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ICICS FOCUS

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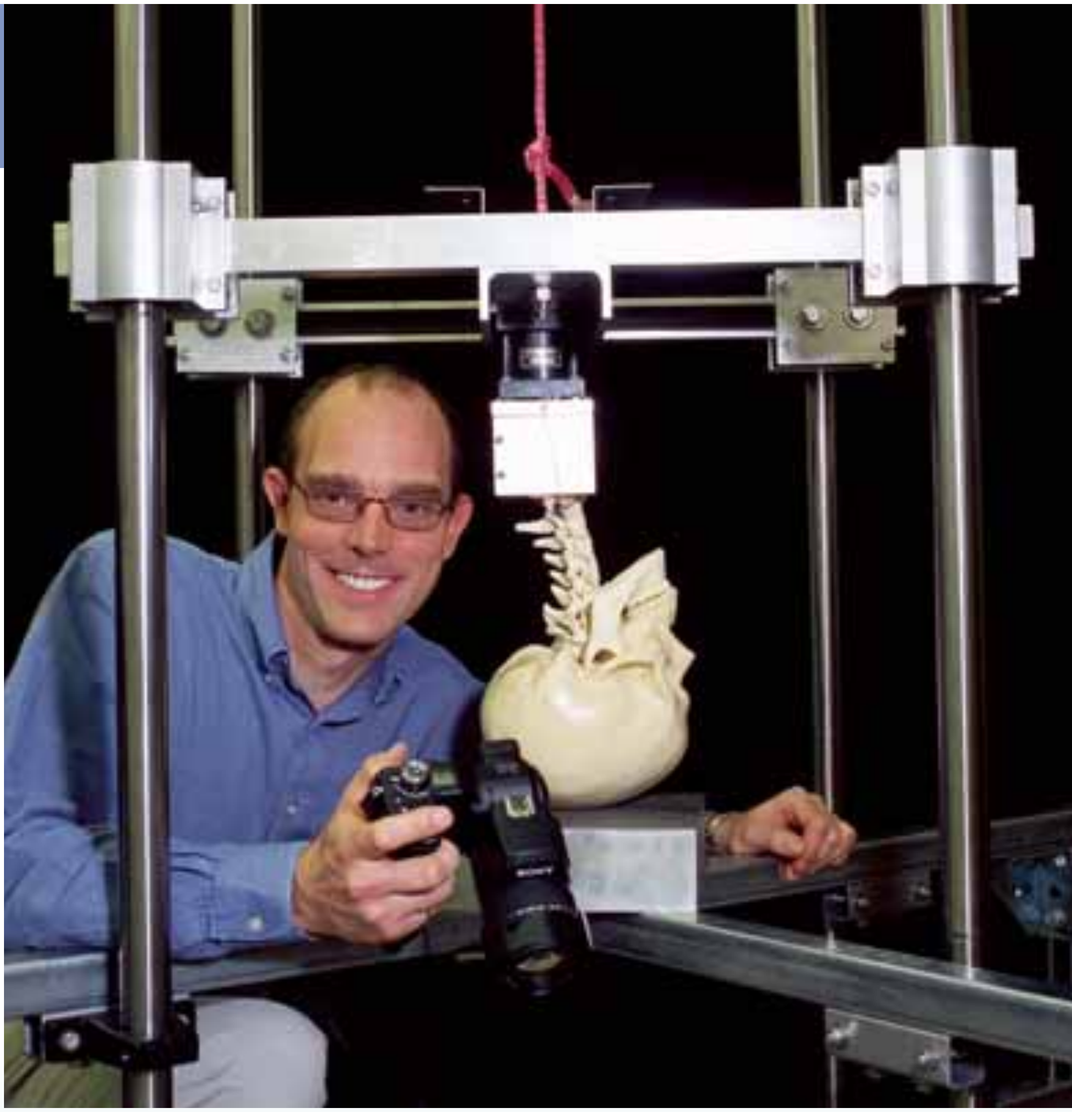
Understanding the Biomechanics of Injury

New ICICS member Peter Cripton is studying the biomechanics of the spinal cord in order to prevent and reverse the effects of traumatic injury.

- **Injury Biomechanics**
- **Spinal Cord Injury**
- **Implantable Surgical Devices**



Understanding the effect of mechanical forces that the body is subjected to in a traumatic injury will help lead to better prevention and treatment. Mechanical engineer and ICICS member Peter Cripton is director of the Injury Biomechanics Lab funded by CFI, the BC Knowledge Development Fund, NSERC, and the BC Neurotrauma Fund. He and colleagues are studying how the effects of compression, tension, shear, and bending of the spinal cord during trauma contribute to its injury. Their work is crucial in the development of new treatments and therapies such as neural regeneration.

"For example, we want to know how much the spinal cord is compressed by the bone," says Cripton. "Also, how fast is the bone moving on impact, and how much compression, bending, and shearing are introduced at the time of injury?"

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ICICS

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ICICS Director's Corner

In this expanded issue of FOCUS we feature nine talented new ICICS members from the Faculties of Science, Applied Science, and Education, whose work spans the fields of biomedical imaging, injury biomechanics, and e-learning.

In Electrical and Computer Engineering, Rafeef Abugharbieh is working with medical professionals to develop imaging tools that facilitate the analysis and interpretation of data. Konstantin Beznosov is working to provide safe and affordable software security systems, improved security assurance methods, and streamlined security administration. Guy Lemieux's work in computer systems architecture and programmable chips allows hardware features to be added or removed at the software level.

In Mechanical Engineering, Peter Cripton is working to understand the biomechanics of the spinal cord to help prevent and reverse the effects of traumatic injury. Derek Yip-Hoi uses geometric and solid modelling methods in CAD systems to develop virtual machining applications for the aerospace industry.

Recent Computer Science member Robert Bridson combines computer graphics with numerical methods to develop physics-based photorealistic animation. Colleague Charles (or "Buck") Krasic designs real-time systems to improve the delivery of continuous multimedia over the Internet. Kevin Leyton-Brown develops powerful algorithm portfolios and uses game theory to solve online problems.

In the Faculty of Education, Don Krug is researching the process and methods of teaching and learning to improve the development of educational technologies.

We hope you enjoy the profiles of our recent ICICS members. Their work reflects the innovative research and collaboration that we strive to support.

Rabab Ward, ICICS Director

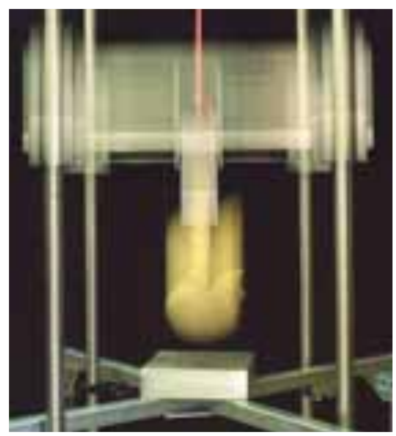
Cripton: ***Continued from page 1***

Creating a Surrogate Spinal Cord

Studying the biomechanics of spinal cord injury is difficult because the human spinal cord is made of very soft tissue that pulses with blood flow. The mechanical properties of cadaveric tissue degrade very rapidly, and spinal cords not perfused with blood will react differently than live tissue. Current studies are done on animal models; therefore, treatments under development run the risk that they might not work as expected in humans.

In collaboration with Dr. Tom Oxland in the Faculty of Medicine, Dr. Wolfram Tetzlaff at UBC's International Collaboration on Repair Discoveries (ICORD), and with funding from the BC Neurotrauma Fund, Cripton and his lab are working to develop an elastomeric surrogate spinal cord to better model the biomechanical effects of trauma.

Once the surrogate spinal cord is complete, Cripton and colleagues will be looking at developing devices—a helmet with cushioning properties, for instance—to prevent neck and spinal cord injuries common in hockey and other sports.



"In order to know if the device will work, we will need to use the surrogate cord to be able to estimate the degree to which the spinal cord damage is mitigated," he says.

Cripton and ICICS member Rafeef Abugharbieh will be collaborating to collect mechanical data relevant to the future development of the surrogate cord using novel imaging methods with high-field MRI data.

"What we want to do is improve the biofidelity, so there is concordance between injuries studied in animal models and injuries that happen in humans."

Cripton is also working with companies like Archus Orthopedics in Seattle on preclinical testing of implantable devices, such as rods, plates, and artificial vertebral discs used in spinal surgery.

Improving Airbag Design and Testing

As an initiative of Partners for Advancement of Collaborative Engineering (PACE), Cripton has worked with General Motors of Canada to design better deployment technology for airbags and to study debris projectiles and eye injury in automobile accidents. In one aspect of this research, he proposed alternative methods for testing the force of airbag deployment that use computer simulation and only the parts of a crash test dummy that would interact with the airbag (head, neck, upper torso). "Crash test dummies are very expensive—something like $100,000 with all the instrumentation," notes Cripton. His methods may allow airbag design modifications to be tested more quickly and inexpensively.

Peter Cripton can be reached at 604.822.6629 or cripton@mech.ubc.ca

Creating Dynamic E-Learning Environments

Education professor Don Krug is studying the processes and methods of teaching and learning to develop educational technologies that enhance, rather than complicate, these processes.

- **Pedagogical Interface Design**
- **Rich Media and Simulations**
- **Educational Technologies**

Fulbright Award recipient and recent ICICS member, Don Krug came to UBC from the Ohio State University (OSU) in 2002 so that he could pursue his interest in educational technologies and pedagogy—or the art and science of teaching and learning. This seems fitting, given that Krug spent ten years teaching art education and the integration of information and communication technologies (ICT) at OSU. As a public school teacher in the early 80s, he was also one of the first to use a computer in the classroom.

Interacting in Reality vs. Virtuality

Krug is now studying how best to use rich media and educational technologies in face-to-face, hybrid, and online learning environments, whether it is a K–12 classroom, an online university course, or professional development seminar. “My research involves asking critical questions about the social-cultural conditions of using ICT in education to ensure that human interaction remains part of the process of teaching and learning,” he says.

For example, how do people interpret being in a virtual environment? Does it change the way we interact or learn? Krug doesn’t believe we should dichotomize between reality and virtuality. “We need to understand that they are actually connected embodied experiences, and that electronic spaces are social spaces,” he says. “I am interested in how people interact within those spaces and how we can use them to improve the social, cultural, and cognitive dimensions of teaching and learning.”

“Most ICTs are designed for business, industry, or entertainment and then are adapted for education. We need to look at designing them for education based on empirical research.”

Improving Teacher-Student-Computer Interaction

Existing online learning systems, such as FirstClass and Blackboard, are organized around a template-driven design,

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Modelling the Physics of Motion

Computer scientist Robert Bridson combines numerical methods with computer graphics to develop physics-based photorealistic animation of natural phenomena.

"In many cases physics tells us exactly how things should move, so by modelling these properties, the computer does the bulk of the work and the animator does the final tweaking."

- **Geometric Modelling**
- **Scientific Computing**
- **Physics-based Animation**

Computer animation has become a ubiquitous part of our lives—from feature films and video games to animation used in modelling for medical and industrial applications. While the industry strives for more photorealistic effects, achieving them is still an art form that computer scientists are working to master.

"In traditional animation, the animator controls all the parameters in a model over time," says new ICICS member Robert Bridson. "With some phenomena, however, it is difficult to determine what exactly you should be tweaking every few times per second."

"Most scientific computing is focused on getting the right answer from a realm of possibilities. In animation, the definition of 'right' is that it looks good."

Consider the challenge in modelling the wrinkles and folds in clothing as it moves with the body. This can involve setting over 40,000 variables for each frame, notes Bridson. By modelling the physical properties of movement, such as elastic forces and the friction of cloth against the body, he develops numerical algorithms that streamline the animation process by allowing the computer to fill in intermediate frames.

Bridson's methodology incorporates both fine triangular mesh models and level set methods, which use the relationship between moving interfaces and computational fluid equations to deal with problems where the interfaces (cloth against skin, for example) develop sharp corners or wrinkles, change topology, or become very intricate. The advantage of his approach over previous methods is not only speed and efficiency, but also less flattening of the modelled surface. The use of advanced numerical algorithms can also facilitate shape modelling and motion processing.

Replicating Rodin

Digital sculpture, claymation, and other graphic applications would benefit from faster and cheaper simulations of solid mechanics, such as elasticity and plasticity, notes Bridson. He uses similar numerical methods to provide better operators and interfaces for interactive sculpting.

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"Programmable logic enables niche markets to design custom hardware without the customized cost or risk."

Road Mapping Programmable Logic

- Programmable Logic
- Interconnection Networks
- Computer Systems Architecture

New ICICS member Guy Lemieux works at the interface of computer software and hardware, designing the complex architecture of programmable computer chips.

With advances in deep submicron technology (DSM), today's largest chips contain 500 million transistors. If Moore's law holds true and density continues to double every eighteen months, a single chip will soon contain a billion transistors. The process of designing for these advanced manufacturing technologies is growing rapidly. As a result, in 2003, only about 2,000 of the 50,000 new chip designs were built as application-specific integrated circuits (ASICs). The rest use pre-designed programmable chips called field programmable gate arrays (FPGAs). "Only specialized applications with very high product volumes can continue to use custom-manufactured ASICs," says Electrical and Computer Engineering professor Guy Lemieux.

FPGAs use programmable logic to break up the logic functions into smaller programmable blocks, or "gates," which then must be reassembled in a predefined grid. Lemieux compares it to designing a congestion-free traffic network that will still be efficient decades later, when many commuters have moved residences or changed jobs. Instead of roads and intersections, he works with electrical wires and switches—designing the road map that interconnects over 1,000,000 gates automatically. He also designs algorithms that compute the shortest routes over a fixed network for all the gates, or signals, without causing congestion.

Interconnecting Programmable Logic

As devices get smaller and the number of transistors increases (consider the palm-sized computer with cell phone, camera, calculator, radio, etc.) designers face the problem of scaling. When transistors shrink below the 90-nanometre size, the rules of physics change and begin to play havoc with signal noise and integrity.

Lemieux recently co-authored *Design of Interconnection Networks for Programmable Logic* with David Lewis of Altera Corporation. The book presents cutting-edge research on merging deep submicron technology with programmable logic.

The Promise and Price of Programmability

Reconfigurable chips have several advantages over custom-built ASICs. With no manufacturing setup fee, upfront design costs for an "off-the-shelf" FPGA are around $10,000 versus $10–$100 million for an ASIC. In addition, the design challenges posed by deep submicron technology mean there is a high risk that custom-designed chips won't work the first time around. Fixes at that stage can cost $1 million for new manufacturing costs alone, and take up to three months to test.

For small to mid-size companies that do not have high manufacturing runs or deep R&D budgets, FPGAs provide an affordable alternative to custom design.

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Security Under Pressure

- Distributed Systems Security
- Engineering Secure Software
- Usable Security

"For consumers every type of software—from air traffic control systems to e-mail programs and cell-phone goodies—becomes security critical."

As software systems become more complex and interconnected, the crux and challenge of Konstantin Beznosov's research is keeping them secure and yet affordable.

When a company decides to invest in security systems, one of the things it must consider is the total cost of ownership, says Konstantin Beznosov, professor in Electrical and Computer Engineering and new ICICS member. He likens it to buying a vehicle. Typically you want one that is safe while also easy to drive and maintain. Unfortunately, when it comes to security systems, these days you can buy either a Hummer or a bicycle.

"I am investigating how to build a range of intermediary versions that would provide a better choice and combination of properties," says Beznosov, who has authored two books on systems security. He came to UBC from industry in August 2003, where his work with Baptist Health South Florida, Hitachi Computer Products (America), and with telecommunications and banking companies has given him an inside view of looming security challenges.

These security challenges include system interconnectedness and distribution over the Internet and networked environments, dependability, and access control, particularly in large organizations. Security designs must also support the evolution of a system—including changes in users, policies, and applications. And in large enterprises, the challenge is to ensure that policies are consistently enforced across different applications.

Separating Security and Application Logic

Like the frame and foundation of a building, software architecture defines structure and provides strength, or rigour. Yet in software security systems, the architecture must be flexible enough to accommodate changes in policy, performance, scalability, and other requirements. Separating security logic from application logic is one way to support flexibility. Beznosov is designing application and security logic components that would be separate and modularized but still able to "speak to each other," so the system could make application-specific decisions.

Agile Security Assurance

Traditional "waterfall" methods of software development follow a plan-driven approach, where each stage is completed before the subsequent stages. Today, this "waterfall-driven" approach to security assurance is too expensive and risky for companies dealing with market competition, changes in requirements, and new developments in technology. More iterative approaches to software development, called Agile Methods, are helping shorten the time to market for non-critical software.

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Modelling Geometry in Virtual Machining

Mechanical Engineer Derek Yip-Hoi uses geometric and solid modelling methods in CAD systems to advance virtual machining technology.

- **Virtual Machining**
- **Layered Manufacturing**
- **Solid Modelling**

What do automotive engines, plastic bottles, and aerospace impellers have in common? They all require metal removal machining in some part of their manufacturing process—whether it is used to make tools, moulds, or the entire part. Recent ICICS member Derek Yip-Hoi is literally working at the “cutting edge” of this process. He uses geometric and solid modelling methods to simulate the complex and changing geometry between the cutter and the workpiece.

Yip-Hoi and fellow ICICS member Yusuf Altintas hold the junior and senior Industrial Research Chairs in Virtual Machining, a technology that incorporates the science of metal cutting, machine tools, and geometry to develop models that accurately predict the machining process. The benefits of virtual machining are reductions in engineering time, error, and machine wear and tear. It could also help manufacturers more accurately determine which processes to follow, as well as optimize equipment selection. Yip-Hoi and Altintas are working with industry partner Pratt and Whitney on virtual machining applications for the aerospace industry.

Aerospace Machining—Simulating Metal Removal with Solid Modellers

Yip-Hoi uses CAD methods to calculate the geometric description of the cutter-workpiece engagement to help predict cutting forces. It is a difficult and computationally expensive task. Not only is the engagement changing as the machining progresses, the 3-D workpiece geometry being modelled must be continually updated by removing complex volumes generated from the cutting tool motions. Accuracy requires numerous updates and over 10,000 engagement calculations.

Many critical aerospace parts, such as compressor housings and impellors, are machined from a solid block of titanium or aluminium for maximum strength. The complex geometries require from 2 1/2 to 5-axis machining involving the three linear x, y, and z axes and two optional rotational axes to change cutting tool orientations.

One of the difficulties is that current solid modelling techniques used to represent 3-D objects are not yet robust enough to handle the type of ill-formed geometries that can be encountered when simulating machining processes. “In design, fewer solid modelling operations are performed, and the designer can intervene when problems occur. This is not an option during machining simulation,” says Yip-Hoi.

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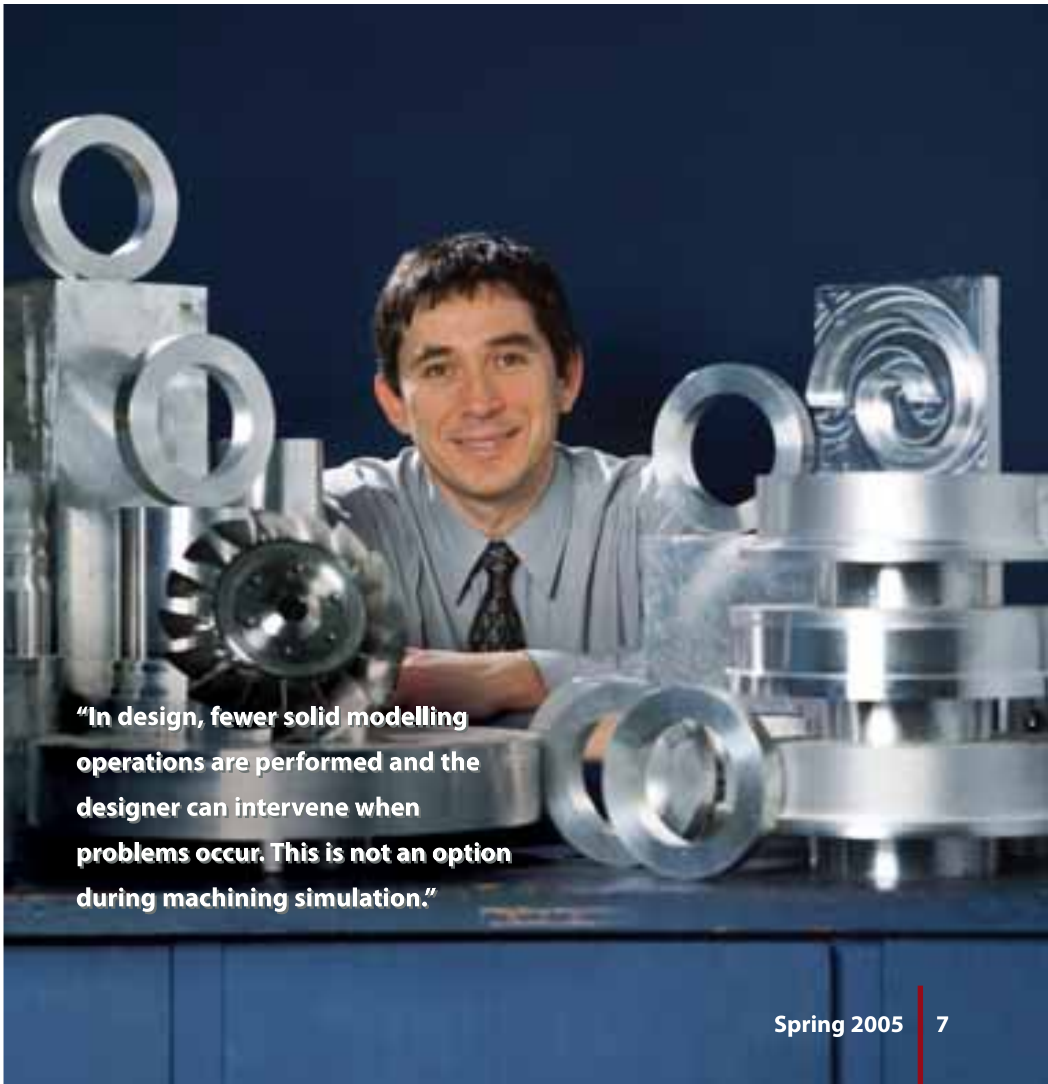


“In design, fewer solid modelling operations are performed and the designer can intervene when problems occur. This is not an option during machining simulation.”

Encode Once—Stream Anywhere

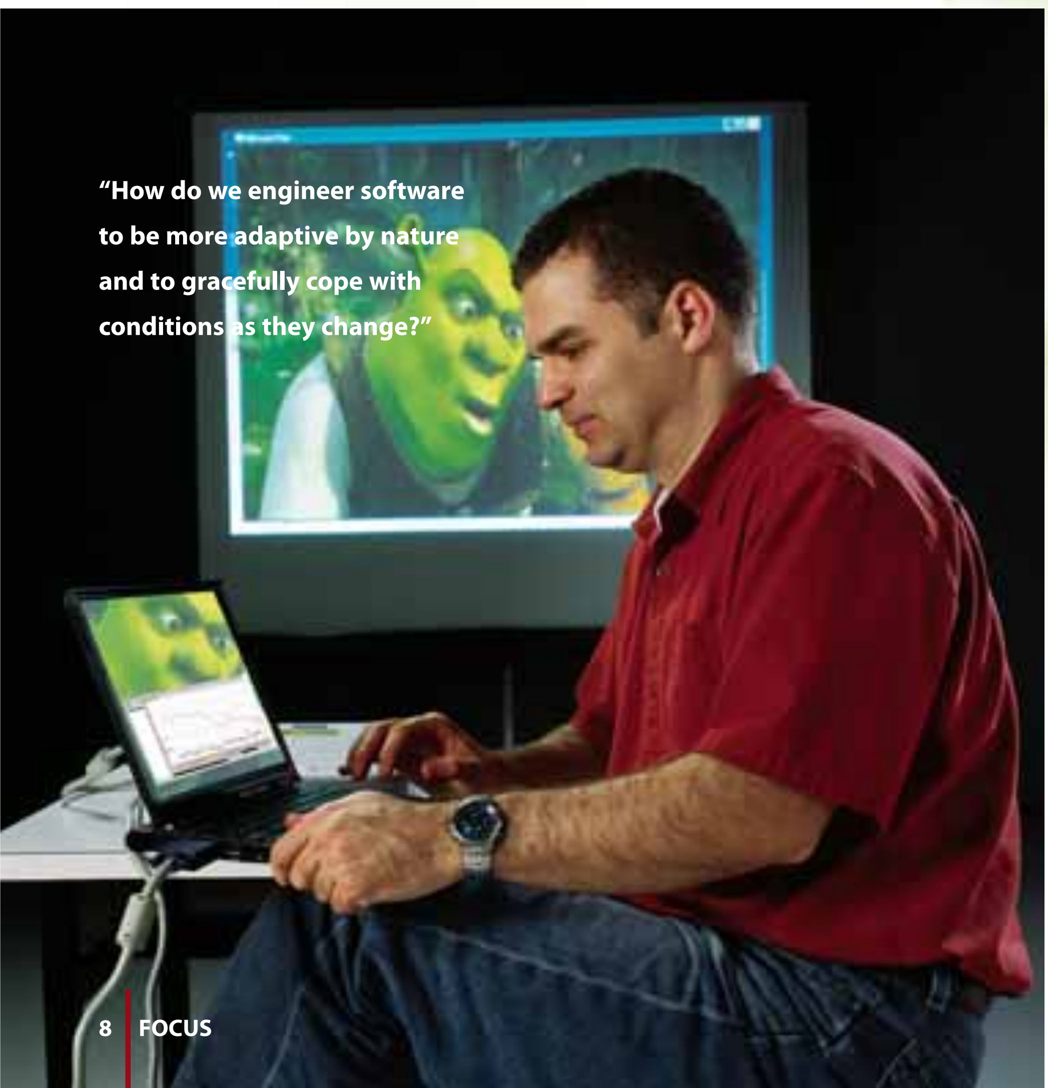
New ICICS member Charles (Buck) Krasic is developing real-time systems to improve the delivery of continuous multimedia services over the Internet.

- **Multimedia Streaming**
- **Real-time Systems**
- **Networking**

Many of us can remember logging on to the Internet for the first time. More than a decade ago, it was a text-based, dial-up experience, slow and cumbersome—but exciting. Today's high-speed and wireless systems enable us to send text, images, audio and video clips almost instantly around the world. The speed with which technology has developed has not been fast enough for computer scientist Charles Krasic, however. "The idea of real-time audio-video communication has been around for years, but we are still not there yet," he says.

With the anticipated convergence of telecommunications and television over the Internet, the problem that content providers face is how to deliver real-time performance with the Internet's best effort service model. One approach has been to try to change the way the Internet operates to better support real-time audio and video.

Krasic believes the more realistic approach is to design adaptive, time-sensitive computing systems that make the most of the existing internet infrastructure. This means breaking with traditional assumptions that video has one quality level and one bit-rate requirement. "If you represent video efficiently, its bit rate is highly variable over time," he says. In the video medium, an action sequence in a movie or sporting event will have a much more variable bit rate than a news anchor speaking into the camera.



"How do we engineer software to be more adaptive by nature and to gracefully cope with conditions as they change?"

Not only is the data transmission rate variable, the available bandwidth on the Internet at any given time is highly variable as well. "The Internet is a shared medium, and more or less an on-demand service," says Krasic. Add the variability of mobile technologies, where data reception and transmission change over time and location, and different types of user devices (home theatre versus multimedia phone), and we begin to see the conundrum he is working to solve.

Streamlining Video with QStream

To enable adaptive video streaming, Krasic developed QStream, a system that adjusts video quality to match resources. QStream's video compression component, called SPEG (for scalable MPEG), allows for multiple bit rates, and system network protocols control how the video quality adapts to available resources. Krasic's goal is not only to design systems that minimize video degradation when network bandwidth decreases but also to increase video quality when network connections improve.

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Decoding Digital Biomedical Images

Electrical and Computer Engineering professor Rafeef Abugharbieh works alongside medical professionals to help them analyze and interpret data from an array of imaging technologies.

- **Biomedical Imaging**
- **Image Analysis**
- **Signal Processing**

An expert in the processing, analysis, and understanding of digital images, Rafeef Abugharbieh joined UBC in January 2004. Since then the new ICICS member has become immersed in the multidisciplinary research of biomedical imaging. Along with Dr. Martin McKeown, a clinical neurologist and professor in the Faculty of Medicine, Abugharbieh co-founded and now co-directs the Biomedical Signal and Image Computing Lab (BiSICL) at UBC (http://bisicl.ece.ubc.ca).

"In recent years we have witnessed rapid developments in imaging technologies for biomedical applications," says Abugharbieh. MRI, CT, ultrasound, and functional imaging like fMRI have become integral tools for diagnosis, therapy planning and evaluation, planning and simulation of surgery, automation of routine medical tests, and medical education.

However, medical professionals face increased challenges in processing and understanding burgeoning amounts of data and in merging information from different modalities. Effective analysis and visualization is extremely difficult and time consuming without the use of automation. Abugharbieh's work in computerized image analysis, interpretation, and visualization is essential for the fast, accurate, and reproducible extraction of information buried within the volumes of high-resolution multidimensional data produced in hospitals and clinics.

Dissecting the Digital Body

Medical images are very challenging to analyze because anatomical structures are usually non-rigid; they do not have well-defined contours, and the size and structure of the body's organs also vary significantly among individuals. In addition, data noise and occlusion are common and result in poorly-defined structures in images.

One of the core problems of medical image analysis is the development of automatic segmentation techniques. Given the data complexity, the image variability, and the variation in the shapes of anatomical structures, the design of computerized techniques for segmenting and reconstructing compact analytical shape representations or models is very difficult.

Continued on page 13

Game Theory Tackles Real Problems

Computer scientist Kevin Leyton-Brown studies the empirical behaviour of algorithms and uses game theory to solve problems that arise on the Internet.

- **Game Theory**
- **Computational Problems**
- **Combinatorial Auctions**

"The idea behind this research is to consider algorithms as though they were natural phenomena, rather than merely human artefacts."

In notoriously intractable NP-hard problems, devising algorithms that can quickly sort through potential solutions to find the true solution is an ongoing challenge, particularly in economic and AI applications. One of the NP-hard problems that new ICICS member Kevin Leyton-Brown has worked to solve is, Who is the winner in a combinatorial auction?

This type of auction involves numerous items and bidders, where items become more valuable in combination than individually. A key industry example that Leyton-Brown worked on is the sale of bandwidth spectrum by the Federal Communications Commission (FCC) in the US for mobile communications. "With all of these separate, partially overlapping bids, it is very difficult for the auctioneer to decide who won," he notes. "And using the best existing techniques, the difficulty grows exponentially with the number of things you are selling."

Recently, Leyton-Brown has been using machine learning to build models that predict algorithm run-time. He also uses these models to combine several algorithms together into a portfolio that can outperform its individual components.

Playing with Game Theory

Leyton-Brown's interest in computational problems arose from his core work in game theory, a mathematical tool for understanding a broad range of interactions where two or more individuals have different or opposing goals. It is easy to see how game theory might apply in network applications where users share computer time on the Internet, participate in peer-to-peer file sharing systems such as Napster, or allocate bandwidth between computing processes. Leyton-Brown is using game theory to determine what incentives would encourage people to use a network in the most efficient way.

Online auctions are a key example. Here, unfortunately, it is easier for bidders to collude than in many conventional settings.

Continued on page 13

Krug: ***Continued from page 3***

which draws on the metaphor of the "screen as book" where users click on a chapter and scroll for information. As an associate of the Human-Computer Interaction (HCI) group and the Media and Graphics Interdisciplinary Centre (MAGIC), Krug is working with ICICS colleagues Sid Fels and Brian Fisher on the pedagogical interface design of virtual education environments to enhance the use of ICT. Krug notes that the interface must also allow for serendipity, reflection, and critical analysis—the precursors and offshoots of creativity and discovery. "If we as teachers can create interfaces that mirror the kind of inquiry we want to undertake as lifelong learners, the chances of students engaging in these processes are much greater."

Getty, Art 21, and Professional Education

In partnership with the Getty Center for Education in the Arts, Krug authored one of their most successful professional development websites, Art & Ecology: Interdisciplinary Approaches to Curriculum. Together with the UBC Faculty of Education, Davis Publications, and *Art 21: Art in the Twenty-First Century*, a PBS documentary series about contemporary visual art and the artists who make it, Krug and colleagues are working to create online courses offered to local, national, and international UBC students.

Krug and his team of graduate students are also helping UBC elementary teacher education students to develop e-portfolios and an educational Web portal called Seeds of Possibility. The project is designed to facilitate critical inquiry around issues of ICT literacy, fluency, and integration, while encouraging teachers to examine the use of ICT to enhance student learning and achievement.

Don Krug can be reached at 604.822.5318 or don.krug@ubc.ca

Bridson: ***Continued from page 4***

He likens his approach to that of master sculptor Rodin, who, in the 1800s, produced a library of body parts in different positions that he used in a tactile "cut and paste" method. "Current 3-D computer graphics don't allow you to cut and paste in a natural way," Bridson admits. "It seems that 3-D animation is just crying out for computerization."

Modelling Complex Materials

Objects and materials that involve a lot of contact and collision are not well described by either fluid or solid models and have proved a major bottleneck in scientific computing. Bridson is adapting his animation algorithms to model these complex interactions in granular materials such as sand, grain, cement, and lava. He is working with ICICS colleague Chen Greif to break down the large linear systems required to solve these materials problems into smaller matrices to get approximate answers. Defining these numerical "pre-conditioners" provides a road map to choosing the next mathematical step, or direction, in order to arrive at the "right answer" to these types of problems as quickly and cheaply as possible.

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Lemieux: ***Continued from page 5***

They also help accelerate product development, reduce time to market, and allow for easy product differentiation, where hardware features can be added or removed at the software level. FPGAs are now widely used in high-end consumer electronics such as HDTVs and the next-generation of SmartPhones (PDA plus cell phone). They are also increasingly being used in lower-end products, such as DSL modems, where hardware technology is changing rapidly.

The downside of adding programmability is that it increases chip size by 20 to 100 times over a custom ASIC. However, with the next-generation of FPGAs coming in at 65-nm, they will have reclaimed 16 times their area penalty simply by containing smaller transistors, notes Lemieux. He is working to improve the density and performance of FPGAs even further.

"There are a lot of niche products, such as medical instruments, that have specific functions and a limited market," says Lemieux. "In places like Canada, programmable chips allow small companies to do the kind of product development that wouldn't have been possible before."

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***Beznosov:* Continued from page 6**

However, security concerns are increasing as more companies adopt agile methods that are difficult to verify, since documentation is minimal. Bringing in experts at each iteration of design is prohibitively costly and time consuming. Beznosov and ICICS colleague Philippe Kruchten are studying ways to modify security assurance to make it more amenable to agile methods of software development.

"Hands-On" Security Administration

Beznosov is also working with ICICS colleagues Sid Fels, Brian Fisher, and Lee Iverson to apply human-computer interaction methods to improve administration of complex security systems. In a university system, for example, organizational policies have regulations about access for instructors, students, courses, buildings, and rooms. On the other hand, security administration uses information resources such as files, users, directors, and database tables. This causes a mismatch between high-level organizational policies and the means of implementing those policies. Administrators have to bridge the gap in their heads, with no way of validating what they are doing. "We want to give administrators better tools to make the job more intuitive, in order to eliminate the gap between these different models and make it less error-prone," says Beznosov.

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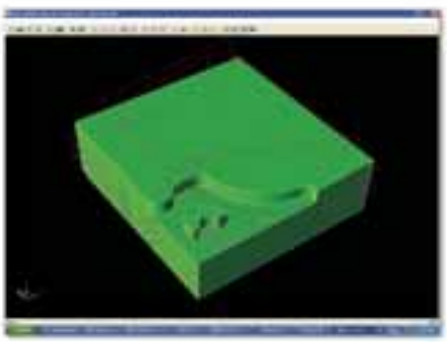
***Yip-Hoi:* Continued from page 7**

His work involves trying to simplify the geometry by reducing the number of intersections involved in order to increase



robustness and decrease computational time. "If we can space the intersections out further by making assumptions about how the geometry is changing on the workpiece, then it reduces the amount of computation required," he says. "However, you need to build intelligence into your algorithms to be able to do that."

Rapid Manufacturing and Tooling—from CAD Design to Device

In Rapid Manufacturing and Tooling (RM&T), additive processes have an advantage over machining processes by significantly reducing the engineering time. Objects are built one layer at a time, by curing of photosensitive materials, deposition of polymers, spraying, and sintering of metals, or through lamination. Yip-Hoi recently received funding from CFI, the BC Knowledge Development Fund, the BC Innovation Council, and several industry partners to develop an RM&T research facility at UBC to advance an integrated approach for rapid product development. "With layered manufacturing you can generate a tool or final part fairly quickly by reducing the hands-on engineering time," says Yip-Hoi. The new facility will help give Canadian manufacturers a competitive edge by bringing innovative products to market faster.

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***Krasic:* Continued from page 8**

"We want to make sure they are 'future proofed' so they can handle advancing technology."

Krasic uses digital high-definition television (HDTV) as an example. "HDTV has been struggling for nearly ten years to become mainstream," he says. Meanwhile, basic communications technologies—computing, storage, networking, and displays—have been advancing rapidly. Given those trends, Krasic believes that current HDTV standards may be at risk of becoming "too little, too late."

And then there is the dream of the "video phone." Surprisingly, the difference between watching a stored video (like a movie) and real-time conferencing is not well understood, even by experts in the field, Krasic notes. "My goal is to provide the tools needed to simplify how we put all forms of video online—from high-definition movies to real-time video conferencing."

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Abugharbieh: ***Continued from page 9***

To help solve the segmentation problems, Abugharbieh is developing novel intuitive deformable models that incorporate underlying geometrical and statistical information about both natural and deviant disparities in organ shape.

Signal Processing in Multiple Sclerosis and Parkinson Disease

Functional and structural MRIs are key diagnostic tools for Parkinson disease and multiple sclerosis (MS). Yet MRI data is very difficult to interpret. Abugharbieh is collaborating with the Pacific Parkinson's Research Center and the MS MRI Group at UBC to devise data analysis methods to quantify findings in MRI data and to build those methods into the imaging and diagnostics pipeline. This will deliver statistically significant information, automatically query deviations from the norm, and decrease errors from intra- and inter-operator variability.

"We want to enable physicians to interactively browse 3-D and higher dimensional data and be able to efficiently and accurately inspect and query the data in the whole image space."

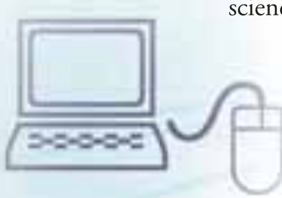
"We want to automate the process for clinicians," says Abugharbieh. "Give us the data and we will align it, register it, find the structures, identify changes, and link this with clinical observations." In other words, they will provide tools to help clinicians visualize, quantify, and interpret the data they are looking at in order to facilitate patient diagnosis and care.

Rafeef Abugharbieh can be reached at 604.822.6034 or rafeef@ece.ubc.ca

"We will use techniques from artificial intelligence to develop strategies for agent behaviour in economic settings that are too complex to analyse with game theory alone."

Leyton-Brown: ***Continued from page 10***

Leyton-Brown has used game theory to determine what collusion protocols are stable, or in other words, what would not lead colluding bidders to lie to each other or to the auctioneer. "It turns out that self-enforcing collusion often doesn't hurt the seller much because it still has to allow competition among the bidders," he says. "An auction site might be willing to allow some collusion in exchange for more traffic."



Getting More Players with LEGs

"In traditional game theory, most games involve two agents and two actions," says Leyton-Brown. "But to model the real world, we need to model many actions for numerous agents in some kind of compact representation." Recently, he has developed a new class of games called local-effect games (LEGs), where each player's utility depends on how many other players choose either the same action or other actions which "locally affect" the chosen action. He has also developed a more general class called action graph games (AGGs), which compactly expresses a broader class of large multi-player games.

Leyton-Brown sees two main ways in which game theory and computer science will affect each other in the near future. "First, computer systems that involve multiple, non-cooperative users, such as networks and P2P file sharing services, will be designed in a way that takes users' incentives into account," he says. "Second, we will use techniques from artificial intelligence to develop strategies for agent behaviour in economic settings that are too complex to analyse with game theory alone."

Kevin Leyton-Brown can be reached at 604.822.1453 or kevinlb@cs.ubc.ca

Passing Notes:

ICICS Welcomes New CS Head
William A. Aiello, newly appointed head of Computer Science, arrives at UBC from AT&T Research Labs in New Jersey, where he managed research into network security, cryptography and data privacy. His research interests include cryptography and complexity theory. Welcome Dr. Aiello.

CS Professors Awarded $US 46,350 from Microsoft Research
Kris De Volder and **Eric Wohlstadter**, members of the Department of Computer Science's Software Practices Lab, have been awarded a Microsoft Research University Relations grant. De Volder and Wohlstadter are developing programming rules to improve software reliability.

First Dahl-Nygaard Prize Awarded to Gail Murphy
Computer Science professor **Gail Murphy** has been awarded the first Dahl-Nygaard Junior Prize 2005 for her teaching and contribution to reducing software-system problems. The prize committee cited Murphy's commitment to preparing a new generation of researchers.

Two CS Professors Receive IBM Faculty Awards for Innovation
Gail Murphy and **Gregor Kiczales** have each received Faculty Awards for Innovation of $27,000 from IBM for research using open source technologies.

CFI New Opportunities Fund Awards
Mechanical Engineering professors Martin H. Davy, **Derek Yip-Hoi**, and **Peter Cripton** have received CFI New Opportunities funding totalling over $1M. Cripton is researching reducing injury through biomechanics. Davy's research centres around pollution and protection of the environment while Yip-Hoi's research focuses on manufacturing and processing techniques.

Funding for Biomedical Signal & Image Computing Lab (BiSICL)
To equip BiSICL, ECE professor **Rafeef Abugharbieh** and Department of Medicine professor Martin McKeown have received $791,000 from the CFI New Opportunities Fund, BCKDF, ECE, the Brain Research Center, and ICICS.

Funding for INTEGrated RAdio-communication Lab (INTEGRAL)
INTEGRAL will get new equipment thanks to five ECE professors—**Lutz Lampe**, **Guy Lemieux**, **David Michelson**, **Shahriar Mirabbasi**, and **Vincent Wong** who have received a total of $1,290,000 from the CFI New Opportunities Fund, BCKDF, ECE, ICICS, and equipment vendors.

Clarence de Silva Appointed
Clarence de Silva has been appointed for a three-year term as Director of the NUS-UBC Applied Science Research Centre at UBC by Michael Isaacson, Dean of the Faculty of Applied Science.

Ian Cumming Publishes New Book on Processing Synthetic Aperture Radar Data
ECE professor **Ian Cumming**'s book *Digital Processing of Synthetic Aperture Radar Data: Algorithms and Implementation* provides complete "how to" guidance on digital processing of synthetic aperture radar (SAR) data.

Outstanding Paper Award for Guy Dumont
ECE professor **Guy Dumont** was awarded (with G. Stewart and D. Gorinevsky) the IEEE Transactions on Control Systems Technology 2004 Outstanding Paper Award at the 43rd IEEE Conference on Decision and Control.

Newly Elected IEEE Fellows
ICICS congratulates two new IEEE fellows from the Department of Electrical and Computer Engineering: professor **Vikram Krishnamurthy** "for contributions to adaptive sensor signal processing" and professor **Tim Salcudean** "for contributions to haptic interfaces, teleoperation systems, and applications."

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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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