in **Focus**
SUMMER 2006

McGill

ENGINEERING

The Biomedical Engineering Boom

THIS ISSUE

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Special thanks to all volunteer
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Chemical Engineering Professor Sylvain Coulombe and doctoral candidate Valérie Léveillé with the non-thermal plasma torch they developed; the computer screen shows a magnified image of the torch's flame. See the story on (page 8)
photo: Owen Egan

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ENGINEERING
ALUMNI PRIDE

Dear Friends & Alumni:

OWEN EGAN

Our Faculty is growing, and we are ensuring it grows in the most productive directions. This past autumn, we began a comprehensive review of academic and research programs in all the Faculty's departments and schools. The review, carried out by both internal and external evaluators, will tell us where we stand in relation to our peers and will enable us to set benchmarks for progress.

Attracting the top graduate students from Canada and abroad, especially at the doctoral level, will certainly be a priority. The best students are accomplished, independent researchers; they are creative and responsible, and form an important part of research projects and centres. We cannot afford to ignore their importance. The research enterprise is based on graduate students.

Our goal is to expand the doctoral program by about 40 per cent, from 340 students currently. This is ambitious and yet feasible. The best students have many graduate school options, so we are working hard to create competitive scholarships to offer top applicants. This involves leveraging research funding from the Natural Sciences and Engineering Research Council (NSERC) at the federal level and le Fonds québécois de la recherche sur la nature et les technologies (FQRNT) at the provincial level – and bodies like the Canadian Institutes of Health Research (CIHR) for interdisciplinary projects – as well as building endowed fellowships. We are also implementing recruitment strategies to convince the best students graduating from bachelors and masters programs to apply to McGill. Having more graduate students will stretch our current physical resources, so the faculty is developing plans to find or create the new or renovated lab and office spaces these students will require.

We are continuing to develop our interdisciplinary research and teaching programs, in areas from bioengineering to new materials to urban design to nanotechnology. Bioengineering, for example, is more than a trend, and its impact on our society will only grow as we discover new applications. It will play a critical role in advancing human health and promoting environmental sustainability. For instance, research in biomedical engineering – an essential branch of bioengineering – has led to new collaborations with our colleagues in the Faculties of Medicine and Dentistry, and its consequences are great: sometimes the difference between life and death. With McGill's history as a centre of world-class medical research, biomedical engineering is a natural direction to expand the Faculty of Engineering's research scope. It must be emphasized that this will not be to the detriment of our existing strengths. Indeed, investment through new faculty recruitment is also aimed at strengthening and growing our core disciplines, and will provide a timely injection of new research into these areas.

So, while I say it can be challenging to foresee the future, some things are certain: we will transform the funding model of our doctoral student and research programs to bring in the very best students, and we will become a leader in the vital world of bioengineering. This issue of In Focus describes some of the exciting work we are doing in this area.

Best wishes,

Christophe Pierre
Dean, Faculty of Engineering

Engineering's Biomedical Boom

When Rosaire Mongrain joined Mechanical Engineering in 2000, he was only the second professor in the Faculty working primarily in biomedical engineering. Now, an additional five young researchers have joined him, and several more positions remain to be filled. The field is a natural for McGill, with its strong engineering programs and world-renowned medical school. "We definitely want to expand our links and develop a more centralized focus, with more shared activities," says Henrietta Galiana, BEng'66, MEng'68, PhD'81, Chair of the Department of Biomedical Engineering in the Faculty of Medicine. So far, relations between these faculties are in their early days – but everything points to a very productive future.

"Many techniques we developed have become routine," says Professor Emeritus Abdul Ahmed, the Faculty's pioneer in the field. "Biomedical engineering today involves fundamental research into cardiovascular mechanics, for example, or characterizing bone material, as well as things like imaging technologies and biocompatibility. Everything in the body has some sort of engineering element – just look at the number of joints, the different tissues, and the control systems."

In January, the Faculty introduced a biomedical engineering undergraduate minor concentration, a collaboration between the Faculties of Engineering, Medicine and Science. "Students have been asking for this type of program because they want exposure to biomedical engineering training," says Galiana. The burgeoning research effort in this field relies upon getting more top graduate students involved. "We still need to enlarge the pool," says Mongrain.

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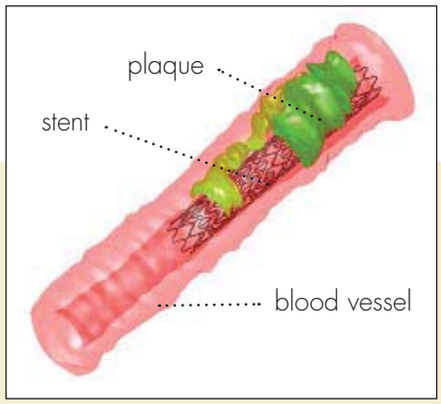
Rosaire Mongrain with a silicon aorta cast from a living heart



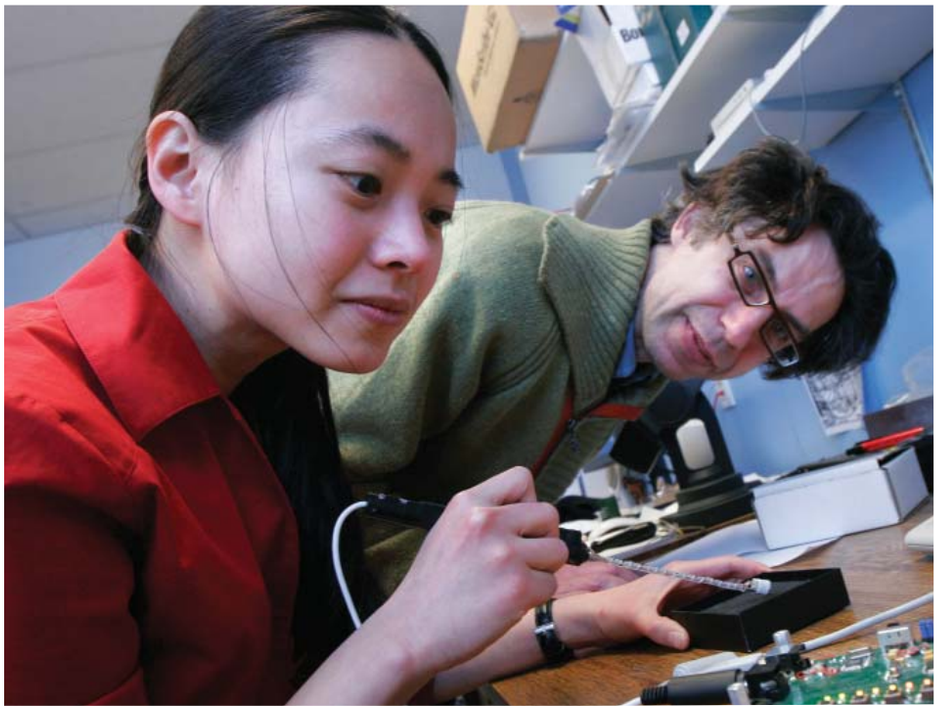
Cardiovascular Engineering

Stent implant operations hit over one million each year around the world, creating a global market worth billions of dollars. The stent – basically a small tube that sits in a blood vessel in order to treat blocked arteries – is a less invasive alternative to heart bypass surgery, but it cannot boast the latter's long-term rates of success. A decade ago, up to half of all blood vessels with stent implants were re-obstructed after about six months. "So there was 'stent mania,' with engineers and doctors collaborating in a race to create a design that would reduce this problem," says Rosaire Mongrain, professor of Mechanical Engineering, who estimates that several hundred stent patents are filed annually (and he has his share). One new approach involves developing stents with a drug-impregnated polymer coating that targets different factors involved in re-obstruction, and Mongrain is collaborating with Chemical Engineering's Richard Leask to develop their own version of this innovation. Across the world, the quest for the optimal design continues.

Stent designs are, however, just one aspect of Mongrain's research, which focuses on both numerical modeling and experimental work. "Our lab is interested in both fluids and solids – in our case, blood and vascular tissue – and we are doing applied work to optimize the design of cardiovascular devices," he says. "Interventional cardiologists need intravascular prostheses like stents, catheters, and similar small gadgets that go inside vessels. But surgeons who are accessing the heart directly are interested in valves and pumps." Mongrain, whose team works in both areas, co-directs the CardioVascular Engineering Lab (CVEL) at the Montreal Heart Institute (MHI) and collaborates with medical researchers such as Jean-Claude Tardif, a cardiologist and director of the MHI's Research Centre.

Mongrain came to biomedical engineering via mathematical physics, where he developed an interest in modeling non-Newtonian fluids and realized that blood was a very practical and interesting example to study. "As I tell my students, biomedical engineering embodies a noble aspect of engineering research. You always feel good trying to do good," he says. "And this work is about improving the treatment of patients."

Visit the Cardiovascular Engineering Laboratory website:
http://cvel.org/index.html



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Hsin-Yun Yao, BEng'00, MEng'04, working with Vincent Hayward

The Haptic Revolution

"Today, we would never think of not training airline pilots on flight simulators," says Electrical Engineering professor Vincent Hayward. "The surgical simulator is set to follow a similar path." With the invention of new technologies to perform minimally invasive surgery, there is growing interest in teaching surgeons with simulators. Hayward and his research group build haptic or force-feedback devices that can simulate the sensations we experience when touching objects. This is especially useful for recreating the feel of a surgical procedure – for instance, the physical resistance a surgeon might expect to encounter when inserting a catheter into a patient's body. There is a growing demand for such tools, with one of Hayward's research projects developed into a commercial product, the Freedom6S, now marketed by Montreal-based MPB Technologies for use in medical mentoring as well as robotic surgery. And two years ago Hayward began working with researchers in Urology at McGill to develop a prototype that would simulate a prostate resection operation, a procedure performed when the prostate grows too large. "We are especially interested in the computational aspect of the simulation of tissue behaviors as you interact with them," he says. "Complexities in tissue behavior make this a challenging project, but we are developing techniques."

Another haptic application involves devices giving tactile sensations that could be used to translate text from a computer into Braille. "Our research is now directed into 'tactile graphics,' which are small diagrams that people can feel," he says. "For instance, in trying to explain geography to a blind pupil, even a crude outline can make a huge difference in the rate of learning."

Check out the Haptics Lab research at www.cim.mcgill.ca/~haptic

The Science of Touch

Surgeons inserting a probe into a knee need a sensitive touch to detect any anomalies in the cartilage surface. Practice is the best training strategy, but often the only practice available involves young doctors honing their skills on patients. "So they need a device that will help improve their sense of touch either in training or during a real operation," says Hsin-Yun Yao. For her master's degree under the supervision of Vincent Hayward, she developed the MicroTactus device. "It can be used in training, or as an accessory to a real surgeon," she says. "Basically, it amplifies touch." Before Yao began to design the tool, which has since been patented, she met with surgeons to confirm what they needed, even assisting on a knee operation to get a sense of requirements. Now in the second year of her doctoral research, funded in part by Immersion Canada, Yao is developing a more power-efficient actuator to communicate tactile sensations more effectively. "For a minimum energy expenditure, it can produce the maximum effect on human skin, and can be applied in medical devices or everyday electronics," she says.

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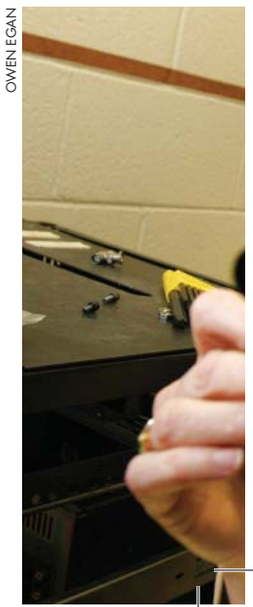
Jerome Pasquero

Stress is a constant for doctoral students, and Jerome Pasquero and his Haptics labmates have taken it to heart, working on the Stimulator of Tactile Receptors by Skin Stretch (STReSS), which seeks to display small-scale shapes and textures by stimulating the fingertip skin. This project is connected to another of the lab's interests, the Virtual Braille Display, a tactile display that reproduces Braille dots. "We've tested it with blind subjects, and their success rates at understanding it were pretty high," he says. "But there is still a lot of work to do."



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Detecting Danger

"Imagine a bowl of fat, more or less homogeneous, with a little chunk of meat inside it. If you radiate a microwave into the fat, it will hit the meat and bounce back," says Milica Popovic, assistant professor of Electrical Engineering. A similar approach can be used in breast cancer detection. Because a tumour's water-content is different from the homogeneous fatty tissue in which it sits, an antenna on the skin surface can emit a microwave and receive the pulses reflected off the tumour. Popovic's research focuses on designing these antennae and testing them with simulated breast models. "Antennae are very sensitive, so their properties can change depending on where we place them around the model. The trick is to design them so that their behavior is reliable," she says. "Our trans-receiving antenna shows promise so far. Next, we want to build an array and develop signal-processing tools to help us interpret information gathered by that array."

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Milica Popovic

Several detection technologies are used for breast cancer. Magnetic Resonance Imaging gives a good resolution but is expensive; x-ray mammography, a standard tool, provides a good image but is physically uncomfortable and uses ionizing radiation that damages tissue; ultrasound cannot differentiate between the benign and malignant cancers. These methods work well in synergy, however, and Popovic thinks microwave detection will complement the mix. "The key is to catch tumours early," she says. "We want to develop an inexpensive device that could be owned by a doctor's office in every little town."

Milica Popovic's research team currently includes three doctoral and two masters students. Amir Hajiaboli, one of Popovic's doctoral students, is modeling the interaction of light with the eye's optical receptors, to see if their shape and size contribute to colour discrimination. Another doctoral student, Houssam Kanj, is examining the optimal antenna design for a microwave breast cancer detection system.

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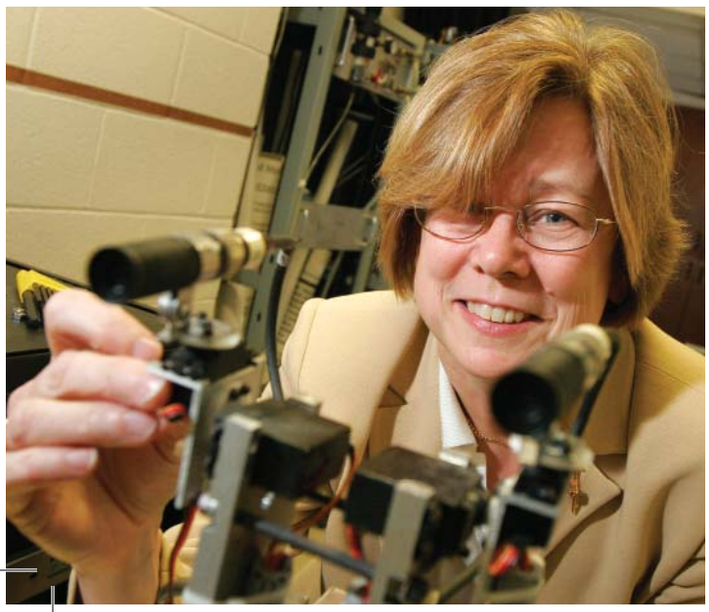
Houssam Kanj with a microwave antenna

Medical Collaborations

While biomedical engineering research ranks as an important priority for the Faculty of Engineering, it is no less a concern for the Faculty of Medicine, whose Department of Biomedical Engineering has twelve full-time faculty members and a host of associate and adjunct members, including Mechanical Engineering's Rosaire Mongrain. "So far, relations between our department and the Faculty of Engineering are informal, being driven by students with joint supervision or by professors consulting on an overlapping area of interest," says Henrietta Galiana, Chair of Biomedical Engineering. But collaborations are growing. For instance, Galiana's department has been consulted by Electrical and Computer Engineering as it recruits new faculty with biomedical engineering expertise. "We're trying to get people who would be complementary to both pools," she says.

With a background in systems and control analysis, Galiana models the brain circuits that control movement - the equivalent of trying to describe a good controller. "Applying these tools to biological problems is like trying to pick up jello," she says. "To design vision platforms or more elegant interfaces between a human and, say, an artificial arm, you need natural interactions. So you need to know how the natural system works." Through her research, Galiana has developed contacts with Engineering professors such as Jorge Angeles and Vince Hayward. "The key word in this field is 'interdisciplinary,'" she says. "Our information collaborations are everywhere, and it's just a matter of time before we develop more formal relations."

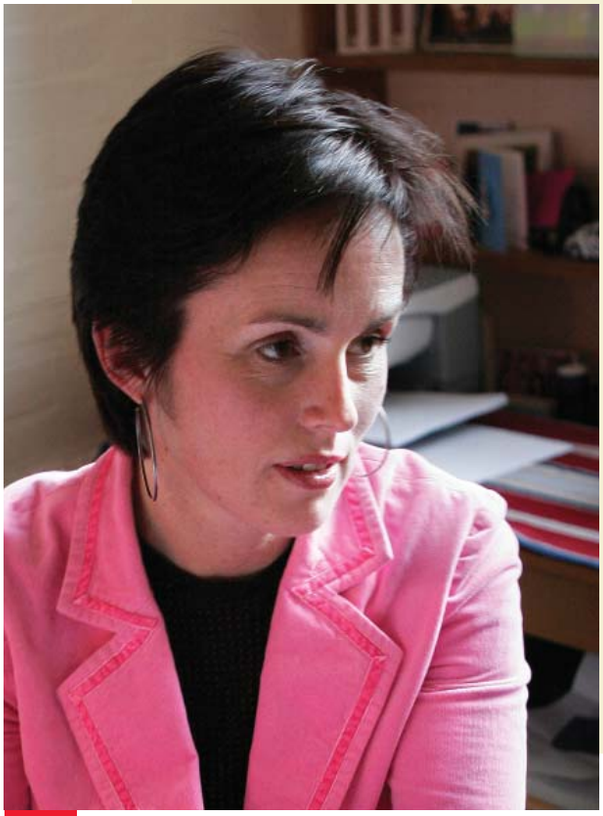


Henrietta Galiana

2006 marks a special anniversary year for the classes of 1981, 1966 and 1956. For more Homecoming info, including the details of the 40th anniversary celebrations for "Mimi" Galiana's class of '66 being organized by Paul Stanfield (Electrical), Dave Taylor (Mechanical), Howard Stotland (Civil) and Peter Jones (Chemical), contact the Engineering Development & Alumni Relations Office at 514-398-1371 or engineering.alumni@mcgill.ca.

Architecture of Medicine

Does a large, sunny hospital atrium help you heal? Architecture Professor Annmarie Adams, BA'81, an architectural historian specializing in medical buildings, is collaborating with University of Toronto Nursing Professor Patricia McKeever to study the health impact of architectural elements in Toronto's Hospital for Sick Children. Supported by the Canadian Institutes of Health Research (CIHR), the project involves interviews with long-term patients, who are given digital cameras to photograph how they use the hospital's atrium. "Whether governments pay for hospital lobbies or atriums has become a major issue, and we are finding many things we didn't anticipate," she says. "The mall-like space is meant to normalize the hospital experience, so after surgery, kids can have a hamburger in the lobby. But often, staff do not find this to be a noble image for a public hospital, which creates a conflict. Also, it can be a terrifying experience for young patients to see so many other very sick kids."



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Annmarie Adams

Adams has been busy with other projects, and is completing a collaboration with professors Rafael Fischler (Urban Planning), Sherry Olson (Geography) and Kevin Schwartzman, MDCM'89, a respirologist in the Faculty of Medicine, on spatial responses to tuberculosis during four key periods in Montreal. "We tracked the movement of TB patients through the city from house to hospital, and then within the hospital system itself."

Adams also recently completed a five-year CIHR-funded comprehensive study of Canadian hospital architecture since World War II. McGill's own back yard is the location for one of the country's best resources: the Royal Victoria Hospital. "The Royal Vic is an incredible collection of hospital types, a timeline of Canadian hospital architecture, with a pavilion plan from 1894, interwar pavilions, and great modern skyscrapers," she says. "It helps us understand the question of what 'innovation' meant in hospital architecture."

Annmarie Adams is a mentor connected with "Health Care, Technology and Place," a CIHR-backed training program, based at the University of Toronto, which supports research by graduate and post-doctoral students. Among her students doing important health-related research are Tom Strickland, who studies private patient hospitals in the 1920s, Nazli Salehi, who explores recent housing for people with HIV/AIDS in North America, and Gaston Castaño, who investigates hospital design for obese people.

Pioneering Ideas

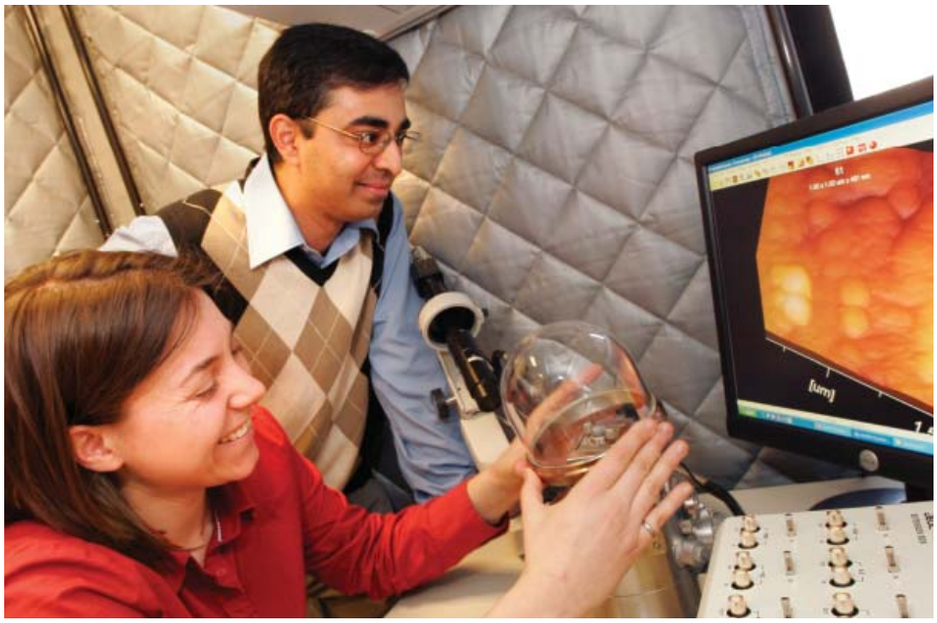
In the early 1970s, when Abdul Ahmed, MEng'64, PhD'71, was a young Mechanical Engineering professor beginning his McGill career, he attended a presentation by Joe Miller, the newly appointed chief of orthopedic surgery at the Montreal General Hospital. Miller preached the virtues of collaborative engineering and medical research, and Ahmed took up the challenge. Soon he was working with Miller, the first of his many interdisciplinary collaborations, the last of which was with Michael Tanzer, current director of McGill's Orthopaedic Surgery program.

Mechanical Engineering Professor Emeritus Abdul Ahmed

"We focused on modeling the mechanics of the knee joint and the lower back, so that we could understand the causes of injuries or degeneration, and we were also trying to find ways of treating these problems," Ahmed says. In addition, artificial hip implants posed some challenging problems, as they were developing a habit of becoming loose after insertion. Ahmed and his students thus began characterizing some of the properties of the bone cement used, as well as the implant design. Today, Professor Emeritus Ahmed (he retired in 2004) stands as the Faculty of Engineering's pioneer in the field of biomedical engineering.

Ahmed was for years the only Engineering professor specializing in biomedical engineering, but he inspired collaborators across the Faculty. "Think of the human body as a structure, with loads added upon the foundation," says Civil Engineering professor Suresh Shrivastava. "The body is a fascinating area for engineering – you cannot run out of problems." Shrivastava and graduate student Aboulfazl Shirazi-Adi (now a professor at École Polytechnique) collaborated with Ahmed on lower back pain research; their study, published in *Spine*, won the 1983 Volvo award for research in biomechanics.

Big Ideas, Small Machines



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Mechanical Engineering professor Srikar Vengellatore with graduate student Janina Crocker, BEng'05.

"Biology interacts with engineered devices on surfaces," says Srikar Vengallatore, assistant professor in Mechanical Engineering and Canada Research Chair in Advanced Materials for Micro/Nanodevices. "Devices can be implanted in the body, or samples of biofluids can be introduced into micromachined analysis systems. Either way, surface characteristics will affect how interactions take place." Surface variables include roughness, chemistry, surface energy, and stress, and each exerts some influence, which raises an important question: what is the best combination of surface characteristics for biomedical devices? Vengallatore, a specialist in micro-electrical-mechanical systems (MEMS), intends to find out, one variable at a time, in collaboration with researchers from the McGill Bone Centre.

"To begin with, we are focusing on surface roughness," Vengallatore says. "We take a smooth surface through a series of well-defined microfabrication processes, measure the change in roughness using an atomic-force microscope, and perform detailed statistical analysis of the surface topography." These processes could be used to construct many biomedical devices, including sensors and, conceivably, automated drug-delivery mechanisms. Vengallatore is also exploring the potential of colloidal self-assembly in order to manufacture a specified roughness. Beginning with a colloidal suspension – a liquid with tiny particles in suspension – and imposing certain conditions during the liquid's evaporation, he coaxes particles to line up on the walls of tiny devices. "Eventually we want to see how these surfaces affect biological interactions, and hopefully we can create a set of descriptions for engineering a surface for a given application."

The Canada Research Chair program was established by the federal government in 2000 to support research, and the Faculty of Engineering boasts twelve Canada Research Chairs so far. Tier 1 CRCs are awarded to outstanding established researchers and nets the university $200,000 annually over seven years; Tier 2 CRCs are given to promising young faculty members, and bring in $100,000 annually for five years.

The Matter of Bones

Conventional metals are often used in fixing fractures, especially to replace or augment a load-bearing injury. But eventually, a second operation is needed to remove the metallic implant, which is otherwise left in the body permanently. Surgeons can use degradable polymers, but these lack the strength to support load-bearing fractures. Jake Barralet, Faculty of Dentistry professor, associate member of Mining, Metals and Materials Engineering, and the Canada Research Chair in Osteoinductive Biomaterials, hopes to address this problem by developing a fracture support system that is both strong and degradable. He is joining with Materials Engineering professor Robin Drew and post-doctoral fellow Guillermo Mendosa Saurez to explore the most promising candidate: magnesium alloys.

Barralet and his team are also building connections with Janusz Kozinski's group in Materials Engineering, to work on the synthesis of phosphate-containing materials that will dissolve in the body after supporting a fracture through the healing process. One possibility is a pyrophosphate-based cement that is dissolved by an enzyme produced by active bone cells. "The dissolution rate will depend on factors like how big a piece of material you insert and where you place it," he says. "Because pyrophosphates are not particularly soluble but are broken down by this enzyme, these materials will only degrade in the presence of active bone formation during the healing process. It is a 'smart' biomaterial, changing properties according to its environment."

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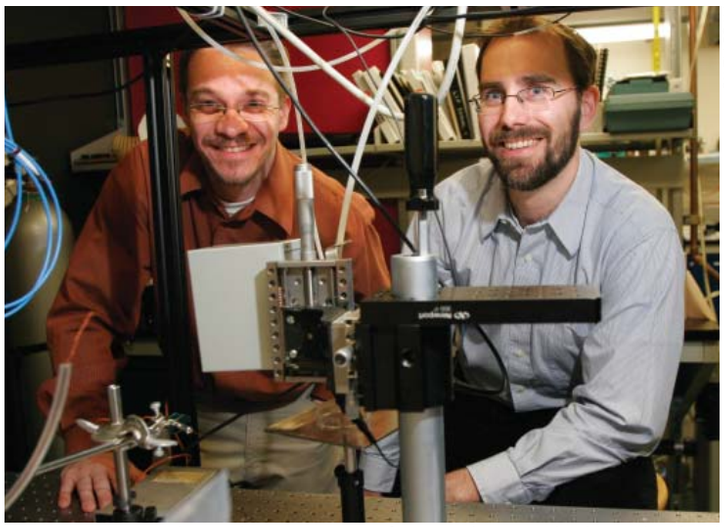
Jake Barralet

Plasma Treatment

Medical practitioners will soon have to learn another definition of plasma. It's not just a clear yellowish liquid in which cells are suspended. Plasma is also an ionized gaz that conducts electricity.

Non-thermal plasma works at low temperatures, opening up plenty of biomedical applications. "If we use a non-thermal plasma beam very gently, we can modify the cell without killing it," says Professor Sylvain Coulombe, PhD'98, Canada Research Chair in Non-Thermal Plasma Processing. To achieve this level of gentleness, Coulombe and doctoral student Valérie Léveillé BEng'02, (shown on the front cover) built a non-thermal plasma torch capable of producing a plasma jet with a diameter of 0.5 mm or less. "This tool enables us to treat surfaces to encourage preferential cell growth, which has huge implications for biomedical devices," says Coulombe's collaborator, Richard Leask, a biomedical engineering specialist and fellow Chemical Engineering professor. "For instance, if we can get the right cells to stick to implants, they become more biocompatible." Furthermore, the non-thermal plasma can also be used to remove cells without destroying them, so it will have potential for use in ablation therapy for such conditions as coronary plaque, or for tattoo removal.



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Chemical Engineering professors Sylvain Coulombe and Richard Leask, adjusting the non-thermal plasma torch

The plasma treatment offers other benefits as well, such as the ability to deposit organic films on the surface on very small scale. "We can use the torch to sterilize an area, remove a lesion or damaged cells, and then deposit a temporary organic film on the surface to close the wound," says Coulombe. And whereas laser treatment burns tissue, the cells remaining on the edge of a plasma cut remain healthy and unaffected, thus speeding up the healing process.

Their work is attracting some welcome attention. Léveillé received the 2005-06 Emil Nenniger Memorial Fellowship awarded to a top graduate student in the Departments of Civil and Chemical Engineering. She and Coulombe have also filed a US provisional patent application on the non-thermal plasma torch design, and in January Leask and Coulombe received a one-year $125,000 NSERC Idea-to-Innovation (Phase I) grant to develop a prototype. "By the end of the year, we want to be able to introduce it to people in science and industry," says Coulombe.

Correlating Causes

Richard Leask is quickly becoming one of McGill's go-to guys in biomedical research. "I have the Faculty's only mammalian cell culture lab, so that brings a lot of people my way," he laughs. In addition, he works at the Montreal Heart Institute, where he collaborates with Rosaire Mongrain to design innovative stents. "Most cardiovascular diseases occur in specific locations throughout the cardiovascular system," he says. "We hypothesize that mechanical forces in these locations change the cell phenotype, making them more prone to creating atherosclerosis, or plaque build-up in arteries, so we look at the cells which line the cardiovascular system. These cells respond to forces and elicit responses in other cells, so we are focusing on their response to fluid sheer stress, using transparent 3-dimensional models to test the effect of real stress patterns created by real geometries."

Leask and Mongrain are also currently looking at regional variations in the biomechanical properties of the ascending aorta. "Diseases of the ascending aorta also occur in focal locations – on one side of the artery, not around the artery in general," Leask says. "Ultimately, we want to correlate the disease, the biomechanics and the biochemistry."

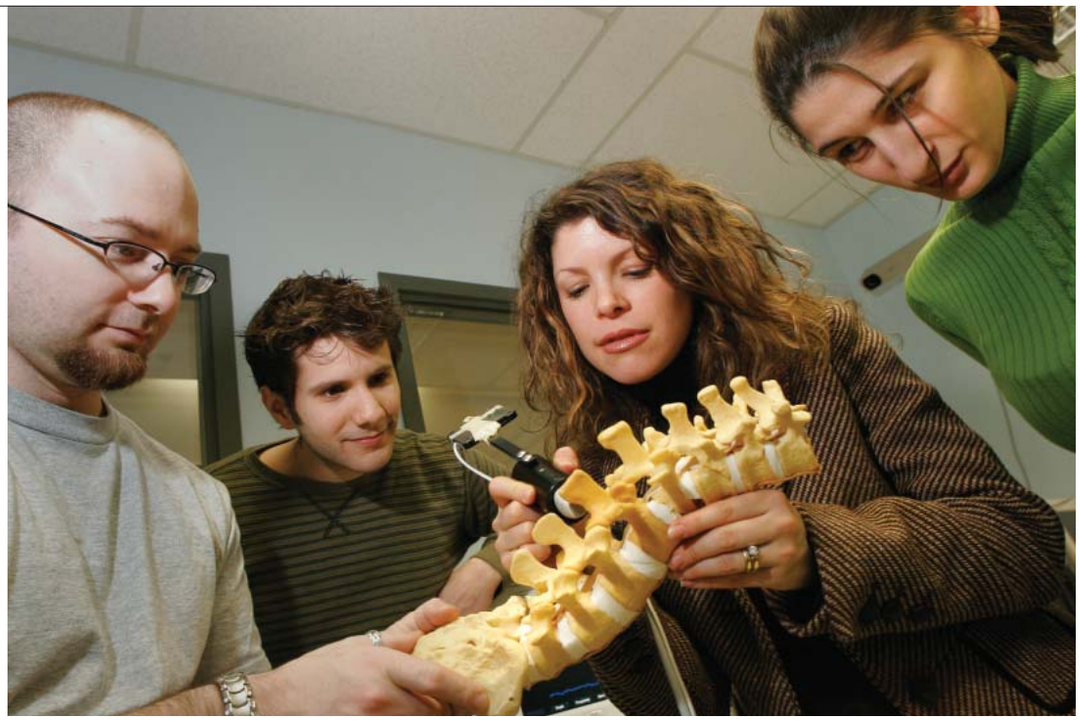
Monitoring Other Pathways…

The Faculty of Engineering has many members performing bioengineering, biomedical and other health-related research, often in collaboration with colleagues in the health sciences. For instance, professors Andrew Kirk (ECE) and Maryam Tabrizian (Biomedical Engineering) are co-supervising graduate students working with micro-electro-mechanical systems (MEMS) and in the nanofabrication of optical scanners. Professors Bernard Segal (Otolaryngology) and David Plant (ECE) are taking the first steps toward a collaborative investigation of how wireless communications technologies inside emergency rooms affect the sensitive electronic equipment for such tasks as drug delivery instrumentation or heart monitoring. Professor Steve Yue (Mining, Metals and Materials) explores the processing and properties of biomaterials; Professor Evgeny Timofeev (Mech), a specialist in shock waves and computational fluid dynamics, has applied his knowledge in collaborations with medical researchers to publish works on neuroradiology; and Professor Anas Hamoui, MEng'98, (ECE) develops integrated microsystems for biomedical applications. Increasingly, faculty members and graduate students are directing their knowledge and skills to the challenges of biomedical engineering research.

Seeing the Brain

Image-guided neurosurgery is on the cutting edge – except that the precise edge to cut can be elusive. Surgeons can employ pre-operative Magnetic Resonance Imaging (MRI) images of a patient's brain so that, during the operation, a tracked probe translates the actual surgical movements in the brain to the pre-op image, in theory conveying the probe's precise whereabouts. But there is a problem. "When you open the cranium, the brain swells and shifts and sags, so when you point to a location, it doesn't necessarily correspond to the pre-op image any longer," says Electrical Engineering professor Tal Arbel, BEng'92, MEng'95, PhD'00. Working in close collaboration with a group led by Louis Collins in the Brain Imaging Centre of the Montreal Neurological Institute, Arbel's team is exploring ways to take ultrasound images during the operation, thus providing information that could be used to correct the guide.

Arbel developed her skills with Electrical Engineering professor Frank Ferrie, BEng'78, MEng'80, PhD'86, who supervised her doctoral research. "Medical imaging is a relatively new field. Until recently, research has focused on actually acquiring images," she says. "Now we're at the cusp of doing important clinical work with these images, replacing a human operator on some tasks and even bringing the technology into the operating room." Her expertise is in demand, and Arbel is developing imaging techniques for spinal surgery as well as working with Montreal Neurological Institute researcher Doug Arnold to develop a means of automatically classifying healthy and pathological tissues in conditions such as multiple sclerosis. "Brain lesions associated with MS are sometimes visible through MRI, but sometimes they look like healthy tissue. We're trying to implement probabilistic techniques to automate the process, and are getting results that are on par with the experts," she says. The technology could facilitate the diagnosis and treatment of MS.



Rupert Brooks, PhD student, Frank Riggi, MEng student, Electrical Engineering professor Tal Arbel, and Rola Harmouche, BEng'03, MEng student, examine a model spine

To find out more, go to www.cim.mcgill.ca/~arbel

Protein Enriched

Protein enrichment isn't something that only concerns manufacturers of breakfast cereals. Sasha Omanovic, assistant professor of Chemical Engineering, is currently exploring how to characterize proteins and their interaction with biomaterials. This fundamental research will shed light on how biomaterial surfaces can be modified to prevent the adsorption of some proteins or enhance absorption of others. Omanovic has also collaborated with Richard Leask to modify metallic surfaces by using proteins in order to promote cell attachment, and this research has broad implications for other biocompatibility issues. "Most biocompatibility problems with metallic biomaterials are related to corrosion, which can result in serious infections, implant rejection, accumulation of toxic metals and sometimes mechanical failures," he says. His team is working on methods to increase corrosion resistance of biomaterials, and has developed a surface modification method that offers 99.95 per cent relative protection against general corrosion of an implant grade stainless steel and complete protection against pitting corrosion – tough enough for the human body, and even for a range of industrial applications.

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Sasha Omanovic

As a member of the Centre for Biorecognition and Biosensors, Omanovic is also working with Pharmacology professor A. L. Padjen to design an electrochemical biosensor that will monitor the brain's dopamine level *in situ*, and is developing an electrochemical immunosensor to detect C-Reactive Protein, which is a marker of certain medical conditions, including Alzheimer's and coronary disease. "So far, testing for this protein involves very expensive and labour-intensive methods," he says. "We want to build an immunosensor similar to those commercially available to detect glucose, which cost about 50 cents."

FACULTY NEWS

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Killam Award winner Rod Guthrie

GUTHRIE WINS KILLAM

Roderick Guthrie, Macdonald Professor of Metallurgy in Mining, Metals and Materials Engineering, has won the 2006 Killam Prize in Engineering for his work in process metallurgy. Professor Guthrie's Killam Prize, worth $100,000, recognizes his research in applying techniques that use mathematical and physical models to predict and improve the performance of metal processing and refining operations. His technique for detecting foreign particles during metal processing has enhanced and assured quality control in a range of products the world over, from soft drink cans to refrigerators to Boeing 747s to high-performance cars. He also holds some 200 patents based on eleven different inventions. "I really like to work with the industry and to tackle everyday problems. Steel and aluminum are ubiquitous, with hundreds of problems and hundreds of technical solutions. They're the building blocks of modern society," says Guthrie, who is director of the McGill Metals Processing Centre. "Global demand for process and extraction metallurgists is higher than it has ever been." The Killam Prizes, Canada's most prestigious awards for career achievement in research, were announced March 27, 2006.

OWEN EGAN

Doctoral student Christina Contandriopoulos, MArch'02, guest speaker Patricia Patkau, and Jean-François Champoux-Lemay, BSc(Arch)'06

ARCHITECTURAL OUTREACH

Avi Friedman led seven international students from the School of Architecture to Drayton Valley, Alberta, for the winter term, where they developed a plan to reinvigorate the city's downtown. Each student was assigned a specific block to remodel, and the result was an integrated, workable plan that was presented before the town council in the spring.

On January 31, Vancouver-based architect Patricia Patkau presented the 2006 Sheila Baillie Hatch Lecture in Architecture. Patkau Architects designed the critically and popularly acclaimed Bibiothèque nationale du Québec in downtown Montreal, in addition to numerous other prominent buildings across Canada. The annual lecture was established in 2001 by Gerald Hatch, BEng'44, and Sheila Baillie Hatch, BArch'46, to celebrate the 55th anniversary of Sheila Baillie Hatch's graduation.

PATKAU ARCHITECTS

La Bibliothèque nationale, Montreal

WANTED: TOP GRADUATE STUDENTS

World-class research demands top graduate students. With this in mind, the Faculty has developed a creative recruitment awards program to attract over thirty top doctoral candidates to the Faculty for September 2006. The co-financing scheme will see the first year of doctoral research supported primarily by the Faculty through the Dean's Doctoral Student Recruitment Research Awards, but also with research grant funds leveraged from the new student's department and supervisor. In the second and third years, the ratio would shift, with the supervisor or department assuming more responsibility. The end result is a three-year guaranteed financing package that should give top students plenty of reasons to join the program.

OWEN EGAN

Associate Dean David Plant

To ensure the top candidates do indeed apply, the Faculty has been sending recruitment letters to all holders of NSERC or FQRNT scholarships at the bachelor's or master's level, and has then built on this personal touch by hosting a recruitment weekend in April. Faculty members are also being enlisted to coax candidates to choose McGill. "We cannot simply flip a switch and see an instantaneous effect," says David Plant, Associate Dean (Research and Graduate Education), who is in charge of the recruitment effort. "This year is a pilot, so we'll be fine-tuning as we go. But we want to make a lot of noise, spreading the word so that students are aware that we are offering these competitive packages. The top applicants apply to numerous institutions worldwide, so we need to convince them to join McGill rather than another university."

THANKS TO 3M

Last fall, international technology giant 3M Canada generously created two new entrance scholarships for McGill's Master in Manufacturing Management (MMM) program, to be awarded for the first time to students entering the program in September 2006. "The MMM program is one of the few in Canada with a focus on manufacturing. This training, especially in areas like supply chain design and management, lead manufacturing and Six Sigma, is very important to us," says Ravi Samuel, Manager of Corporate Quality and Manufacturing for 3M Canada. "We've had good experiences working with intern students from the program, and have hired some of them afterwards. Plus, MMM students come from around the world, and we're a global organization, so it is a good fit."

FACULTY KUDOS

Electrical Engineering professor David Plant has been named a Fellow of the Optical Society of America. Plant is also Principal Investigator and Centre Director of the McGill-based SYTACom, the Centre for Advanced Systems and Technologies in Communications, a province-wide network of researchers.

In the feature article on "Fifty Ideas that Changed Plastics" in the October 2005 issue of *Plastics Technology*, Professor Emeritus Musa Kamal (Chem) is the first researcher listed among the pioneers leading the field in Injection Molding Simulation.

This July, Mechanical Engineering Professor Wagdi Habashi, BEng'67, MEng'70, will receive a Lifetime Achievement Award from the Computational Flow Dynamics Association of Canada. Habashi's research has been especially influential for understanding phenomena such as aircraft icing and de-icing.

Electrical Engineering professor Jeremy Cooperstock, a member of the Centre for Intelligent Machines, is a founding member of the Centre for Interdisciplinary Research in Music Media and Technology (CIRMMT), based in the Schulich School of Music at McGill. Cooperstock will contribute his expertise in human-computer interaction and next-generation network transport protocols to CIRMMT's leading-edge research in music technologies.

URBAN DESIGN MASTER'S PROGRAM LAUNCHED

McGill's Schools of Architecture and Urban Planning have joined with their counterparts at the Université de Montréal to create a Master of Urban Design program aimed at professionals in architecture, landscape architecture, urban planning and related fields wishing to acquire a specialization in urban design. Urban design is becoming an essential discipline, thanks to a growing demand for efficient and livable urban environments and an increasing need to improve older urban areas, recover industrial sites and integrate new infrastructure. The program has the support of Montreal's municipal administration and professional staff, and Montreal itself will serve as the students' state-of-the-art laboratory of urban living.

JACK GOLDSMITH

Max Kalman at 100

KALMAN RETROSPECTIVE

The School of Architecture, in association with the École d'architecture at the Université de Montréal, hosted a retrospective exhibit of M.M. Kalman's influential architectural designs from 1930-1960 in honour of the architect's 100th birthday. The exhibit ran from May 30 – June 16.

Jackie English

RELATIVELY BRILLIANT

Creating award-winning educational animation is a long way from a Mechanical Engineering honours thesis on unsteady flow in a pulse detonation engine, but Jackie English, BEng'00, working with teammates Kiran Sachdev, BSc'01, and Bogdan Luca, made the leap by winning the €25,000 prize for the prestigious Pirelli Relativity Challenge 2005, held to mark the centenary of Albert Einstein's special relativity theory. English co-conceived, wrote and narrated "Al's Relativistic Adventures," an on-line animated narrative telling the story of "Little Al" and his exploits in relativity. "The piece is directed at a general audience, but kids like it, and we have had positive responses from people working in physics too," she says. According to the judges, this project best explained the theory to layfolk . "The piece has also been used as a teaching tool, and we have been approached to make vignettes for other groups." English is currently a presenter on TV Ontario's kids' show *The Space*, where she developed the character "Engineering Savi" to help youngsters understand what engineers do. "I really enjoyed studying engineering, although I didn't gravitate toward working in it. But it suits the way I think," she says. "I'm a problem-solver."

BOGDAN LUCA

Al's first inklings of relativity: from "Al's Relativistic Adventure"

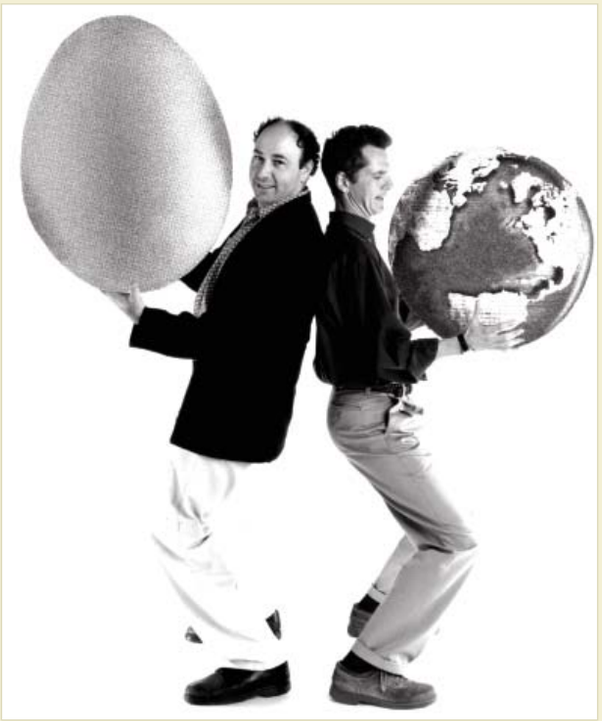
Check out Al's adventures, and brush up on your "special theory of relativity" chops, at www.onestick.com/relativity.

ARCHITECTURAL OEUFORIA

From small eggs spring mighty fowl. In October 2005, L'OEUF (L'Office de l'eclectisme urbain et fonctionnel), a Montreal-based architectural firm founded in 1992 by Daniel Pearl, BArch'86, and Mark Poddubiuk, BArch'85, and later joined by Bernard Olivier, BArch'92, MArch'97, won the inaugural Holcim Foundation Gold Medal for Sustainable Construction in the North American division. At the international face-off in Thailand, L'OEUF – the sole North American representative – took home the bronze medal. The much-lauded project, "Greening the Infrastructure of Benny Farm," focuses on the construction and renovation of 187 units in four buildings at Benny Farm, a complex built in 1946 and 1947 to house returning war veterans in Notre-Dame-de-Grace, Montreal. The buildings share environmentally friendly energy, water and waste systems designed to reduce greenhouse gas emissions, drinkable water use, and waste production. According to the Holcim Foundation, "This work offers a financially viable as well aesthetically sensitive contribution to sustainable neighborhood planning."

The Benny Farm project has also received the ACC/ACI (Cement Association of Canada/American Concrete Institute, Quebec section) merit prize.

Visit www.loeuf.com for more information about the project.



L'OEUF's Dan Pearl and Mark Poddubiuk

INNOVATOR EXTRAORDINAIRE

Philippe Simard, BEng'98, MEng'99, PhD'03, wants to give a bit more shape to the two-dimensional. And his efforts to do so, by developing software that can use two-dimensional photographs to update three-dimensional images, have won him the 2005 Young Innovator Award from the Networks of Centres of Excellence Programme. Simard created his software as a member of the GEOIDE (Geomatics for Informed Decisions) Network, and, with his brother Louis, BEng'01, MEng'03, has spun off the technology to form his own company, SimActive. "Although there are technologies to create and display 3D urban models, there exists no tool to track structural changes over time," says Simard. "Our technology is expected to give the Canadian forces and their allies a significant technology advantage in surveillance and reconnaissance, by updating 3D maps for mission planning."

Louis and Philippe Simard of SimActive

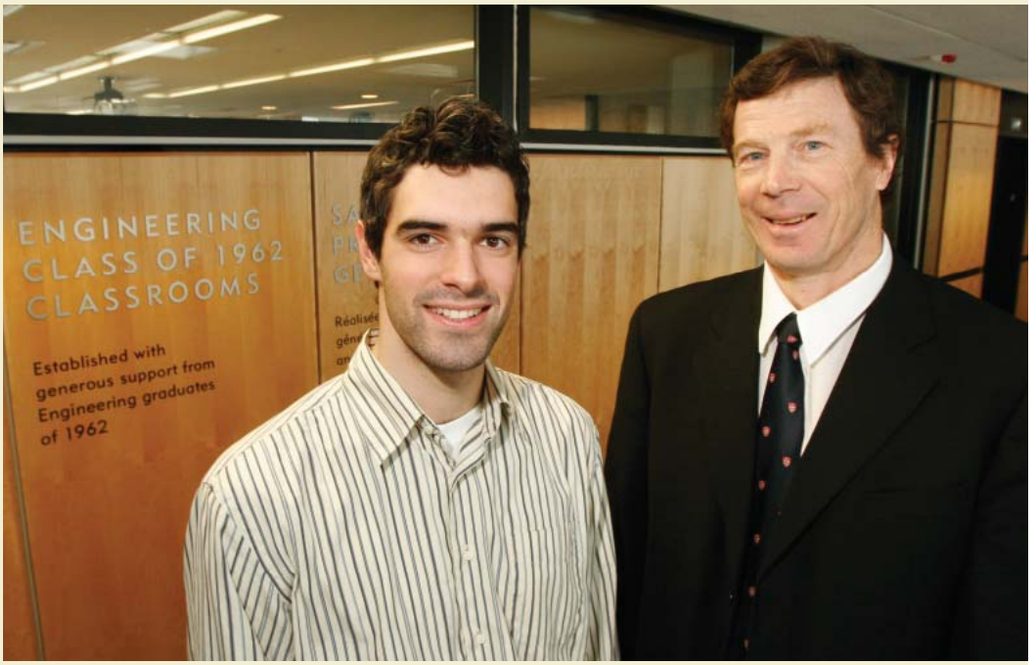
Both Simard brothers honed their computer vision skills by working with Professor Frank Ferrie in the Artificial Perception Lab at the Centre for Intelligent Machines. Philippe Simard's doctoral research brought him into contact with the GEOIDE network, where he collaborated on developing automated methods for generating accurate topological databases, including 3D images, from 2D data. SimActive, which he created upon his graduation in 2003, has worked with Defence Research and Development Canada to develop software yielding real-time 3D images of urban environments, and has collaborated with Neptec, an Ottawa company, to design 3D modelling software for the camera system on the space shuttle Discovery. He has also won contracts to work with the Department of National Defence, and is developing projects with companies such as CAE. Other potential applications include urban planning, disaster assessment, and cartography.

ENGINEERING CLASS OF '55: GALES FORCE

In celebration of the lively connection the Engineering '55 maintains to their alma mater, the McGill Alumni Association has chosen to honour the class with the D. Lorne Gales Award, which was presented at the annual awards banquet on May 23. Look for photos on the Engineering web page: www.mcgill.ca/engineering.

Special congratulations to Tom Rogers and his team of classmates leading their 50th anniversary campaign. As of April, over $40,000 in gifts and pledges have been counted towards the goal of $100,000, which will be used to finance renovations to create the Engineering Class of 1955 Seminar Room, a much-needed multi-purpose space for the use of students and faculty alike. Thanks to all of the project's supporters!

OWEN EGAN



The first recipient of the Engineering Class of 1962 Scholarship, second-year Mechanical Engineering student Jean-François Haeck, with David Lowther, Chair of Electrical and Computer Engineering

FOR THE PLEASURE OF GIVING

When Elliot Levine, BEng'70, received an inheritance upon his mother's death, he knew where he wanted some of it to go. "I wanted to experience the pleasure of giving something back," he said. So he approached the Faculty about making a donation, and as a result of his generosity, this summer the Department of Mechanical Engineering will be able to perform some much-needed renovations in its aging Student Affairs Office. "I believe a post-secondary education is extremely important," he says, noting that his two daughters and his wife graduated from McGill as well. Levine runs Plomberie Levine Brothers, a business begun by his grandfather (as his son and son-in-law are also working for the company, the company spans four Levine generations). "I wanted to do something in recognition of the 36 years of professional life McGill has given me."

OWEN EGAN

Arun Misra, Chair of Mechanical Engineering, and Elliot Levine

OWEN EGAN

GREEN AS THE NEW-FALLEN SNOW:

Mechanical Engineering Professor Peter Radziszewski, Arthur Lau, BArch'62, and special advisor to the VERT (Vehicle Engineering Education, Research and Tech Transfer) program, Mechanical Engineering graduate student Simon Ouellette, BEng'04, the Electric Snowmobile project coordinator, and undergraduate students Albert Mathews, Ming-Tuong Dao and Katie Allan, at the Mechanical Engineering Project Exhibition on April 6. The zero-emissions electric snowmobile project (one of 34 exhibited) is partially supported by the VERT program. In 2004 the McGill team won the Best Electric Snowmobile prize at the SAE Clean Snowmobile Challenge. This latest version of the electric snowmobile will be spending its summer in Greenland, being tested for use in a zero-emissions base camp for scientific research.

Tara Kitts, Colleen Cowman, Emily Kulin and Ibrahim Inayatali, McGill's Ontario team for Development, Alumni and University Relations

McGill in Ontario

If you are in Ontario and wish to stay connected to your alma mater, McGill's Ontario Regional Office for Development, Alumni and University Relations is there to provide the link. The team of Ibrahim Inayatali, MBA'82, Colleen Cowman, Emily Kulin, BA'05 and Tara Kitts will maintain McGill links with alumni and friends in the Greater Toronto Area and central and southwestern Ontario, while also coordinating programs and activities in collaboration with the McGill Alumni Association.

For further information, please contact:
(416) 703-9795 or 1(888)448-0499
toronto.alumni@mcgill.ca

Federal Tax Change Benefits Donors

The April 2 federal budget brought some good news for McGill, the Faculty of Engineering, and our donors. Thanks to tax changes announced in the budget and taking immediate effect, donors will no longer be taxed on the capital gain accrued on securities they donate to a registered charity. Previously, a taxpayer who donated shares which then raised in value had to pay tax on 25% of the increased value. Under the new rules, if a donor donates stock that was originally purchased for $400 and now has a fair market value of $1,000, the donor will receive a tax receipt from McGill for $1,000 and will not have to pay any tax on the gain. This will result in a $460 donation tax credit (using the top marginal tax rate of 46%).

For more information on gifts of securities, please contact Terry Tobin, Director of Development for the Faculty of Engineering, McGill University, at 514-398-4705, or via email at terry.tobin@mcgill.ca.

OWEN EGAN

Robyn Ouimet, Development Officer, Christophe Pierre, Dean of Engineering, and Terry Tobin, Director of Development

McGill wants a share in your company's future success.

Over the last 15 years, corporate stock options have become a valuable and popular commodity. Options are typically seen as an inexpensive way for a company to compensate employees. Lesser known but equally valuable is a class of stock options known as Charitable Options, providing a low-cost way to make a significant gift to charity.

Charitable Options were approved by the Toronto Stock Exchange (TSX) in October 2000 and can be issued by companies undertaking an initial public offering (IPO). A gift of Charitable Options enables a company to celebrate "going public" with a tangible commitment to the community. Charitable Options represent a significant opportunity because most young, growth-phase companies cannot afford to donate to charity using traditional methods of giving. With a gift of Charitable Options, a company can signal its intention to be a good corporate citizen as it steps into the public arena and heightens its public profile.

Charitable Options are a separate class of options that must remain within approved guidelines. Charitable Options for companies to be listed on the TSX must have the following characteristics:

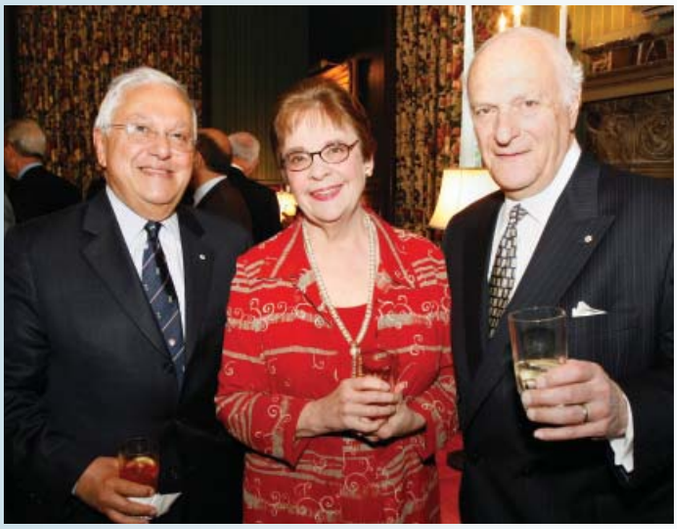
1. Charitable Options may only be issued to charitable organizations and public foundations, such as McGill University, within the meaning of the Income Tax Act, not a private foundation;
2. They have a 10-year term exercisable at any time during the term;
3. The exercise price is equal to the public offering price and payable only in cash;
4. They vest 100% on issue;
5. The total limit on Charitable Options for a single TSX listed issue is 1% of outstanding stock;
6. They are not transferable, and except in application of the anti-dilution protection that they may contain, may not be amended during their term.

Donors are encouraged to seek independent legal and financial advice before entering into any charitable option arrangement with McGill University.

For more information, contact
Bequests and Planned Gifts Office
McGill University
Tel.: (514) 398-3560 or 1-800-567-5175
or plannedgifts.dev@mcgill.ca

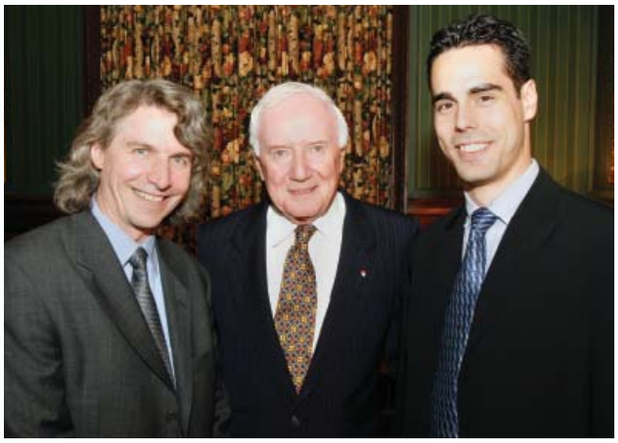
CONVOCATION DINNER 2006

Louise and Lorne Trottier, BEng'70, MEng'73, DSc'06, with Dean Christophe Pierre and Myriam Pierre.



Professor Mostafa Elhilali, PhD'69, Chief of Surgery for the McGill University Health Centre, with Holly Jonas, BA'58, MSW'71, and Emeritus Professor John Jonas, BEng'54

Howard Stotland, BEng'66, Emeritus Professor John Gruzleski, Vivian Stotland and Terry Tobin, Engineering Development Office.



Professor David Plant, Don Murphy, and Julien Faucher, PhD'06 and Tomlinson Doctoral Scholar.

Professor Vikram Bhatt, MArch'75, Dr. Balkrishna Doshi, DSc'06, Professor David Covo, BArch'74, and Jean-François Champoux-Lemay, BArch'06.

Make Your Donation Online!

You can make your gift online at www.alumni.mcgill.ca/online-giving. Don't forget to select the Faculty of Engineering or specify your Department or School as your preferred area of support.

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