering

CIVIL ENGINEERING PROFESSOR CARLOS VENTURA GROUNDS HIS EARTHQUAKE ENGINEERING RESEARCH IN 30 YEARS OF HANDS-ON EXPERIENCE.

- Earthquake Engineering
- Structural Health Monitoring
- Scenario Modelling

EARTHQUAKE ENGINEER

Carlos Ventura thought he would go into the family coffee business after completing his civil engineering studies. But in his final year, a 7.8 magnitude earthquake struck Guatemala and changed his life. Instead of entering the family business, he decided to study the structural mechanics involved when earthquakes damage buildings. Today, he is Director of UBC's Earthquake Engineering Research Facility (EERF) and an internationally respected expert in the field.

MONITORING STRUCTURAL HEALTH

The first known seismometer dates from second-century AD China. It consisted of eight dragon heads arranged around the lip of a large jar, each with a ball in its mouth that dropped into the jar to register an earthquake. The sensors now used in seismic assessment projects such as the one Carlos Ventura works on for the BC Ministry of Transportation will produce a reading if you breathe next to them. Once completed, the network of sensors will allow the province to remotely monitor the structural health of BC's most important bridges. In the case of the Second Narrows Bridge, vibrational data generated by traffic are transmitted to the EERF, and used by Ventura and his team to refine their finite element model of the bridge. "When we are confident that the model represents the actual bridge," he explains, "we can use it to do earthquake analysis and other tests." He has performed similar analyses of high-rise towers in Vancouver's downtown core, and of airport control towers in New Orleans after Hurricane Katrina.

SHAKING OUT VULNERABILITIES

Japanese tsunami records indicate that the last major subduction earthquake to hit southwestern BC was in 1700, as a result of the Juan de Fuca Plate sliding under the North American Plate off the west coast of Vancouver Island. This type of earthquake—the Big One—occurs roughly every 500 years. Intra-plate and crustal earthquakes are more frequent, and Ventura feels it is these types we should be most concerned about. In a shake-table test he conducted in 2001, a full-sized non-engineered house typical of the region suffered extensive damage from the ground-motion acceleration and velocity typical of these latter earthquakes. Given these results, Ventura estimates that up to 20,000 families in the region could have no housing for up to a year following such an event. "It's not the doomsday scenario of buildings collapsing," he says. "We're more concerned about the effect of an earthquake on the community if we don't have properly designed houses."

Continued on Pg. 10 >>

Arrays and Assays: Thinking Big on a Small Scale

ELECTRICAL AND COMPUTER ENGINEERING PROFESSOR KAREN CHEUNG DESIGNS BIOMEDICAL MICRODEVICES FOR NEUROPROSTHETIC APPLICATIONS AND CELL CULTURE AND CHARACTERIZATION.

> Biomedical Microdevices
> Neural Interfaces
> Lab-on-a-Chip

ADVANCES IN MICROELECTRO-MECHANICAL SYSTEMS (MEMS) have enabled low-cost, high-functionality devices such as inertial sensors, microscale vacuum pumps, automotive airbag accelerometers, and many others. This breakthrough technology has also made it possible to bring together the previously unrelated disciplines of biology and microelectronics, in a field known as BioMEMS. Biomedical engineer Karen Cheung is exploring significant potential applications of this promising field.

IMPROVING THE BIOCOMPATIBILITY OF NEURAL IMPLANTS

Neural interfaces provide a connection between the electrical activity of neural tissue and technology. They are used in applications such as deep-brain stimulation of Parkinson's disease patients, and recording neuronal electrical activity to control prosthetic devices. For the latter application, current technology uses scalp-based electrodes to record electroencephalograph signals, which are then used to control the prosthesis. Although non-invasive, this approach suffers from distortion through the skull and dura, which causes reduced spatial resolution. Silicon-based neural implants have the necessary spatial resolution to record individual neurons, but their stiffness causes inflammation and scarring that interfere with the signal and eventually make them ineffective.

Karen Cheung has used her microfabrication expertise to design a flexible, polymer-based microelectrode array with a better mechanical match to brain tissue than silicon-based probes. Her probe has been shown to work as well as silicon-based arrays in short-term (acute) applications in rodents, and to function well for several months in chronic applications.

In collaboration with Dr. Jay Kizhakkedathu of the Centre for Blood Research at UBC, Cheung is now investigating novel surface coatings to minimize the central nervous system's response to polymer-based implants, including protein adsorption. She also hopes to incorporate anti-inflammatory drugs in the coatings.

"Our group is focusing on biocompatibility," she says, "changing the surface properties of the implants to improve the tissue reaction." If successful, Cheung's work will go a long way toward making long-term neural interfaces feasible. An Ontario biomedical device manufacturer has already expressed interest.

Continued on Pg. 10 >>

"We wanted to develop a professional program that was both rigorous and relevant."

The Master of Software Systems Program: Nine Years After

ICICS RESEARCHERS have a long history of industrial collaboration. This close relationship has produced many successful innovations, not the least of which is the Master of Software Systems (MSS) program. Responding to the personnel needs of the software industry, the program was developed by ICICS in 1999 in consultation with the Departments of Computer Science and Electrical and Computer Engineering (ECE) at UBC, and with industry. Despite subsequent downturns in the software industry, the program flourished, because of a strong initial foundation and a willingness to evolve. The tenth cohort of students began classes this January.

The program's current and founding director, Professor Panos Nasiopoulos (ECE), was recruited from a high-profile executive position in the multimedia industry. He knew that companies needed people with both software systems and managerial skills, and a broad perspective on market trends. "We wanted to develop a professional program that was both rigorous and relevant," Nasiopoulos recalls, "and that repays a student's investment many times over."

The MSS program retools students who have bachelor degrees in science, engineering, mathematics, business and other disciplines with a broad set of software systems skills. Overhauled in 2006–07 to reflect the changing needs of industry, the 16-month program covers topics such as low- and high-level systems design, network architecture, security, database design, web programming, and real-time distributed systems. Most courses have scheduled lab components, where students learn from each other in dedicated Windows or Linux labs. Technical electives allow them to pursue individual interests.

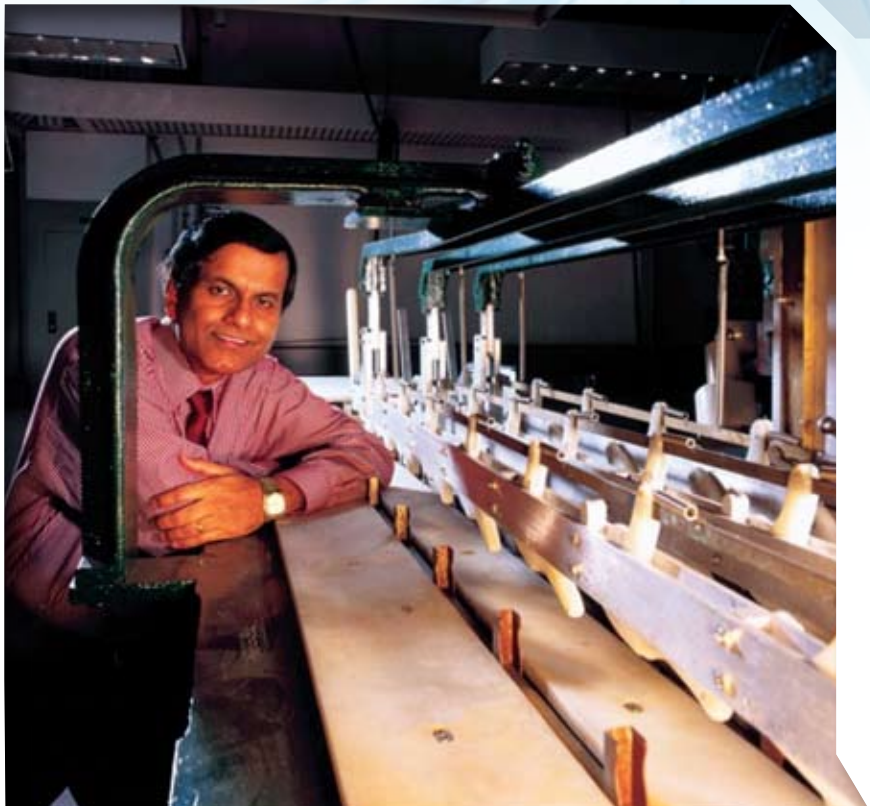
In their third term, MSS students gain valuable industrial experience through a 4-month, paid internship with high-profile companies such as Adobe Systems, Electronic Arts, IBM Canada, MDA, and Shell Canada, which benefit from the professionalism and knowledge of MSS interns. In the final term, students synthesize what they have learned by working in teams to design, implement, and test a large software system, drawing upon the collegiality and tight bond they have developed by this point in the program.

MSS students are a diverse bunch. The program has always had a good blend of Canadian and international students, and many have been working for a number of years. Their varied backgrounds are a hidden resource: they learn from each other. As one graduate recalls, "An exuberant class, with a unique blend of experience and knowledge, made the MSS program a wonderful experience."

The 177 graduates of the program since its inception have been highly successful in finding employment, often with prominent Canadian and international companies. With ICICS' industrial antennae up in the guise of Nasiopoulos and others, the MSS program should continue to produce software systems specialists who are in high demand.

For more information on the MSS program, contact info@mss.icics.ubc.ca, or visit www.icics.ubc.ca/mss

Clarence de Silva Elected to the Royal Society of Canada



ELECTION AS A FELLOW OF THE ROYAL SOCIETY OF CANADA is considered the highest honour a researcher working in Canada in the arts, humanities, or sciences can achieve. ICICS member and Mechanical Engineering professor Clarence de Silva can now add this distinction to a long list of honours. A Tier 1 Canada Research Chair in Mechatronics and Industrial Automation, de Silva has written 17 technical books, 43 book chapters, over 180 journal articles, and edited 14 books. As the NSERC-BC Packers Professor of Industrial Automation from 1989–99, he helped establish and continues to direct UBC's Industrial Automation Laboratory, which has produced such innovations as a fish-cutting machine, a herring-roe grading machine, and numerous robots.

De Silva is also Director of UBC's Applied Science Research Centre, founded in 2004 on the advice of then Dean Michael Isaacson to promote collaboration between UBC and the National University of Singapore. The Centre now engages in international collaboration with other institutes (primarily Pennsylvania State University, the National Taiwan University of Science and Technology, and the Sri Lanka Institute of Information Technology) on practically applicable research projects that fall within the scope of de Silva's Canada Research Chair. Current projects include cooperative robotics for safety/security-intensive tasks, and remote monitoring and control of industrial processes.

New Dean for Applied Science

UBC'S FACULTY OF APPLIED SCIENCE encompasses 11 different engineering disciplines, the School of Architecture and Landscape Architecture, and the School of Nursing. Over 5,400 undergraduate, graduate, and professional students at the Vancouver and Okanagan campuses, and over 400 faculty and staff, call Applied Science home. Michael Isaacson, who stepped down as Dean in June 2008 after serving since 1997, leaves a proud legacy. His successor, Dr. Tyseer Aboulnasr, will guide the Faculty over the next six years.

As Dean of the Faculty of Engineering at the University of Ottawa from 1998–2004, Aboulnasr oversaw significant growth in the Faculty, and the formative years of the School of Information Technology and Engineering. SITE was created in 1997 when

ICICS Forms Partnership with

THE PETER WALL INSTITUTE

IN RECOGNITION OF THE CURRENT FUNDING LANDSCAPE, one of the major goals of ICICS' Strategic Plan is to foster new collaborative, multidisciplinary research groups to tackle important problems in computing, information, and cognitive systems. The Peter Wall Institute for Advanced Studies (PWIAS) promotes a similar approach to a wide range of basic research, aimed at fostering research excellence and interdisciplinarity, and creating a community of scholars across the UBC campus. It therefore made sense for ICICS Director Nimal Rajapakse to approach his counterpart at PWIAS, Dr. Diane Newell, about pooling resources.

Newell, a social historian with an interest in science and technology, liked the idea, and the two of them identified the following programs for joint funding; each must target research in areas of mutual interest to ICICS and PWIAS:

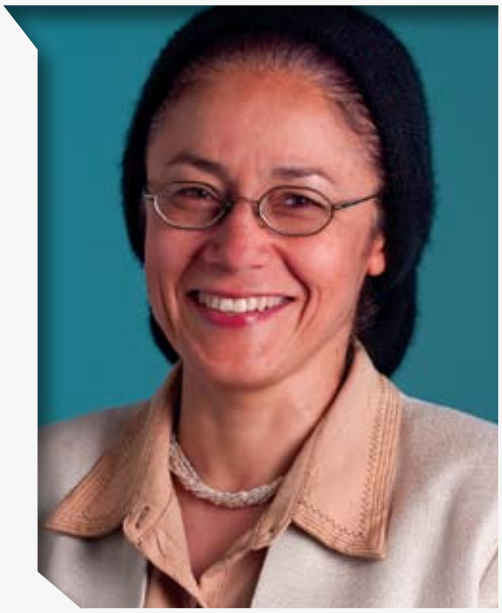
1. Up to four PWIAS Theme Development Workshops per year, each consisting of an informal, half-day meeting of UBC researchers to exchange ideas about a research theme.
2. Up to two PWIAS Exploratory Workshops per year, in which 25–50 scholars from a broad range of disciplines are brought together for several days to discuss a proposed multidisciplinary research project with major potential impact.
3. Three PWIAS Early Career Scholar Awards per year, targeting tenure-track faculty whose multidisciplinary research shows great promise.

Under this three-year, renewable, partnership agreement, proposals must be submitted to PWIAS by a full ICICS member, as Project Leader.

See **www.pwias.ubc.ca/programs** for funding amounts and further application details. PWIAS conference facilities and ICICS facilities will also be made available to ICICS and PWIAS members, respectively, upon the approval of both directors.

the Departments of Computer Science and Electrical and Computer Engineering merged. Like their ICICS counterparts, SITE researchers carry out multidisciplinary applied research in collaboration with industry. Aboulnasr chaired ICICS' external review team in 2006 and was a member of UBC's Applied Science review committee in 2002.

Aboulnasr is an electrical engineer with signal processing expertise. She is currently Principal Investigator of a multidisciplinary study exploring advanced signal processing strategies for hearing aids that can adapt to the user's acoustical environment. We warmly welcome Dean Aboulnasr and look forward to working closely with her in fulfilling ICICS' mandate. Watch for a profile of Dr. Aboulnasr in an upcoming issue of FOCUS.



« Continued from Pg. 04

Harnessing the Properties of Carbon Nanotubes

with the ultimate goal of timed single-electron emission." Potential applications include electron microscopy and lithography, ultra-fast vacuum nanoelectronic devices, and a host of others awaiting the right electron source.

Exploring the full potential of carbon nanotubes, however, requires a range of expertise. Nojeh is collaborating with ECE head Andre Ivanov to investigate using CNTs as optical antennas in future wireless microchips, partially supported by Ottawa-based SilconPro. ICICS director Nimal Rajapakse (ME) is contributing his continuum-modelling expertise to Nojeh's simulations of the torsional properties of CNTs for possible use in applications such as mechanical resonators. John Madden (ECE) has tapped Nojeh to help model the electromechanical actuation of CNTs for artificial muscle applications.

By rigorously examining the behaviour and properties of carbon nanotubes, Alireza Nojeh is doing the groundwork necessary to realize the enormous potential of this recent discovery. "Carbon nanotube research is very new," he concedes, "and much of the science still has to be learned. We've barely scratched the surface."

Alireza Nojeh can be reached at 604-827-4346 or anojeh@ece.ubc.ca

« Continued from Pg. 05

The Art and Science of Earthquake Engineering

The structural recommendations he and his collaborators made after the tests (minimum nailing requirements, properly anchoring frames to foundations, etc.) have been incorporated into the Canadian Mortgage and Housing Corporation's building manuals. Ventura hopes they will eventually be reflected in the National Building Code. The good news is that stucco, a common cladding material in the Lower Mainland, substantially helps reinforce a house, because of the wire mesh holding it in place.

SCENARIO MODELLING FOR RESPONDERS

In the late 1990s, Ventura assessed the seismic performance of southwestern BC's building stock for the insurance industry and other stakeholders. The study provided insurers with a comprehensive basis for estimating their risk exposure in the region. It also gave Ventura the tools he needed to contribute to the Joint Interdependent Infrastructure Research Program (JIIRP), a national effort to coordinate the responses of infrastructure managers during major disasters. The UBC arm of JIIRP comprises a 12-member multidisciplinary team led by ICICS member José Marti (ECE). Their prototype simulator enables the coordinated real-time response of UBC infrastructure managers to events such as an earthquake knocking out the water supply to UBC hospital. Ventura helps the team design these scenarios, and models their anticipated effects. "We use analytical studies and lessons learned from past earthquakes," he says. "It's both a science and an art." The team is now scaling up its well-received simulator to the provincial level, and tailoring it to 2010 Winter Olympics venues.

Ventura never forgets where he came from, and finds time each year to advise people in developing countries how to reduce their seismic risk, by lining adobe walls with chicken wire and other simple techniques. Citizens of these countries, and of the Lower Mainland, are better off for his strong sense of social responsibility.

Carlos Ventura can be reached at 604-822-6946 or ventura@civil.ubc.ca

« Continued from Pg. 06

Arrays and Assays: Thinking Big on a Small Scale

MIMICKING THE IN VIVO ENVIRONMENT

In another strand of research, Cheung is fabricating a microfluidic device to culture and characterize breast cancer cells for screening of anti-cancer agents. By capturing traditional lab processes such as incubation and assaying on a lab-on-a-chip device, a much smaller number of cells, as obtained in needle biopsies, can be examined. They can be more easily tracked and characterized, making diagnosis and drug screening faster and cheaper.

Cancer cells are introduced into Cheung's device suspended in a hydrogel. In this three-dimensional environment, signalling between cells, and their mechanical support on the hydrogel "scaffolding," more closely approximate the in vivo situation than in the 2D environment of a flat Petri dish. Oxygen concentrations, crucial to the effectiveness of anti-cancer drugs, can be modelled more accurately. The flow rate of the drug can be governed via a channel on the bottom of the device to mimic varying concentrations in the body. "I wanted to create a model where we can better control parameters," Cheung says, "decide how big our gel structure is, and the distance of the cells from the oxygen or drug flow. We're combining some of the hydrogel approach with microtechnology to do assays on a small scale."

Cheung plans to collaborate with Dr. Calvin Roskelley at UBC and Dr. Marcel Bally of the BC Cancer Agency to test different concentrations and administration sequences of existing anti-cancer drugs using her new assay technique. Pharmaceutical companies, among others, may soon be knocking on her door.

By going small, Cheung is tackling some big issues in neuroprosthetics and breast cancer research.

Karen Cheung can be reached at 604-827-4114 or kcheung@ece.ubc.ca

P2P:

<< Continued from back page

Optimized fuel injectors are key to the efficiency of hydrogen-based engines. ICICS Director **Nimal Rajapakse** (ME), **Mohamed Gadala** (ME), Tom Troczynski (Materials Eng), and Rudolf Seethaler (Engineering, UBC Okanagan), will explore the use of piezoelectric fuel injectors for this application, and assess their performance and durability in hydrogen environments. The team has been awarded $445,790 and is supported by Westport Power Inc.

James Olson (ME), Mark Martinez (Chem/Bio Eng), and Robert Gooding of Advanced Fiber Technologies (AFT), have received a $326,500 grant to investigate "Energy Reduction in Processing Pulp Suspensions." The researchers, supported by AFT, will focus on reducing turbulent drag in suspension flows used in the papermaking process, by adding drag-reducing polymers and modifying wall contours. These refinements should lead to significant energy savings.

Dolby Endows Research Chair and Professorship

High Dynamic Range (HDR) display technology uses hundreds of light-emitting diodes to provide a range of contrast close to what we see in the real world. It was invented at UBC by a team led by Lorne Whitehead (Physics), and led to the spin-off company Brightside Technologies, recently acquired by Dolby Laboratories. Now Dolby has invested $1.15M toward endowing the Dolby Computer Science Research Chair, held by **Wolfgang Heidrich** (CS), and the Dolby Professorship in Digital Multimedia, held by **Panos Nasiopoulos** (ECE). Heidrich, whose image-processing algorithms are key to HDR, is investigating human perception of extreme contrast and colour, and developing new HDR applications such as content-authoring tools and software for converting legacy video to HDR. Nasiopoulos is researching devices capable of capturing, compressing and delivering HDR images, essential to transfer HDR technology to society.

Dinesh Pai (CS) has received a highly competitive program grant in the amount of US$375,000 from the international Human Frontier Science Program for "Learning from the Unlearnable: Probing the Architecture of Control in Tool Manipulation." Pai and collaborators in Rome, Italy will employ novel computational methods, sensing technologies, computer graphics, and haptic displays to investigate whether the brain uses a modular architecture to simplify motor control and learning in tool use.

ECE Professors Awarded CHRP Grant

Guy Dumont and **Meeko Oishi** from ECE, along with **Mark Ansermino**, Stephan Schwarz and Bernard MacLeod from Anesthesiology, have received a 3-year NSERC/CIHR Collaborative Health Research Project (CHRP) grant of $392,400 to investigate closed-loop control of anesthesia.

Idea-to-Innovation Grant for ECE Professor

Juri Jatskevich (ECE), awarded a $119,500 grant under NSERC's Idea-to-Innovation program, is looking at "Improving Performance and Reliability of Hall-Sensor-Controlled Brushless DC Motors." The research is aimed at ensuring the operability of mission-critical components in motion control and aircraft automation, and is supported by industrial partners Curtiss-Wright Controls and EM Technologies.

ICICS Members Inducted as Fellows of the Engineering Institute of Canada (EIC)

ICICS Director and Mechanical Engineering professor **Nimal Rajapakse** was recently inducted as a Fellow of the EIC for his contributions to engineering in Canada, in the areas of computational mechanics, smart materials, and solid mechanics. **Victor Leung** (ECE) was also inducted as a Fellow for his contributions to the development of protocols and management techniques for mobile communication systems. Only 20 new EIC Fellows were inducted this year, less than .01% of the membership.

Animating Fluids for Films and Games

Robert Bridson (CS), works on the core algorithms and numerical methods involved in creating photorealistic animations of smoke, liquids, clothing, and more. He has recently published the first book on the subject, *Fluid Simulation for Computer Graphics*, with A. K. Peters. His work is more visible in the special effects used in films such as *10,000 BC*, *Hell Boy II: The Golden Army*, *The Dark Knight*, and *Inkheart*.

Smart Wheelchair Developments

For safety reasons, individuals with cognitive disabilities such as Alzheimer's or dementia are not permitted to use powered wheelchairs. A smart powered wheelchair developed by CS PhD student Pooja Viswanathan and her supervisors **Alan Mackworth** and **Jim Little** may change that, increasing the length of time that these people can live independently. The chair uses computer vision techniques to recognize landmarks and calculate available space through depth perception, and stops a certain distance away from obstacles.

Lieutenant Governor's Technology Innovation Award

James Olson (ME), **Carl Olivier-Gooch** (ME), Mark Martinez (ChemBio Eng), and industrial collaborator Robert Gooding of Advanced Fiber Technologies have developed low-energy pulp-screen rotors that can be operated at much lower speeds than conventional rotors. Since the pulp and paper industry consumes nearly 20% of the electricity produced in BC, the resulting energy savings and reductions in greenhouse gas emissions will be considerable. The team's contribution was acknowledged recently when they were given the 2008 BC Innovation Council's Lieutenant Governor's Technology Innovation Award. The new rotors are in use at 30 mills in Canada.

ICICS Welcomes New Members

We would like to welcome the following new members to ICICS: **Sathish Gopalakrishnan** (ECE), **Peyman Servati** (ECE), **Mark Ansermino** (Anesthesiology), **Bhushan Gopaluni** (ChemBio), **Hsi-Yung (Steve) Feng** (ME), and associate member **Hendrik (Mike) Van Der Loos** (ME). Watch for profiles of these researchers in upcoming issues.

P2P: Peer-to-Peer

ICICS Members Awarded 3-Year NSERC Strategic Grants

ECE professors **Vincent Wong, Lutz Lampe, Victor Leung, Shahriar Mirabbasi, Jane Wang**, and Ian Blake (adjunct) have been awarded $679,000 to investigate "RFID-based sensor networks for detecting and tracking mobile targets." Industrial partners include Guard RFID Solutions Inc., Kintama Research Corp., SST Wireless Inc., and Wireless 2000 Inc.

High dynamic range (HDR) display devices, invented at UBC, provide life-like picture quality, due to vast improvements in luminance and colour dynamic range over conventional display technology. **Panos Nasiopoulos** (ECE), **Rabab Ward** (ECE), and **Wolfgang Heidrich** (CS), supported by Dolby Laboratories, will use a $631,500 grant to develop a complete HDR video capturing, compression, and transmission solution that should lead to HDR's widespread adoption.

ECE professors **Victor Leung, David Michelson**, and **Jane Wang**, along with Richard Yu (Carleton Univ.) and researchers from the Neil Squire Society and Defence Research and Development Canada, will investigate "Enabling Technologies for Secure and Reliable Wireless Body Area Sensor Networks" through a $615,100 grant. These networks can sample, process, and communicate one or more vital signs and/or environmental parameters over extended periods. The team will work to make them more secure, reliable, and effective. Industrial partners include Nokia, Agilent Technologies, Ascalade Communications, and Western Clinical Engineering.

Robert Rohling (ECE/ME), **Tim Salcudean** (ECE), **David Lowe** (CS), Christopher Nguan (Urologic Sciences), and Purang Abolmaesumi (Queen's Univ.) have been awarded $499,200 for their project, "Real-time Image Guidance for Robot-assisted Laparoscopic Surgery." The team will focus on incorporating ultrasound imaging into robot-assisted partial nephrectomy for kidney cancer treatment. They are supported by Intuitive Surgical, developers of the da Vinci surgical robot, and by Ultrasonix Medical Corporation. Kidney cancer is the sixth most frequently diagnosed malignancy, and is very difficult to treat surgically.

Our networked world and mobile devices are often a source of sensory and cognitive overload. **Karon MacLean** (CS/ME), **Elizabeth Croft** (ME), and **Joanna McGrenere** (CS) will address this human–computer interaction problem in their project, "HALO: Transparent Guidance of Networked Interactions through a Haptic-Affect Loop," awarded $481,000. This "loop" will sense the user's reaction to an environment or situation, and trigger interface changes while giving haptic feedback about the change. Industrial supporters include Nokia, Thought Technology Ltd., and Spark Robotics Technology Inc.

The exponential growth in digital media creation, use, and sharing over the last decade poses serious management and intellectual property issues. **Rabab Ward** (ECE), **Jane Wang** (ECE) and H. Vicky Zhao (Univ. of Alberta) will tackle these issues in their project, "Information Management and Security in Media-sharing Social Networks," awarded $470,400. The researchers will develop a framework to effectively manage, and securely and reliably share, digital multimedia in large-scale social networks. Industrial partners include BroadbandTV, TELUS, Microsoft Research and Thomson Corporate Research.

Lutz Lampe (ECE), **Robert Schober** (ECE), Xiaodai Dong (UVic), and R. Fischer (Friedrich-Alexander University of Erlangen-Nürnberg) have received $452,900 for their project, "Intelligent Signal Processing for UWB Wireless Communication Networks." Ultra-wideband (UWB) radios use extremely large bandwidth signals. UWB's low power and power-spectral density of the transmit signal, high resolution of multipath fading, and low cost have generated intense industrial interest in the technology. The researchers will develop the intelligent signal-processing algorithms necessary to realize UWB's full potential. Industrial collaborators include Omnex Control Systems ULC, AMS Homecare Inc., Wireless 2000 RF & UWB Technology Ltd., and Kensington Computer Products Group.

Continued on Pg. 11 »

UBC's Institute for Computing, Information and Cognitive Systems (ICICS) is an umbrella organization that promotes collaboration among researchers from the faculties of Applied Science, Arts, Commerce, Education, Forestry, Medicine, and Science, and with industry. ICICS facilitates the collaborative multidisciplinary research of approximately 150 faculty members and 800 graduate students in these faculties. Our members attract approximately $18 million annually in grants and contracts. Their work strengthens Canada's strategic Science and Technology research priority areas, benefiting all Canadians.

PUBLICATIONS MAIL AGREEMENT NO. 40049168
RETURN UNDELIVERABLE CANADIAN ADDRESSES TO:
ICICS, University of British Columbia
289-2366 Main Mall,
Vancouver, BC, V6T 1Z4
info@icics.ubc.ca

EDITOR: Sharon Cavalier, ICICS Administrative Manager
WRITING: Craig Wilson, ICICS Communication Writer
PHOTOS: Janis Franklin, UBC Media Group
DESIGN: Jarret Kusick, Hitman Creative Media Inc.

OFFICE: ICICS, University of British Columbia
289 – 2366 Main Mall,
Vancouver, BC, Canada, V6T 1Z4
TEL: 604.822.6894 **FAX:** 604.822.9013
E-MAIL: info@icics.ubc.ca