From Solar Cells to System-on-a-Chip

IEEE Fellow David Pulfrey finds meaning in work that has a social impact.

David Pulfrey believes in a balanced lifestyle. He lists forming the first ECE cricket team alongside his year 2000 appointment as an Institute of Electrical and Electronics Engineers (IEEE) Fellow among the highlights of his long career at UBC. Since joining ECE in 1968, Pulfrey has enjoyed several incarnations in his field of semiconductor devices. An ICICS member, he currently works in the System-on-a-Chip group with other members such as Reze Saleh (see Focus Spring 2001 issue), specializing in physical problems associated with signal integrity in mixed-signal circuits.

Pioneering alternative energy systems

Starting as an “experimentalist” mainly in the area of solar cells, in 1979 Pulfrey wrote Photovoltaic Power Generation, one of the first books on solar cell systems, which ranged from the physics of devices to the socio-economic implications of their implementation in alternate energy-generating systems. This led to an invitation to teach a related course at the Institute of Engineering in Kathmandu, which he describes as the most rewarding teaching experience of his life. He taught engineers, planners and bankers in a country where the very real prospect exists for alternate energy systems to improve the lifestyle of inhabitants. This experience solidified his deep interest in teaching, and holistic view of his work.

Pulfrey’s research focus evolved from solar cell devices to high-speed bipolar transistors, mainly for use in very fast digital systems. During a sabbatical in 1982 he worked for Plessey Research in England, where his orientation shifted from experimentalist to theorist/device modeller. His specialty moved from bipolar junction
Our new name, ICICS (the Institute for Computing, Information and Cognitive Systems) was officially approved at the November 26, 2000, meeting of the UBC Board of Governors. A final decision on the archives, who will design the new building, will have been made in late summer. The four short-listed firms are Architecture Planning Architecture Interiors Inc.; Chernoff Thompson Architects; The Colborne Architectural Group, Pacific Inc.; and Hutton Bakker/Bergman + Hamann Associated Architects.

ICICS name officially approved

Building a new research institute is a demanding and rewarding challenge. My warm thanks to Anne Condon for her excellent work as Acting Director during my recent sabatical and to everyone who has contributed to making ICICS a reality.

With the evolution of CICS into ICICS, we have been busy with the exciting task of allocating $22 million in infrastructure funding. We have identified seven ICICS user clusters and appointed cluster leaders: Modelling Humans and Their Environment (Sidney Fels, ECE); Creating Human Experience and Multimodal Interfaces (Dinesh Pai, CS); Multi-Agent Systems (Claude de Silva, ME); Global Information Systems (Mabo Ito, ECE); Computational Models Complexity, New Paradigms & Applications (Holger Hoos, CS); System-on-a-Chip Technolo-gies (André Ivens, ECE); Social & Behavioural Sciences (Ron Rensink, CS and Psychology).

This issue of Focus profiles senior and recent ICICS members. ECE faculty member David Pulfrey’s career has spanned three decades—from photovoltaic power to mixed signal circuits. New CS faculty member Will Evans’ work has applications in wireless devices and software visualization tools.

Robert Rohling (ECE and ME) is working to improve 3D ultrasound and medical imaging techniques. Kris de Volder (CS) is using logic meta pro-gramming to bridge the gap between software design and writing code. And Antony Hodgson (ME) is studying the biomechanics of motor skills to help test and design prosthetic robots.

Rabab Ward, ICICS Director

Pulfrey, continued from cover

transistors in silicon to heterojunction bipolar transistors (HBTs) in other material systems, notably gallium arsenide, indium phosphide and gallium nitride.

Much of his work has been sponsored by Nortel and the creation of physical models for HBTs contributed to that company’s development of the world’s first very high-speed (100G/s) fibre optic telecommunications systems. He continues to do consulting work with Nortel.

Working for positive change

Effecting change is an important compo-nent of Pulfrey’s work. He notes, “The award from IEEE resulted from having an impact on the community, and the work with HBTs for Nortel is the same; also a couple of other devices have had documented impact by their inclusion in widely available software for programmable memories (EPROMs), and in portable power systems for artificial hearts.”

Given this outlook, it is not surprising that his enthusiasm for teaching has remained high. His 1989 undergraduate text book, An Introduction to Microelectronic Devices, set the trend for using popular circuit simulators as a pedagogic tool to analyze devices. In 1990 he became the inaugural recipient of the UBC Killam Teaching Award for Engineering. He was one of the inaugural professors enlisted by PMC-Sierra to give courses at their in-house university on the physics and technology of deep sub-micron systems in May of this year. He is a Distinguished Lecturer for the IEEE, and was a Distinguis-hed Visiting Lecturer at the University of Western Australia earlier this year.

Pulfrey’s philosophy: “Keeping groups small and working collegially instead of managerially.”

Simon Yiu wins first Peter Cahoon Memorial Internship

Congratulations to Simon Yiu (ECE) who is the first winner of the Peter Cahoon Memorial Internship. The internship was created in memory of Peter, a long-time mentor to UBC students, by MAGIC (the Media and Graphics Interdisciplinary Centre) and ICICS, and provides partial support over the summer to students who are involved in an interdiscipli-nary research activity. It is also hoped that the internship will encourage further education at the graduate level. Simon is working with Victor Leung (ECE) on the potential application of remote monitoring and control of residential appliances and electronic devices using a Wireless Application Protocol (WAP) phone and X10 devices.

Rohling, continued from page 5

However, most techniques are developed for biomechanics of motor skills to help test and design prosthetic robots. Rohling’s other challenge is to help standardize how data is shared and displayed on medical imaging machines across networks and from various manufacturers. Currently, there is no Digital Imaging and Communications in Medicine (DICOM) standard for 3D ultrasound. However, with every degree of freedom the complexity of the technology increases significantly. “We found out that four degrees of freedom is sufficient even for complex tasks such as suturing if you can give surgeons the impression that their hands are inside the patient,” he says. One of his goals is to design an inexpensive instrument with this capability. The other major question he is trying to answer is does practice on a simulator really improve performance in the OR? “Nobody really knows the answer yet,” he says. “The ICICS initiative will help me work with haptics specialists like Karon MacLean in Computer Science to understand what this means. How do you get the surgeon to improve in the OR?”

Antony Hodgson can be reached at ahodgson@mech.ubc.ca or (604) 822-3240

Murray Hodgson (ME) has won the 2001 Martin Heinschorn Prize from the Institute of Noise Control Engineering (USA) for a paper he published in the institute’s journal.

The first class of the Master of Software Systems (MSS) program graduated at the spring convocation. Twenty-three students were awarded the MSS degree.

Martha Saloudean (ME Professor Emerita) was awarded an honorary PhD at UBC’s spring convocation in recognition of her contributions to the university and the engineering profession.

Gregor Kiczales (CS) was one of “The Technology Review Ten” in the Jan/Feb 2001 issue of MIT’s Magazine of Innovation Technology for his work on “Untangling Code.” See www.technologyreview.com/magazine/jan01/tr10_kiczales.asp

Mohamed Gadala (ME) has recently named the Patrick Campbell Chair in Mechani-cal Engineering Design. The chair was made possible by a generous donation from Mr. Patrick Campbell, an ME alumnus. Gadala will lead the development and presentation of the design curriculum at the undergraduate and graduate levels.

Simon Yiu

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Four ICICS members—Rabab Hamidzadeh (ECE), Alan Backworth (CS), Nicholas Pippen (CS), and Tim Salcudean (ECE)—and associate member Izak Benbasat (Commerse MIS division) are among nineteen UBC recipients of a new Canada Research Chair (CRC) announced this past spring. This funding targets experi-enced researchers acknowledg-ed by their peers as world leaders or younger researchers having potential to lead in their fields. The CRC program will invest 490 million over the next five years to establish 2,000 research chairs in Canadian universities, their affiliated research institutes and hospitals. UBC’s allotment of chairs placed it among the top three universities in Canada.

Rabab Ward (Director of ICICS) has been inducted as a Fellow of the Canadian Academy of Engineering. Fellows of the Academy are elected by their peers on the basis of their distinguished achievements, contributions to society, to the country, and to the profession. The total number of fellows in the Academy is just under 550, out of a total of over 15,000 registered engineers across the country. [from the IEEE Canada Newsletter, July 2001].

Nick Jaeger (ECE), together with his collaborators at NxtPhase, ASI and BC Hydro, has been awarded the 2001 BC Technology Industries Association Award for Excellence in Technology Innovation. Nick’s work with NxtPhase in bringing a project that started in ECE to commercial fruition is an excellent example of university/industry research collaboration.

Mr. Patrick Campbell, an ME alumnus.

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Understanding the Way We Move

Biomedical engineer Antony Hodgson’s research in neuromotor skills has applications in medical robotics, rehabilitation, and surgical ergonomics.

The human body in motion is a magnificent and complex system. Consider a dancer’s effortless leap, a golfer’s hole-in-one or a neurosurgeon’s deftly scalpel. Even the most mundane task every require an intricate interchange between neurons and muscles. The complexity of human movement is what Antony Hodgson is working to decipher.

“The body isn’t thinking about exactly where the arm is going,” says Hodgson, ICICS member and director of UBC’s Neurorobotic Control Lab. “We use information from all of our senses to tell us where our limbs are in space. And this information is used to refine our motor plans—whether executing an inside fastball or a pirouette.

Practice makes perfect

“A robot’s sensors can tell you within a fraction of a millisecond where it is and how fast it is going, and its controller can rapidly change the amount of torque being applied,” says Hodgson. In contrast, human actuators—or muscles—behave more like controllable springs than torque sources. The brain smoothly varies the muscles’ equilibrium lengths when working on the task at hand. Sensors in the muscles send information back to the brain relatively slowly, so the brain is not involved in fast reflex responses. Rather, it plays more of a planning and supervisory role, issuing occasional corrections to the plan if needed. “The brain acts in a largely feed-forward way; it pre-plans the movement and then gets information back about how the movement went,” says Hodgson. “This means practice really does make perfect.”

The nature of Hodgson’s research demands collaboration with neuroscientists, kinesiologists, electrical and computer engineers, and computer scientists. He is currently working with Janice Eng at the GF Strong Rehabilitation Centre to assess upper limb function following traumatic brain injury in order to establish more quantitative clinical assessment techniques for rehabilitation.

“Current techniques are very subjective; if a patient transfers from one physician to another, the measurements of their performance may also change,” Hodgson is also working with Elizabeth Croft in Mechanical Engineering on air muscle-powered robots. Their goal is to build low-cost robotic devices with built-in compliance to mimic how humans handle objects. These could be useful in the home—for example, to assist the elderly to perform tasks they find difficult to do.

Improving orthopaedic surgery

In collaboration with Bob McGraw and the Orthopaedics Dept. at UBC School of Medicine, and with funding from Johnson and Johnson, Hodgson is using robotic and computer technology to aid orthopaedic surgery. One project is a non-invasive alignment system to improve the accuracy and lifespan of knee implants.

Laparoscopic surgery—minimally invasive for the patient but a major challenge for the surgeon—is the area of Hodgson’s research that involves the largest collaborative effort. He is working with Karen MacLean in Computer Science, Karim Qayumi, head of the Centre for Excellence in Surgical Education at Vancouver Hospital, laparoscopic surgeon Alex Nagy, and Lance Becker, head of the Centre for Operative Simulation in the Department of Surgery.

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Hodgson demonstrates the use of an optoelectronic localizing probe to find the anatomic centre of the ankle during a mock-up of a computer-assisted knee replacement procedure. A current project in his lab aims to replace this anatomic digitization with a kinematic analysis of the ankle joint motion.

Continued on page 7

Will Evans uses information theory techniques as tools to visualize data and compress code.

Right triangled irregular networks

“I wanted something between these two methods, and that required less storage space,” says Evans. “With TopoVista, users can virtually walk or fly over modelled terrain in real time while the surface changes with the position of the viewer.” TopoVista uses right triangled irregular networks, which allow a more accurate approximation of terrain data. For example, if you have highly irregular or mountainous terrain next to an open valley, data triangles in one area can easily be made smaller without changing the data triangles in the entire region (the denser the triangles, the more irregular the terrain).

Because TopoVista uses coarse data sets with small space requirements, it can be used on hand-held devices. TopoVista is currently funded by the Defence Advanced Research Projects Agency (DARPA) in the US. One application appeared out of the blue—the Sea of Cortez, in fact. Researchers in Mexico are using TopoVista to visualize the ocean floor in order to study the schooling behaviour of fish. Evans notes that TopoVista would also allow people to browse geological survey data from the web. “For instance, if you want to find a meteor crater in Northern Arizona, you can now browse data sets visually.”

Code compaction and code factoring

As computers and programs become more complex, compilers have been designed to produce increasingly fast code, regardless of how large the result (consider how the amount of memory on PCs has expanded). However, on small portable devices such as palm pilots and cell phones, memory is limited. Code compaction, or compaction, is another practical problem that Evans is working on. He’s trying to make these devices more reliable and robust.

General compression facilities such as GZip require that a program be decompressed before it is executed, and this in turn requires extra storage space or execution time. In collaboration with Saumya Debray at the University of Arizona and Robert Muth at Compaq, Evans uses “compaction” to squeeze a program down to the smallest executable form. By looking at program code as a control flow versus a linear sequence of instructions, he is able to recognize similarities between chunks of code. And by identifying similar chunks of code (usually several lines long), deleting the redundant chunks and replacing them with a two- to three-line “jump and return” function, one main code group can be accessed from different locations within the program.

This technique, called code factoring, is not yet used by most compilers. “The function calls are additional instructions that have to be executed, so we expected it to slow down the process down,” Evans says. “The amazing twist is that it actually sped things up in our tests.” The National Science Foundation in the US is funding this work, and NSERC is funding Evans’ general research.

“I really am a theoretician, even though I’m doing all of these software-related things,” he says. “I came back to UBC because I felt that this was an excellent environment for doing theoretical work.”

Will Evans can be reached at will@cs.ubc.ca or (604) 822-0827.

Flying Around with Computational Theory

Computer scientist Will Evans’ research spans information theory, data compression and computational geometry. Trained as a theoretician at Yale and Berkeley, his work tackles some very practical software problems. Evans came to UBC from the University of Arizona, and a prior position at UBC laid the groundwork for much of his current research.

Hiking the North Shore mountains provided inspiration that led Evans to develop a software tool for visualizing terrain data. TopoVista allows users to visualize and explore elevation data by interactively traversing a digital surface. If you have ever dreamed of flying—and dream in colour—you will have an idea of the images that TopoVista is able to produce. Evans developed TopoVista along with David Kirkpatrick of UBC and Greg Tessendorf from the University of Arizona. Former methods, such as elevation grids and triangulated irregular networks, either provided an inaccurate visual model or required too much disk space.

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In the Beginning is the Code

ICICS member Kris De Volder wants to bring the language of humans and computers closer together.

Software development is extremely complex—and, according to computer scientist Kris De Volder, one of the least predictable of industrial processes. “There is a notion that you can start from a general picture and then continue to refine it until you finally get something that works, but it’s not that simple.” The current approach to software design and maintenance is like trying to climb up a waterfall. When you start from the concept and work down to code, it is almost impossible to go back and make revisions. “That’s why we have so much bad software and why there is so little code reuse,” says De Volder. “In many cases it is simpler just to start from scratch.”

Bridging the gap between human and computer, or programmer and compiler, may help solve this problem. “In the beginning we didn’t have any programming languages, only binary code,” says De Volder. Simple assembly languages were developed, followed by procedural languages, data abstraction, and then object and aspect-oriented programming. “By adding these layers of abstraction we can raise the language we use to instruct the computer to a higher level.”

Logic meta programming

De Volder is using logic meta programming to navigate this gulf in software evolution. Logic programming involves writing programs based on logical inference, or rules of proof and implication. Most popular programming languages are imperative. A computer is given a set of procedural instructions: do A and then B followed by C. Logic programming is more declarative. “You never really instruct the computer in a direct way. Instead you give it different rules to infer truths, so it is a totally different flavour of programming.”

Meta programming is writing programs about other programs. This is not as uncommon as one might think. For example, a compiler is a meta program that translates high-level programming language into a lower level language. But writing programs that write other programs is extremely complex. De Volder believes that using logic programming to do meta programming might provide the right kind of formalism to simplify the task.

TyRuBa

If we compare a programming language to a car, and a programmer to the driver, we can more easily understand De Volder’s work. As drivers we typically don’t build vehicles, we just drive them. Similarly, programmers don’t usually develop programming languages—they use existing ones to write programs. And like cars, there are many different types, or models, of programming languages and not all work equally well for certain tasks. Typically, the vehicle we buy must traverse variable terrain. And the options we choose for our car are only available on certain models and must be installed by the manufacturer.

“What meta programming does is promote the programmer/driver to mechanic,” says De Volder. “So the programmer can design, build and install new options for the program.”

Logic meta programming could also be a mechanism to help develop generic programs that are reusable in many contexts.

De Volder developed TyRuBa (for Type Rule Base), a prototype logic meta programming system to generate Java code. TyRuBa allows the programmer to add new options to the programming language more easily. For example, when programs operate on a shared resource—such as a printer or memory—to do several tasks simultaneously, synchronization is critical. Unsyncronized behaviour results in bugs, crashes and data anomalies. This is particularly true for programs that work on networks or the Internet. “Incidentally, Java, considered the ‘language of the Internet, provides very poor support for synchronization,” says De Volder. He uses TyRuBa to add ad extra control to the ‘dashboard’ of the Java vehicle to help circumnavigate the synchronization pitfalls in the road.

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The Man with Ultrasound Vision

Biomedical engineer Robert Rohling is blazing a trail in 3D diagnostic imaging techniques.

When it comes to medical imaging techniques, ultrasound is the largest growth industry. Yet there are a number of obstacles to overcome before it becomes the imaging tool of choice. ICICS member Robert Rohling is working to perfect 3D ultrasound technology. He has also developed a 3D imaging tool for hospital networks, and is helping to set new international standards for these emerging imaging technologies.

3D tool for imaging systems

Over the past several years, hospitals have been replacing film-based imaging with networks of digital archives that can be accessed by individual workstations. A doctor simply types in a patient’s name to access a library of images and a variety of tools to help analyze them. At ALI Technologies, Richard Rohling led the development of a 3D ultrasound tool now widely used in Ultra PACS hospital network systems. The 3D tool uses the volumetric data sets produced by computed tomography (CT) and magnetic resonance (MR) systems to produce 3D renderings, which facilitate image identification and interpretation, diagnosis and surgical planning. Rohling recently received an ASI fellowship with matching funds from ALI to continue this work at UBC.

Ultrasound has considerable benefits over more conventional imaging technologies. It is portable, produces images of the body in real time, and is safe for both the patient and the technician. With the advent of better image processing and faster computers, the latest machines can generate very high-resolution images for an average cost of an MR machine ($100,000 to $200,000 versus $1-$2 million).

While 3D ultrasound technology has been available commercially since 1987, there are still several factors that limit its usefulness and acceptance, such as accuracy and robustness of sensors, calibration, speed of reconstruction, and quality of data. Rohling has recently received NSERC funding for research that will help improve 3D ultrasound imaging. The standard visualization tools now in use were developed for MR and CT, not for ultrasound. This has led to an inherent problem with ultrasound images—the appearance of speckle (a product of interference from the ultrasound echoes). It is almost impossible to filter out the noise without losing too much image detail and information. Rohling has revived an old technique, spatial compounding, to successfully “clean up” 3D ultrasound images. “If you look at the same object from different directions, the speckle pattern changes. But what you are looking at, a kidney for example, does not change,” he says. When these images are averaged together the random components, or noise, tend to cancel each other out and disappear. Since the tissue components are in the same spot, they reinforce one another, heightening the anatomical features in the image.

Image interpolation and reconstruction

Rohling is also working to solve problems of interpolation and reconstruction. Imagine the ultrasound volume data as a stack of images, similar to a deck of cards all slightly misaligned. “Image reconstruction becomes a mathematical interpolation problem because the data points are scattered,” he notes. “In order to reconstruct ultrasound images in real time, current interpolation techniques are very simple and often ad hoc in nature.”

In collaboration with researchers at the National Centre for Supercomputing Applications at the University of Illinois, Rohling developed a more sophisticated radial basis function technique to analyze these large data sets.

“The approach actually takes into account the shape and nature of the ultrasound image. It looks at how the data is created and models the curves of the data itself.”

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It is extremely important to the medical community that ultrasound images be of high quality, but this requires the development of new imaging methods and visualization technologies. Proving that ultrasound images can be more accurate and more useful is the ultimate goal of ICICS member Robert Rohling and his research team at UBC.

**continued on page 7**
Flying Around with Computational Theory

Computer scientist Will Evans' research spans information theory, data compression and computational geometry. Trained as a theoretician at Yale and Berkeley, his work tackles some very practical software problems. Evans came to UBC from the University of Arizona, and a prior postdoc at UBC laid the groundwork for much of his current research.

The North Shore mountains provide inspiration that led Evans to develop a software tool for visualizing terrain data. TopoVista allows users to visualize elevation survey data by interactively traversing a digital surface. If you have ever dreamed of flying—and dream in colour—you will have an idea of the images that TopoVista is able to produce. Evans developed TopoVista along with David Kirkpatrick of UBC and Gregg Townsend from the University of Arizona. Former methods, such as elevation grids and triangulated irregular networks, either provided an inaccurate visual model or required too much disk space.

Right triangulated irregular networks

“I wanted something between these two methods, and that required less storage space,” says Evans. “With TopoVista, users can virtually walk or fly over modelled terrain in real time while the surface changes with the position of the viewer.” TopoVista uses right triangulated irregular networks, which allow a more accurate approximation of terrain data. For example, if you have highly irregular or mountainous terrain next to an open valley, data triangles in one area can easily be made smaller without changing the data triangles in the entire region (the denser the triangles, the more irregular the terrain).

Because TopoVista uses dense data sets with small space requirements, it can be used on handheld devices. TopoVista is currently funded by the Defence Advanced Research Projects Agency (DARPA) in the US. One application appeared out of the blue—the Sea of Cortez, in fact. Researchers in Mexico are using TopoVista to visualize the ocean floor in order to study the schooling behaviour of fish. Evans notes that TopoVista would also allow people to browse geological survey data from the web. “For instance, if you want to find a meteor crater in Northern Arizona, you can now browse data sets visually.”

Code compaction and code factoring

As computers and programs become more complex, compilers have been designed to produce increasingly fast code, regardless of how large the result (consider how the amount of memory on PCs has expanded). However, on small portable devices such as palm pilots and cell phones, memory is limited. Code compression, or compaction, is another practical problem that Evans is working on to try to make these devices more reliable and robust.

General compression facilities such as GZip require that a program be decompressed before it is executed, and this in turn requires extra storage space or execution time. In collaboration with Saumya Debray at the ICICS member and director of UBC’s Neurorobotic Control Lab. We use information from all of our senses to tell us where our limbs are in space. And this information is used to refine our motor plans—whether executing an inside fastball or a pirouette.

Practice makes perfect

“A robot’s sensors can tell you within a fraction of a millisecond where it is and how fast it is going, and its controller can rapidly change the amount of torque being applied,” says Hodgson. “In contrast, human actuators—or muscles—behave more like controllable springs than torque sources. The brain smoothly varies the muscles’ equilibrium lengths while working on the task at hand. Sensors in the muscles send information back to the brain relatively slowly, so the brain is not involved in fast reflex responses. Rather, it plays more of a planning and supervisory role, issuing occasional corrections to the plan if needed. “The brain acts in a largely feed-forward way; it pre-plans the movement and then gets information back about how the movement went,” says Hodgson. “This means practice really does make perfect.”

The nature of Hodgson’s research demands collaboration with neuroscientists, kinesiologists, electrical and computer engineers, and computer scientists. He is currently working with Janice Eng at the GF Strong Rehabilitation Centre to assess upper limb function following traumatic brain injury in order to establish more quantitative clinical assessment techniques for rehabilitation.

Understanding the Way We Move

Biomedical engineer Antony Hodgson’s research in neuromotor skills has applications in medical robotics, rehabilitation, and surgical ergonomics.

The human body in motion is a magnificent and complex system. Consider a dancer’s effortless leap, a golfer’s hole-in-one or a neurosurgeon’s deftly scalpel. Even the smallest laparotomy every day require an intricate interchange between neurons and muscles. The complexity of human movement is what Antony Hodgson is working to decipher.

“The body isn’t thinking about exactly where the arm is going,” says Hodgson, ICICS member and director of UBC’s Neurorobotic Control Lab. “We use information from all of our senses to tell us where our limbs are in space. And this information is used to refine our motor plans—whether executing an inside fastball or a pirouette.

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Will Evans uses information theory techniques as tools to visualize data and compress code.

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Dr. Hodgson demonstrates the use of an optoelectronic localizing probe to find the anatomic centre of the ankle during a mock-up of a computer-assisted knee replacement procedure. A current project in his lab aims to replace this anatomic digitization with a kinematic analysis of the ankle joint motion.

“Current techniques are very subjective; if a patient transfers from one physician to another, the measurements of their performance may also change.”

Hodgson is also working with Elizabeth Croft in Mechanical Engineering on air muscle-powered robots. Their goal is to build low-cost robotic devices with built-in compliance to mimic how humans handle objects. These could be useful in the home—for example, to assist the elderly to perform tasks they find difficult to do.

Improving orthopaedic surgery

In collaboration with Bob McGhee and the Orthopaedics Dept. at UBC School of Medicine, and with funding from Johnson and Johnson, Hodgson is using robotic and computer technology to aid orthopaedic surgery. One project is a non-invasive alignment system to improve the accuracy and lifespan of knee implants.

Laparoscopic surgery—minimally invasive for the patient but a major challenge for the surgeon—is in the area of Hodgson’s research that involves the largest collaborative effort. He is working with Kevin MacLean in Computer Science, Karim Qayumi, head of the Centre for Excellence in Surgical Education at Vancouver Hospital, laparoscopic surgeons Alex Nagy, and Lance Radder, head of the Centre for Operative Simulation in the School of Dentistry. With funding from NSERC and the Society of American Gastrointestinal Endoscopic Surgeons (SAGES), they are working to improve the technology and training for this procedure. Hodgson’s involvement includes developing tools and protocols for making biomedical and ergonomic assessments, assessing new
ICICS name officially approved

Our new name, ICICS (the Institute for Computing, Information and Cognitive Systems) was officially approved at the November 26, 2000, meeting of the UBC Board of Governors. A final decision on the archives who will design the new building will have been made in late summer. The four short-listed firms are Architectura Planning Architecture Interiors Inc.; Chernen Thompson Architects; The Colborne Architectural Group; Pacific Inc.; and Heton Bakken/Bregman + Hamann Associated Architects.

Building a new research institute is a demanding and rewarding challenge. My warm thanks to Anne Condon for her excellent work as Acting Director during my recent sabbatical and to everyone who has contributed to making ICICS a reality.

With the evolution of CICS into ICICS, we have been busy with the exciting task of allocating $2 million in infrastructure funding. We have identified seven ICICS user clusters and appointed cluster leaders: Modelling Humans and Their Environment (Sidney Fels, ECE); Creating Human Experience and Multimodal Interfaces (Dinesh Pai, CS); Multi-Agent Systems (Clarence de Silva, ME); Global Information Systems (Mabo Ito, ECE); Computational Models Complexity, New Paradigms & Applications (Helder Hoo, CS); System-on-a-Chip Technolo- gies (Andre Iones, ECE); Social & Behavioural Sciences (Ron Rensink, CS and Psychology).

This issue of Focus profiles senior and recent ICICS members. ECE faculty member David Pulfrey’s career has spanned three decades—from photovoltaic power to mixed signal circuits. New CS faculty member Will Evans’ work has applications in wireless devices and software visualization tools. Robert Rohling (ECE and ME) is working to improve 3D ultrasound and medical imaging techniques. Kris de Volder (CS) is using logic meta pro- gramming to bridge the gap between software design and writing code. And Antony Hodgson (ME) is studying the biomechanics of motor skills to help test and design medical robotics.

Rabab Ward, ICICS Director

Pulfrey, continued from cover

transistors in silicon to heterojunction bipolar transistors (HBTs) in other material systems, notably gallium arsenide, indium phosphide and gallium nitride.

Pulfrey’s philosophy: “Keeping groups small and working collegially instead of managerially.”

Nick Jaeger (ECE), together with his collaborators at NextPhase, ASI and BC Hydro, has been awarded the 2001 BC Technology Industries Association Award for Excellence in Technology Innovation. Nick’s work with NextPhase in bringing a project that started in ECE to commercial fruition is an excellent example of university/industry research collaboration.

Simon Yiu wins first Peter CAHOON Memorial Internship

Congratulations to Simon Yiu (ECE) who is the first winner of the Peter CAHOON Memorial Internship. The internship was created in memory of Peter, a long-time mentor to UBC students, by MAGIC (the Media and Graphics Interdisciplinary Centre) and ICICS, and provides partial support over the summer to students who are involved in an interdisciplinary research activity. It is also hoped that the internship will encourage further education at the graduate level. Simon is working with Victor Leung (ECE) on the potential application of remote monitoring and control of residential appliances and electronic devices using a Wireless Application Protocol (WAP) phone and X10 devices.

Rabab Ward, ICICS Director

Rohling, continued from page 5

However, most techniques are developed for standard gold and Si (the gold layer) — the challenge now is to find the middle group,” he says. Rohling’s other challenge is to help standardize how data is shared and displayed on portable power systems for artificial limbs. “Performing laparoscopic surgery is described as trying to tie your shoelaces with chopsticks,” says Hodgson. Current tools provide four degrees of freedom (normal movement has six). However, with every degree of freedom the complexity of the technology increases significantly. “We found out that four degrees of freedom is sufficient even for complex tasks such as suturing if you can give surgeons the impression that their hands are inside the patient,” he says. One of his goals is to design an inexpensive instrument with this capability. The other major question he is trying to answer is does practice on a simulator really improve performance in the OR? “Nobody really knows the answer yet,” he says. "The ICICS initiative will help me work with haptics specialists like Koran MacLean in Computer Science to figure this out.”

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From Solar Cells to System-on-a-Chip

IEEE Fellow David Pulfrey finds meaning in work that has a social impact.

David Pulfrey believes in a balanced lifestyle. He lists forming the first ECE cricket team alongside his year 2000 appointment as an Institute of Electrical and Electronics Engineers (IEEE) Fellow among the highlights of his long career at UBC. Since joining ECE in 1968, Pulfrey has enjoyed several incarnations in his field of semiconductor devices. An ICICS member, he currently works in the System-on-a-Chip group with other members such as Reze Saleh (see Focus Spring 2001 issue), specializing in physical problems associated with signal integrity in mixed-signal circuits.

Pioneering alternative energy systems

Starting as an “experimentalist” mainly in the area of solar cells, in 1979 Pulfrey wrote Photo-voltaic Power Generation, one of the first books on solar cell systems, which ranged from the physics of devices to the socio-economic implications of their implementation in alternate energy-generating systems. This led to an invitation to teach a related course at the Institute of Engineering in Kathmandu, which he describes as the most rewarding teaching experience of his life. He taught engineers, planners and bankers in a country where the very real prospect exists for alternate energy systems to improve the lifestyle of inhabitants. This experience solidified his deep interest in teaching, and holistic view of his work.

Pulfrey’s research focus evolved from solar cell devices to high-speed bipolar transistors, mainly for use in very fast digital systems. During a sabbatical in 1982 he worked for Plessey Research in England, where his orientation shifted from experimentalist to theorist/device modeller. His specialty moved from bipolar junction transistors to physical problems associated with semiconductor devices.

Avid cyclist and IEEE Fellow David Pulfrey has been spotted in Stanley Park on his way to work—from his home on Dunbar Street, taking the long route.