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

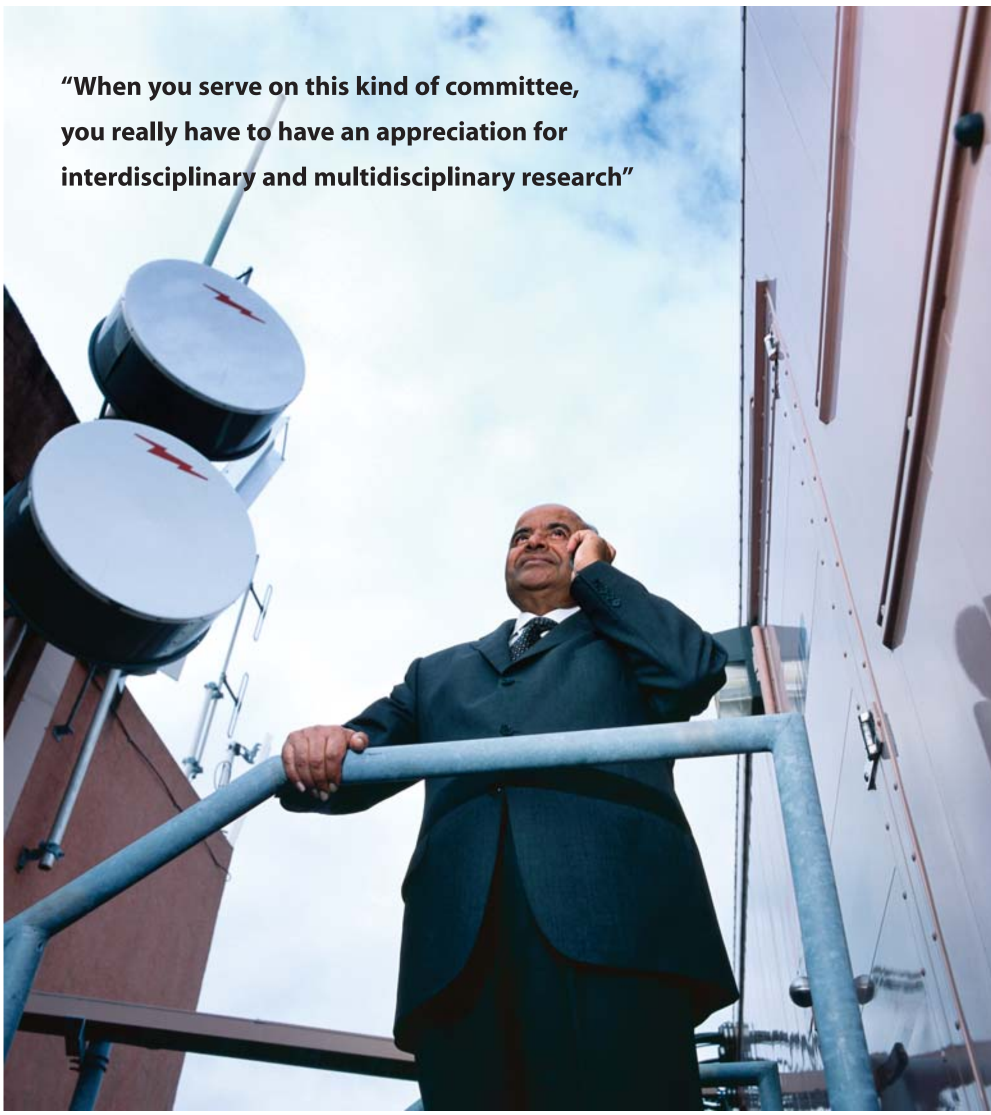
ICICS FOCUS

THE UNIVERSITY OF BRITISH COLUMBIA

Shaping the Future of ECE and Wireless Systems

ICICS member Vijay Bhargava is an international leader in wireless communications. As head of Electrical and Computer Engineering (ECE) he leads a growing department in a competitive era.

"When you serve on this kind of committee, you really have to have an appreciation for interdisciplinary and multidisciplinary research"



- **4G Wireless Systems**
- **Ultrawide Bandwidths**
- **CDMA**

When I went to interview Professor Vijay Bhargava I was not allowed into his office; it was in the midst of a construction zone and I had forgotten to wear close-toed shoes. Instead, hardhat in hand, the busy new head of Electrical and Computer Engineering came to meet me in the CICSR building. The current ECE building has been undergoing major renovations to make it code-compatible with its adjoining new building, to be completed in the early fall 2004 or spring 2005. Overseeing the progress, managing a department, and working amidst the noise and chaos, are challenges Bhargava takes in stride.

"Accommodating the increase in undergraduate and graduate students before the infrastructure is ready for them, and recruiting faculty and staff to fill vacancies and meet our growing needs, are probably the greatest tasks facing me right now," he admits.

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ICICS
Director's Corner

This fall is an exciting time at ICICS. Our new building is almost complete. Our institute has grown to over 135 members from disciplines as diverse as curriculum development to nanotechnology. This issue of *FOCUS* introduces fifteen ICICS members and profiles five-all leaders in their respective fields.

Head of Electrical and Computer Engineering, Vijay Bhargava is a world leader in wireless communications. As well as running a busy and expanding department, he is working at the forefront of 3G and 4G wireless systems.

Philippe Kruchten (ECE) has literally written the book on software engineering, The Rational Unified Process®. Now, after 30 years in industry, he brings his expertise to UBC to help train the next generation of software engineers. His research focuses on developing reliable, robust software systems, while also establishing a code of ethics for the industry.

Digital geometry processing has numerous applications, from computer graphics to scientific computing. Computer scientist Alla Sheffer uses tools from applied computational geometry, geometric modelling and solid modelling to generate and manipulate three-dimensional geometric models.

Canada Research Chair in MicroElectro-Mechanical Systems and Nanotechnology, Mu Chiao (ME) is researching the biomedical application of MEMS, such as implantable biosensors and drug delivery systems.

Computer scientist Ian Mitchell develops numerical algorithms to solve problems related to the control and safety of complex hybrid systems. He has recently released an online tool box for solving equations that involve moving surfaces.

We are very pleased to welcome these outstanding members to ICICS.

Rabab Ward, ICICS Director

Bhargava: *Continued from page 1*

Bhargava came to UBC from UVic, where he spent a successful 19 years, accruing many prestigious appointments and awards along the way. He is a member of the Royal Society of Canada, and recently received their Thomas W. Eadie Medal for his "profound effect on the field of wireless communication." Another highlight was his appointment as chair of the Canada Research Chair Program Adjudication Committee for 2002 and 2003. "When you serve on this kind of committee, you really have to have an appreciation for interdisciplinary and multidisciplinary research," Bhargava says.

Piloting a Broad Range of Research

As a pioneer in third generation (3G) wireless communication—which aims to provide wire-line grade multimedia services worldwide, anywhere at any time—it is impossible to summarize all areas of Bhargava's research. In the past five years, his group has published over 40 journal articles alone. For example, his work on code-division multiple access (CDMA) helped to address problems of varied data rates, traffic patterns and Quality of Service requirements over error-prone wireless channels, and limited and changing bandwidth.

A classical lay explanation of CDMA is a conversation at a cocktail party, explains Bhargava, where two people are talking amidst a score of other conversations or "interference." His work on multi-user detection helps to mitigate interference in wireless systems.

"Power control is another issue that is peculiar to CDMA," he notes. "If you spread the signal over a very wide bandwidth, then CDMA systems suffer from what is called a near-far problem, where a signal from a desired transmitter is overwhelmed by a signal from an undesired transmitter, which is nearby." Bhargava and his students have developed a novel power control algorithm to solve the problem.

Taking Wireless Systems Beyond 3G

Bhargava is now working beyond 3G on the collection of technologies known as fourth generation wireless systems (4G), which aim to provide increased bandwidth and higher data rates at lower costs. One aspect of 4G will be the use of ultrawide band-widths. Current cell phones operate in a relatively small portion of the radio frequency spectrum near 800 MHz. Second and third generation systems are designed to operate in the 2 GHz range, and 4G will operate at 5 GHz and beyond. "As you go to higher frequencies you have bigger chunks of bandwidth available, and significant portions of that are licence exempt," notes Bhargava.

"As you go to higher frequencies you have bigger chunks of bandwidth available, and significant portions of that are licence exempt,"

When asked how he plans to juggle research with demanding administrative duties, Bhargava credits his graduate students with keeping him involved. "I used to supervise a large number of students, but now as head I will limit myself to six," he says. Working with students is obviously a part of his job that he relishes. In 2002, he was the first person from outside the US to receive the IEEE Graduate Teaching Award. "To me, a successful department must have the right kind of culture in the research lab, so students benefit from the synergy of the group."

Vijay Bhargava can be reached at 604.822.2342 or vijayb@ece.ubc.ca

Process and Ethics in Software Engineering

After 30 years as a software engineer, new ICICS member Philippe Kruchten brings his experience to UBC to help train a new generation of software developers.

- **Rational Unified Process®**
- **Software Code of Ethics**
- **Global Software Development**

"For certain types of software, we need to have licensed software engineers, who are aware of the standards that exist and the consequences of the technology for the safety of the public."

We have all read and e-signed ponderous and even ludicrous disclaimers prior to loading new software on our computer. "Imagine approaching a bridge with a sign on it saying that you cross at your own risk, that anything can go wrong and the builders are not liable" says Philippe Kruchten. "This is what we do with most software products. We need to raise the quality of software and change the underlying ethics of the discipline—at the individual level, the company level, and the industry level," he states. With almost three decades in the business, and a PhD in Information Systems from l'École Nationale Supérieure des Télécommunications in Paris, he speaks from experience. Now, as professor in Electrical and Computer Engineering, he feels he is better able to make a difference.

Kruchten led the design of the Canadian Automated Air Traffic Control System for Hughes Aircraft (now Raytheon Canada). While applications such as air traffic control are safety critical, there are many others that may not be critical to physical safety but can cause immense harm financially to companies and to individuals. In 1999, the discipline of software engineering was recognized by the Association of Professional Engineers and Geoscientists of BC, and Kruchten became the first "professional" software engineer in the province.

Writing the Book on Software Engineering

Software engineering, unlike other engineering disciplines, is not a clearly defined process—and this creates major challenges for designers. Software is dynamic, creative, and tactical. Unlike a bridge or a building, it is developed by trial and error and is designed to evolve. Imposing processes derived from other engineering disciplines simply leads to poor quality software. "The world of bits and the world of atoms do not follow the same rules," says Kruchten, adding that the rapid evolution of computer science technologies adds to the difficulty of developing software-intensive systems.

As these systems become larger and more complex, they become "brittle" or increasingly difficult to modify. A major challenge in software architecture is keeping track of the decisions made early on in the process. "You want to retain an understanding of a software system's original design decisions, so that new decisions don't violate them," says Kruchten.

From 1987 to 2003, Kruchten held several positions with Rational Software Corp., working with branches all over the world. There, he and colleagues developed the Rational Unified Process®, or RUP, a 5,000-page online handbook for software engineers that is now used worldwide. He has also recently co-authored a book on RUP, as well as two textbooks.

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Making the Most of MEMS

New Canada Research Chair Mu Chiao is developing MicroElectroMechanical Systems (MEMS) for biological applications.

- **MEMS**
- **Micro Energy Sources**
- **Nanoscience**

"When you are implanting something inside the body, you don't want it to fail and you don't want the body to destroy the device,"

Someday soon, people suffering from chronic diseases that require ongoing monitoring and regular doses of medication will be able to worry less and enjoy life more. This is the goal of recent ICICS member and Mechanical Engineering professor Mu Chiao's research in biomedical applications of MEMS, such as implantable biosensors and drug delivery systems.

Engineering nano and microscale medical devices poses considerable technical challenges. "When you are implanting something inside the body, you don't want it to fail and you don't want the body to destroy the device," says Chiao, who was recently appointed Canada Research Chair in MicroElectroMechanical Systems and Nanotechnology. Power supply is another challenge, as biosensors require energy sources that are safe, reliable and long-lasting, yet small enough to power a microscale device.

The Importance of Packaging

The reliability of microresonators depends upon designing the right packaging. In order for resonating microdevices to work in cellular applications, they require a vacuum environment. Without it, too much energy is lost to air friction, or damping. "With current methods, the packaging cost is 70 percent of the total cost," notes Chiao. "We hope that by using a microcavity seal we can reduce the packaging cost to less than 30 percent."

For cellular applications, he has worked on a vacuum packaging process called Rapid Thermal Processing (RTP), which has proved effective, easy to implement and stable over the long-term. Chiao plans to develop the process for biomedical device packaging as well.

Another key function of packaging is to facilitate biological screening. Biosensors require a selective filter process that provides access to key body chemicals while screening out the rest. Chiao is developing the same technology used to filter out signal interference in cellular applications for use in biosensors.

Tackling Frequency Tuning

Improved packaging can also improve quality control of MEMS manufacturing by reducing damage during automated assembly. However, post-fabrication tuning is often required to control the dynamic characteristics of microresonators. Chiao has developed an innovative method called post-packaging frequency tuning using pulsed laser deposition. First, a thin glass covering is bonded to the microresonator and then its dynamic characteristics are measured. "If it is not what you want, you can introduce a local laser through a tiny spot in the glass, which heats up the metal film on the glass and deposits it onto the microresonator surface," explains Chiao. The deposit of metal film changes the microresonator's mass, which changes the dynamic and tunes the frequency.

MEMS research is extremely multidisciplinary. Chiao is collaborating with ICICS colleagues John Madden (ECE) and Shahriar Mirabbasi (ECE) on developing hybrid polymer mechanical structures and standalone radio frequency MEMS sensors.

Continued on page 9

Fourteen New ICICS Members

We welcome fourteen outstanding new researchers to ICICS. Watch for more about their work in this and upcoming issues of FOCUS.

Rafeef Abugharbieh,
Electrical and Computer Engineering
Research: Image Processing and Analysis.

"In recent years we have witnessed the rapid development of imaging technologies for biomedical and industrial applications. Ultrasound, MR, CT, and microscopy images are integral tools for disease diagnosis, surgery planning, and therapy evaluation. Similarly, a huge growth in the use of lasers and ultra high-speed cameras for imaging various industrial processes has enabled us to visualize and characterize rapid events and minute structures, which has not been possible in the past. The main aim of my research is the development of computerized processing and identifying techniques for the fast, accurate and reproducible extraction, analysis and visualization of information buried in huge volumes of image data. Application areas are in medical, biological, and laser spectroscopic imaging. I'm very enthusiastic about starting new collaborations at UBC, especially within ICICS, related to biomedical and industrial imaging and other associated areas."

Konstantin Beznosov, Computer Science
Research: Secure Systems.

"My research focus is on novel ways to engineer, administer and operate secure systems. Specifically, I am working to develop new methods for engineering security mechanisms for large-scale distributed applications. I also investigate approaches to software security and study the effectiveness, cost of ownership, usability, and other characteristics that influence adoption of secure applications. Coming from industry, I am a strong believer that—along with technical factors—human, economical, business, legal, social, and political aspects are keys to the successful research of useful secure systems. With ICICS's mission for interdisciplinary research, I look forward to collaborative explorations in the highly interdisciplinary domain of security."

Robert Bridson, Computer Science
Research: Scientific Computing and Computer Animation.

"My research brings together numerical methods and computer animation. It is difficult to animate many natural phenomena (at least to the level of photorealistic motion) with traditional keyframe approaches. A powerful alternative is to directly simulate the underlying physics of the phenomena. For example, the motion of a digital actor's clothes can be simulated automatically with a good model for the elastic forces and the frictional contact interactions. I am also interested in mainstream scientific computing, both adapting the robust and scalable (but not necessarily accurate) algorithms for animation to scientific challenges, and developing basic numerical tools that are usable in a wide range of applications. For example, solving sparse linear systems often takes up most of the CPU time in a simulation, so efficient but also robust (no tuning needed) linear solvers are required."

Mu Chiao, Mechanical Engineering
Research: MicroElectroMechanicalSystems (MEMS).
(See profile on page 4)

Peter Cripton, Mechanical Engineering
Research: Injury Biomechanics.

"Injury biomechanics is the field of biomedical engineering that is dedicated to understanding, preventing and, in some cases, attempting to reverse the effects of traumatic human injury. My research spans the injury of very soft biological materials that compose the spinal cord and the eye, fracture of the geriatric hip and spine, and the function of injury prevention devices such as airbags and child safety restraints. In these areas, the overall goals are to improve our understanding of the mechanical and biological mechanisms occurring at the time of acute injury, and to use this information to improve the efficacy of injury prevention devices, as well as to increase the accuracy of computer or biological models that are used in the development of improved clinical treatment."

Charles (Buck) Krasic, Computer Science
Research: Operating Systems, Networking, Multimedia.

"My research concerns systems and application support for quality adaptive, time-sensitive computing, which is about the design of systems that simultaneously support the normally conflicting goals of real-time performance and a best-effort service model. For example, a main focus of my research has been the development of a system called QStream which does adaptive video streaming over the Internet. Video streaming exemplifies the type of application that must be both real-time and best-effort. The goal of QStream is to simplify the resource management issues of video streaming to the point of an 'encode once, stream anywhere' ideal. The research associated with QStream has spanned several areas such as scalable video compression, network protocols, and operating system support of time-sensitive applications."

Philippe Kruchten,
Electrical and Computer Engineering
Research: Software Engineering, Global Software Development.
(See profile on page 3)

Don Krug,
Curriculum Studies, Faculty of Education
Research: Educational Technologies.

"My research investigates information and communication technologies (ICT) in pedagogical knowledge and virtual education. This includes both teachers' and learners' cognition and the use of ICT simulations and information systems in formal and informal learning environments. My focus is on the interface design and development of educational technologies used within face-to-face (F2F), hybrid, and online distance education (ODE) learning environments. Currently, I am working with K–12 teachers and students using a self-directed, critical inquiry research intervention (e.g., video ethnography and action research) as a way to study one's own evolving knowledge and increase the efficiency of ICT literacy, fluency, and integration in educational settings."

Lutz Lampe,
Electrical and Computer Engineering
Research: Coding and Modulation for Digital Communications—Theory and Applications.

"As Claude E. Shannon, the father of Information Theory put it, 'the fundamental problem of communication is that of reproducing at one point either exactly or approximately a message selected at another point.' My research is centered on this formidable task and methods to solve the problem. These methods are collectively referred to as 'coding' and 'modulation' and concern the generation of signals suitable for reliable communication, as well as the effective extraction of information from weak and disturbed received signals. The overall goal of my work is to devise and analyze practical coding and modulation techniques which enable higher data rates, lower power consumption, and less-complex implementation in communication systems and networks. Current fields of application include wireless personal and local area networks, third generation mobile communication systems, and power-line communication systems."

Guy Lemieux,
Electrical and Computer Engineering
Research: Architectures and Algorithms for Programmable Logic Chips.

"Imagine that you are designing the road network for a brand-new city. You know where everyone lives and works, and you want everyone to have their own congestion-free commuting route, but you have to balance this against the cost of building the road network. Also, your road design must be sufficiently general that it is just as efficient in 25 years, after everyone has moved or changed jobs several times. My research involves precisely this problem, but using electrical wires and switches instead of lanes and intersections. The end result is a computer chip where the hardware itself can be reprogrammed to support completely different functions. The challenge in this is twofold: a) architecture—how to design the interconnection network efficiently, and b) algorithms—how to efficiently compute the shortest routes for everyone over a fixed network without suffering from congestion. This problem is of great importance for reducing the cost of future computer chips."

Kevin Leyton-Brown, Computer Science
Research: Multiagent Artificial Intelligence, Empirical Hardness of Algorithms, Game Theory.

"My research falls into two main categories. First, I am interested in problems that are fundamentally computational, but that have application to multiagent systems. For example, I have been working on the use of machine-learning techniques to characterize the empirical hardness of NP-Hard optimization problems, and on applying these models to the construction of algorithm portfolios and benchmark distributions. Second, I study fundamentally game-theoretic problems with applications to problems in AI or computer networks. Most recently, I have been working on a novel class of games I call Action-Graph Games. This representation can compactly express large multi-player games in which each player's utility depends on the number of other players who choose either the same action or other actions which 'locally affect' the chosen action."

Ian Mitchell, Computer Science
Research: Hybrid and Embedded Systems, PDE Methods for Control, Mathematical Software, Verification.

(See profile on page 8)

Alla Sheffer,
Computer Science
Research: Computer Graphics, Digital Geometry Processing, Computer-Aided Engineering, Applied Computational Geometry.

(See profile on page 7)

Derek Yip-Hoi, Mechanical Engineering
Research: Geometric and Solid Modelling methods for Virtual Machining; Computer-Aided Product Development.

"The primary focus of my research is to develop computational techniques for characterizing the engagement geometry between cutting tools and the workpiece during metal removal processes. This requires modelling of the changing in-process geometry of a part as it is manufactured. A variety of methodologies based on solid modelling and computational geometry theory are being investigated. This research will be integrated with physics-based models of metal removal processes facilitating simulation of cutting forces, prediction of process stability, and process optimization within a virtual machining environment. Another aspect of my work targets computer-aided product development using feature-based methodologies, knowledge-based engineering, distributed and Internet-aided techniques, and product similarity analysis."

"Meshing Around" with Digital Geometry

Recent ICICS member Alla Sheffer's research in geometry processing has applications in a wide range of fields—from computer graphics and multimedia to scientific computing.

- **Geometric Modelling**
- **Digital Geometry**
- **Computer-Aided Engineering**

Artists are trained to see the world in terms of shape, texture and dimension. But how do scientists translate the texture of grass, or the contour of a hand into computer code? The answer is geometry. In fact, three-dimensional geometric models form the base data for almost every computer application that requires a description of a shape. Computer Science professor Alla Sheffer is interested in the various algorithmic aspects of digital geometry processing. Sheffer came to UBC from Technion in Israel, attracted by BC's lifestyle, and the level of research and spirit of collaboration in the department and within ICICS.

Geometric modelling represents an object as a "mesh" of triangles (or polygons) which capture the outside surface of a 3D shape. Smaller triangles provide a more accurate description of the modelled object. However, this means using a larger number of triangles, which requires longer computational running time. "That's why this work is becoming relevant," admits Sheffer. "Ten to fifteen years ago we simply didn't have computers that were fast enough. Now they are reasonably fast, but you still need mathematics to do this modelling efficiently."

Texture Mapping and Morphing

Computer graphics and animation utilize numerous geometry processing tools, such as morphing and blending shapes, and transferring textures. Transferring texture from one shape to another (for instance from a camel to a horse) so that the texture appears in roughly the same areas requires a mapping process called cross-parameterization. This process ensures that the texture at a specific location—the horse's eyes, for example—is the same as the texture on the camel's eyes, while maintaining each animal's proper shape. Sheffer and colleagues have developed a cross-parameterization method that satisfies those requirements.

In addition to texture-mapping, the method can also be used to morph or blend shapes. (An example on her website shows a cow with the legs of a camel.)

Surface Remeshing with Geodesic Distances

Given one mesh that describes a model, it is often necessary to replace it by another mesh with different properties (triangle shape, size, etc). In order to do this the remeshing algorithms must measure distances between points on the surface.

Continued on page 9

"The moment you want to describe anything on a computer, you have to start with its shape."

Verifying Hybrid Embedded Systems

Computer scientist Ian Mitchell devises numerical algorithms to solve problems related to control and safety for complex hybrid systems.

- **Mathematical Software**
- **Dynamic Implicit Surfaces**
- **Optimal Control Methods**

Whether we like it or not, we are reliant upon computer-controlled systems to run almost every facet of our lives—cars, appliances, communications and power networks, games, and a plethora of other technologies and devices. These systems can be hybrid systems, which contain both discrete and continuous components, or embedded systems, which are "hidden" in devices that are not user programmable. Or they can be both.

"The problem is that the methodologies used to design these systems have not developed as fast as the complexity of the systems themselves," says new ICICS member Ian Mitchell. He is developing improved methods to design, analyze and verify these systems—many of which are used in safety critical applications.

Onboard Control Thwarts Terrorism

Aircraft are an excellent example. Twenty years ago, large aircraft were mechanically controlled by human pilots. Today, they are almost entirely controlled indirectly through electronic computer systems. "In fact, most of the cost of designing new aircraft is in proving that electronics work correctly," says Mitchell.

New systems will allow aircraft to communicate with each other and ground control without having onboard radar. While Mitchell admits that designing robust onboard navigational controls increases the verification process and overall cost, the technology prevents terrorists from taking over a plane—a serious consideration for airlines and governments today.

Mitchell came to UBC from UC Berkeley, where he worked on a project called "Soft Walls" with Edward Lee. Their goal was to design a system that would prevent the plane from entering restricted airspace, while still giving the pilot a sense of control. Mitchell studied ways of "gently" modifying the pilot's input as the aircraft approaches the restricted zone so as to ensure safety.

In hybrid embedded systems, often problems are not detected until late in the design cycle—and this also increases costs. Designing systems for reuse and future modification is another task that Mitchell is working on. As part of the design verification process, Mitchell uses mathematical models to discover discrepancies between high- and low-level design.

Continued on page 9

"It is easy to start at the top and design your way down to the operational system. However, by the time you get to the bottom, the original high-level description has little to do with what was implemented."

Kruchten: Continued from page 3

Global Software and Cultural Difference

While working with Rational in Europe, Asia, Australia, and North America, Kruchten was impressed by the impact of culture on global software development. In today's global environment, major software systems involve multiple designers, working in several companies in various countries with different cultures. "The issues are not technical as much as procedural," he says. "When we establish processes to build software we tend to assume a certain cultural model."

Whether these models are equally applicable in Bangalore or Budapest is one issue. They might work or fail, but they are still contained within a certain cultural context. Where the issue becomes critical is in outsourcing, where projects are created across cultures. For most software engineers, this is unfamiliar terrain. For Kruchten, it is a new area of research, and to navigate it he recently completed a certificate in Intercultural Studies at UBC. "Software development is mostly about people having to work together, communicate with one another and share ideas; it is not so much about the technology."

Philippe Kruchten can be reached at 604.827.5654 or pbk@ece.ubc.ca

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Chiao: Continued from page 4

He is working with ICICS members Nimal Rajapaske (ME) and Robert Rohling (ECE), and physicists Andre Marziali and Mario Beaudoin on multiphysics nanoscale simulations and microfabrication. On drug delivery systems, Chiao is collaborating with Dr. Helen Burt in the Faculty of Pharmaceutics. He is also working with ICICS member Jonathan Wu of the National Research Council to make novel MEMS sensors.

One of the challenges of MEMS and microfabrication in general is that it involves such a broad range of research. Another is finding people skilled in maintaining the sophisticated fabrication equipment. "The establishment of this CRC chair will help to bring this group of researchers together, and to train the highly qualified personnel needed in the areas of MEMS and nanotechnology," says Chiao.

Mu Chiao can be reached at 604.822.4902 or muchiao@mech.ubc.ca.

Sheffer: Continued from page 7

Typically, this has been done using Euclidian distances. But planar measurements on a curved surface can generate large discrepancies between the original surface and the constructed mesh. Sheffer solves the problem by using geodesic distances, which take into account the curvature or circumference of shapes. Rather than measuring the shortest planar distance between two points, this method measures the shortest path between two points along a surface.

Sheffer notes that equilateral triangles are most efficient for processing data and running simulations on models. Her remeshing algorithm can take a model, such as a medical scan, which might have millions of triangles or ill-shaped triangles, and regenerates the mesh with fewer, more symmetrical triangles that accurately define the original geometry—without costly parameterization techniques.

Sheffer's work also has applications in scientific computing. At the University of Illinois at Urbana-Champaign she worked on joint research with the Sandia National Labs. She has also worked with Fluent Inc. in the US, who specialize in fluid dynamic simulations. "If you are an engineer, it's not enough just to draw models that look good," says Sheffer. "You want to test the physics behind them, and you first want to do this on the computer before you actually build a beta model."

Alla Sheffer can be reached at 604.822.4030 or sheffa@cs.ubc.ca

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Mitchell: Continued from page 8

Taking Topological Control

The same methods used to study control problems in aircraft can be used for applications where modelling moving surfaces is critical. Funded by NSERC, Mitchell's research in "dynamic implicit surfaces" has applications in fluid dynamics, financial mathematics, computer vision, image enhancement, noise removal, shape detection and recognition, microchip fabrication, and computer-aided design.

Current modelling methods based on triangulation do not work well with surfaces that constantly break apart and merge, such as the surface of water. Mitchell has designed numerical algorithms to solve the Hamilton–Jacobi equation—a partial differential equation commonly used to solve optimal control problems—for use in modelling dynamic surfaces. This technology automatically handles the breaking and merging in fluid dynamics, and has been used to model flames, combustion, detonation, and the motion of shock fronts. Since coming to UBC, Mitchell has released an online "tool box" for solving these type of equations. "Any industry that must keep track of moving surfaces and follow the motion of a surface very accurately can potentially use this technology," he says.

Ian Mitchell can be reached at 604.822.2317 or mitchell@cs.ubc.ca

Passing Notes:

Congratulations to these ICICS members on their achievements!

New Buildings Nearing Completion
Our new $40-million ICICS building is scheduled for occupancy this December. The 8,900 sq. metre Fred Kaiser Building, formerly the Electrical and Computer Engineering Building is scheduled for completion in February 2005. Watch for a special building feature in our next issue of *FOCUS*.

Vijay Bhargava Receives James R. Evans Avant Garde Award
Professor **Vijay Bhargava**, head of Electrical and Computer Engineering, was awarded the James R. Evans Avant Garde Award at the IEEE Vehicle Technology Fall Conference on September 28, 2004, in Los Angeles, CA. He was recognized for his outstanding contributions to the development of wireless communications.

Mabo Ito Elected Vice-President of APEGBC
ECE professor emeritus **Mabo Ito** has been elected vice-president of the Association of Professional Engineers and Geoscientists of British Columbia (APEGBC).

Anne Condon Appointed NSERC/General Motors Chair
Computer Science professor **Anne Condon** has been appointed chair of a new program (The Jade Project) designed to increase the participation of women in science and engineering in BC and the Yukon. The $700,000 Chair for Women in Science and Engineering is funded by NSERC and General Motors of Canada. Condon's Jade project will encompass four initiatives, including the development of an interdisciplinary introduction to computer science and a bridging programme that will provide funding to universities across the province for initiatives that support women in science and engineering. See www.jadeproject.ca for more details.

Joanna McGrenere Receives Anita Borg Early Career Award
Computer scientist **Joanna McGrenere** is the first recipient of the Anita Borg Early Career Award from the Committee on the Status of Women in Computing Research. McGrenere was chosen for her contributions to the field of human computer interaction (HCI) and her commitment to promoting computer science to young women.

Holger Hoos Publishes New Book on Stochastic Local Search
Computer Science professor **Holger Hoos** has recently published Stochastic Local Search: Foundations and Applications. The 672-page book, which provides the first unified view of the field, was co-authored with Tomas Stützle from Darmstadt University of Technology, Germany. Their work provides an extensive review of state-of-the-art stochastic local search algorithms and their applications. The book also comprises a number of research contributions that represent significant advances in the analysis and design of stochastic local search algorithms.

Martha Salcudean Named to Order of Canada
Mechanical Engineering professor emerita **Martha Salcudean** was recently named to the Order of Canada for her career contributions to engineering and her research on fluid flow, heat transfer and computational fluid dynamics.

Gary Schajer Receives Teaching Award
Mechanical Engineering professor **Gary Schajer** was awarded the 2004 Teaching Award of Excellence in Engineering and Geoscience Education by the APEGBC.

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UBC's Institute for Computing, Information and Cognitive Systems (ICICS) is an umbrella organization that promotes collaboration between researchers from the faculties of Applied Science, Arts, Commerce, Dentistry, Education, Forestry, Medicine, Pharmacy, and Science. ICICS supports the collaborative computer-oriented research of more than 135 faculty members and over 500 graduate students in these faculties. ICICS researchers attract approximately $15 million in annual grants and contracts. Their work will have a positive impact on us all in the future.

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ICICS, University of British Columbia
289-2366 Main Mall,
Vancouver, BC, V6T 1Z4
info@icics.ubc.ca

Editor: Gale Ross, ICICS Administrative Assistant

Writers: Mari-Louise Rowley, Pro-Textual Communications; William Knight, Wilyum Creative

Photos: Janis Franklin, UBC Media Group

Design: Jarret Kusick, Hitman Creative Media Inc.

Office: 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