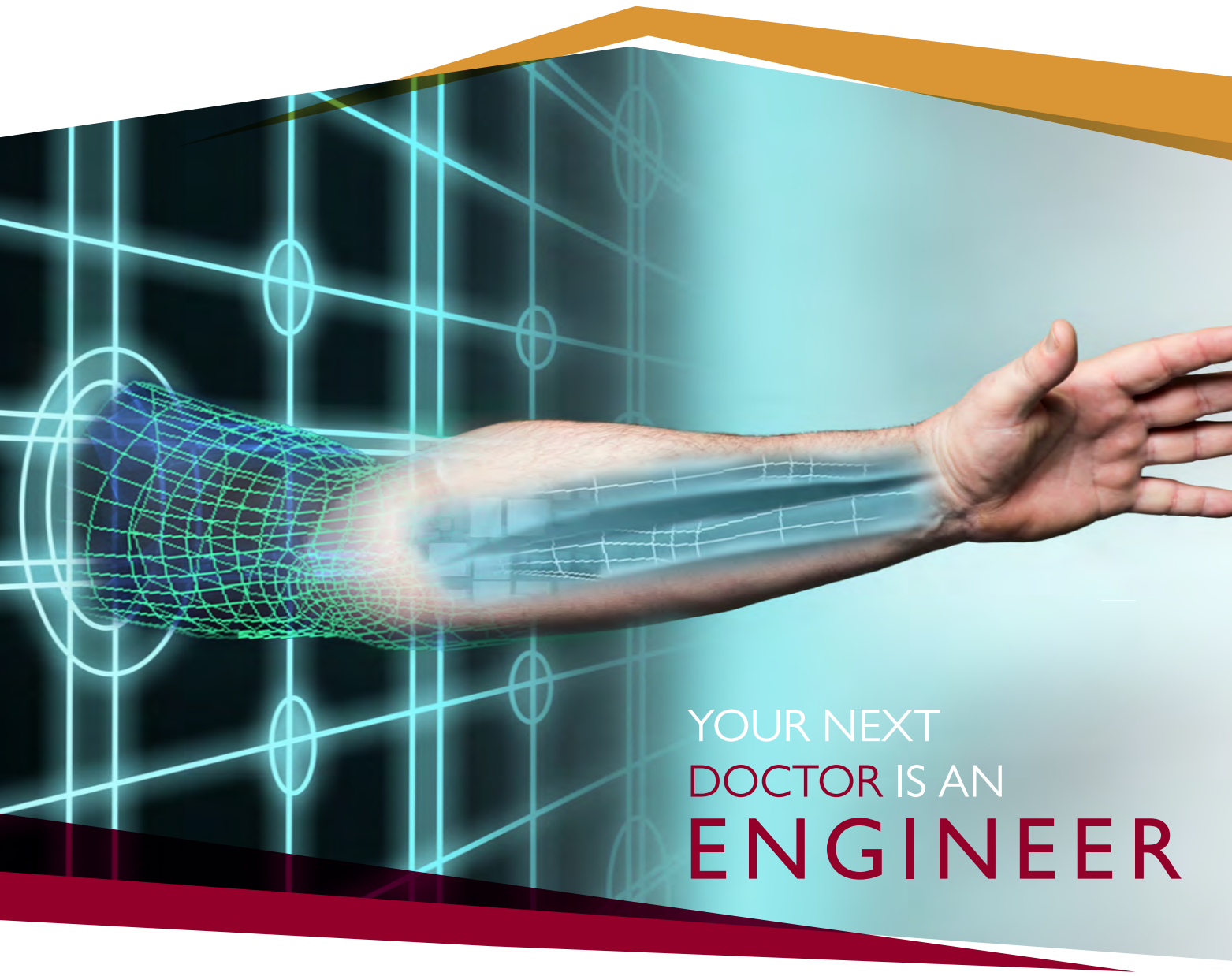
CONCORDIA ENGINEERING

NEWS



YOUR NEXT DOCTOR IS AN ENGINEER

Université Concordia University

FACULTY OF ENGINEERING AND COMPUTER SCIENCE

INSIDE

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MESSAGE FROM THE DEAN

Convergence is one of the themes of this issue of Concordia Engineering News, and I feel it's an appropriate word with which to begin this, my first message of our Faculty newsletter. Convergence is integral to so much of what we do at Concordia. We help bring together many different individuals with diverse talents and interests, and unite them with a common purpose: to advance education and research for the benefit of a 21st century globalized society.

Ours is also an institution where disciplines converge. In this issue you'll read about the convergence of engineering, computer science and the life sciences, but many more examples abound in our Faculty: business leaders working with engineering students, administrators forging partnerships with civic leaders, budding entrepreneurs joining forces with experienced researchers, university faculty forming alliances with private sector collaborators. These complex and ever-changing social arrangements in a relatively young university such as ours, at the heart of a cosmopolitan city like Montreal, combine to unleash a dynamic energy. It was the allure of this energy that was a big part of my decision to accept the job as Dean and move here from Toronto during the summer.

As I embark on my tenure, it is a key opportunity to evaluate where convergence is contributing to the kinds of advances we want for our Faculty, and where more relationship-building is required to take us even further. I am particularly keen to ensure we strengthen our relationships with alumni, industry, and other engineering institutions.

Earlier this year, I had the chance to host the Dean's Cocktail Reception at my first ever Concordia Homecoming. It was a wonderful opportunity to see alumni from the 1960s, 70s, 80s, 90s and over the last decade come together with young students. This bond between alumni and current students can be a particularly fruitful one. Alumni have furnished our students with many great working opportunities, not to mention countless acts of mentoring; in turn, students give back their capacity to innovate and think differently about the future. Many of the young men and women I have met have their fingers on the pulse of big technological changes. They understand social media intuitively; they are eager to exploit the potential of wireless technology; and they know that in a competitive work world, they'll increasingly need to invent their own jobs.

I believe our students are very capable of that task, and that the education and work opportunities they are receiving here are contributing to their future goals. But we can always do better. Along with expanding on our engagement activities with alumni, I want to identify more opportunities to collaborate with industry. We have enjoyed unprecedented growth in recent years in terms of the funding we obtain from industrial partners. I think we can capitalize on the networks we've established and the expertise we've developed and take these efforts to the next level.

Convergence opens up numerous possibilities for an ambitious and academically-rigorous institution such as ours. I hope to meet as many of you as possible along the way as together we ignite many new sparks of creativity, insight and technological progress. Please join me as we collectively embark on a path of achieving excellence at all levels in our Faculty.

Amir Asif

Dean and Professor
Faculty of Engineering and Computer Science
Concordia University

FACULTY NEWS HIGHLIGHTS

On **June 1, 2014**, Ali Dolatabadi, professor in the Department of Mechanical and Industrial Engineering, was appointed President of the Canadian Society for Mechanical Engineering (CSME). CSME is the first constituent society of the Engineering Institute of Canada (EIC) and is associated with its American and British counterparts: the American Society of Mechanical Engineers (ASME) and the Institution of Mechanical Engineers (I.Mech.E.)

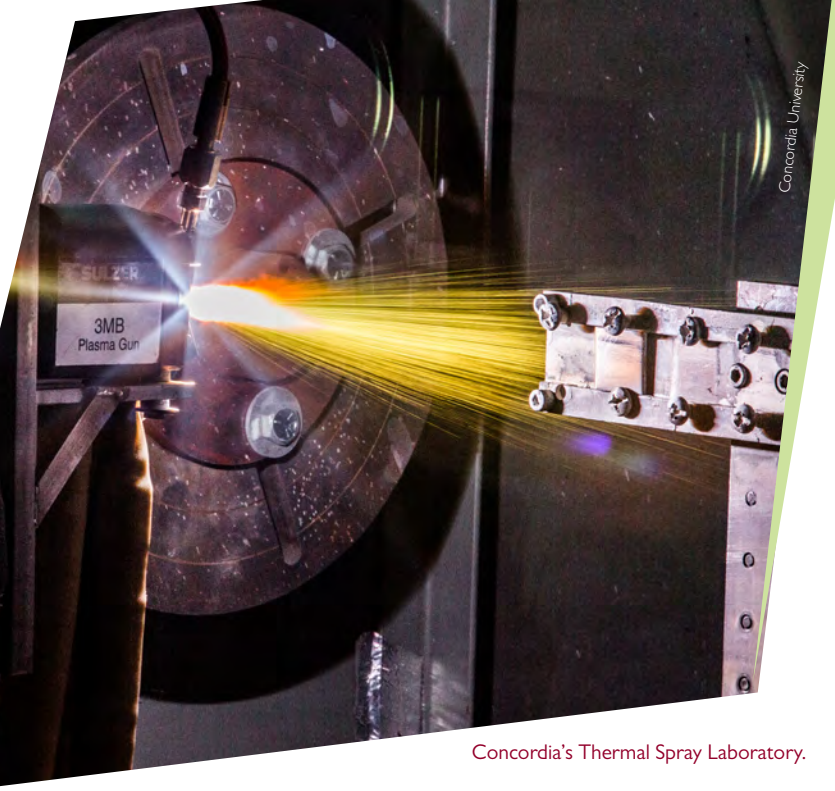
At Spring Convocation, **June 9, 2014 – June 11, 2014**, Peter Rigby, assistant professor in the Department of Computer Science and Software Engineering, was one of four winners of Concordia's 2014 University Research Awards. Glenn Cowan, associate professor in the Department of Electrical and Computer Engineering, won the Concordia Emerging Leadership Award. Lyes Kadem, associate professor in the Department of Mechanical and Industrial Engineering, won the President's Excellence in Teaching Award.

Undergraduate student **Amélie Lessard** has won a prize – "Prix Excelle Science" – worth $2,000 from Quebec's Ministère de l'Enseignement supérieur, de la Recherche et de la Science. She was one of just 20 university prize winners this year. The industrial engineering student was previously enrolled in East Asian studies and Japanese before becoming a coordinator for business development with an engineering firm. It was this experience that compelled her to enroll in the Faculty at Concordia. She was honoured along with other award winners at Quebec's Assemblée Nationale on **June 9, 2014**.

The five-year term of the new Dean of the Faculty of Engineering and Computer Science began **August 1, 2014**. Amir Asif came to Concordia from York University, where he was chair of the Department of Electrical Engineering and Computer Science for seven years, building it from a classic computer science department into the large multidisciplinary unit at the core of the Lassonde School of Engineering. Asif holds a PhD and a Master of Science in Electrical and Computer Engineering from Carnegie Mellon University.

In **September 2014**, the Canadian Association of Composite Structures and Materials announced the creation of a new prize that bears the name of Suong Hoa from the Department of Mechanical and Industrial Engineering. The *Professor Suong V. Hoa Student Paper Award* will be presented for the first time in a special session of the Canadian-International Composites Conference to be held in Edmonton, Alberta next summer. The prize is valued at $1,000 for the first-place winner, $500 for the second-place winner, and $250 for the third-place winner. In related news, Montreal's Palais des Congrès this summer engraved Hoa's name on its red floor in recognition of the professor's organization of the 19th International Conference on Composite Materials (ICCM19) in 2013, which brought almost 2,000 delegates to Montreal.

New CSeries from Montreal-based aerospace company, Bombardier, a partner in the new $1.3 million project, led by Concordia, *Lean Aerospace Value Streams*. Photo courtesy of Bombardier.



Concordia's Thermal Spray Laboratory.

Effective **October 1, 2014**, Christian Moreau in the Department of Mechanical and Industrial Engineering was elected as President of the Thermal Spray Society of ASM International [American Society for Metals] for a two-year term. Moreau is a Tier 1 Canada Research Chair whose team develops diagnostics and modeling tools to improve coating materials and to tailor them for optimum performance in industrial applications. His work will improve energy efficiency and can boost economic growth in the aerospace sector.

On **October 31, 2014**, a fact-finding mission was announced by the newly-created Big Data Consortium. The consortium will conduct the Big Data and Data Analytics Talent Gap Survey to assess current needs in education and research related to Big Data, which is a term that describes data sets so large and complex that they are difficult to process using traditional data processing applications. The Big Data Consortium is a new partnership of Concordia, Ryerson University, Dalhousie University and Simon Fraser University, with industry represented by Deloitte, TMX Group, the Information Technology Association of Canada and SAS Canada, as well as government partner, Industry Canada. Greg Butler, a professor in the Department of Computer Science and Software Engineering, is Concordia's official representative to the consortium.

Concordia announced **November 25, 2014** that it was a co-recipient of a $1.3 million CRD (Collaborative Research and Development) grant from the Natural Sciences and Engineering Research Council (NSERC), Bombardier and Bell Helicopter that will fund a project called *Lean Aerospace Value Streams*, led by principal investigator, Nadia Bhuiyan from the Department of Mechanical and Industrial Engineering. This project focuses on developing lean techniques for the aerospace industry, leading to increased efficiency and greater profitability. Concordia's university partners in this initiative are École de technologie supérieure (ÉTS), École Polytechnique, and Consortium de Recherche et innovation synergétiques en aérospatiale (CRIAQ).

NEW FACULTY

AMIR ASIF, the new Dean of the Faculty, became a professor in the Department of Electrical and Computer Engineering. Asif holds a PhD and a Master of Science in electrical and computer engineering from Carnegie Mellon University. His research specifically focuses on distributed detection in sensor networks, robust detection and imaging with special emphasis on bioimaging and cancer visualization by time reversal, signal processing on graphs and analytics for Big Data, and transcoding framework for high-definition video transcoding for multimedia communications.

BRUNO LEE is a new Assistant Professor in the Department of Building, Civil and Environmental Engineering. He graduated from Concordia with a BEng in building engineering. He completed an MSc in architectural engineering from Pennsylvania State University, and a PhD from the Department of the Built Environment at Eindhoven University of Technology in the Netherlands. He investigates how to holistically employ computational simulation techniques to evaluate the energy performance of buildings so as to facilitate building design decisions based on objective and data driven reasoning to ensure robust building design.

FUZHAN NASIRI has joined the Department of Building, Civil and Environmental Engineering as an Assistant Professor. He completed his BSc and MSc at the Sharif University of Technology in Iran, and his PhD in environmental systems engineering at the University of Regina, Saskatchewan. He also has a post-doctoral certificate from Yale University. Nasiri uses systems modelling, simulation and optimization techniques to address energy sustainability problems in a holistic fashion. He describes his research as being at the intersection of systems engineering and sustainability science.

EMAD SHIHAB is joining the Department of Computer Science and Software Engineering as Assistant Professor. He holds a BEng and MEng in electrical and computer engineering from the University of Victoria and a PhD in computer science from Queen's University. His research interests are in mining software repositories, software quality assurance, software maintenance, empirical software engineering, mobile applications and software architecture. He mines historical project data and applies data mining, artificial intelligence and statistical analysis techniques in order to build pragmatic solutions that maximize software quality.

HASSAN RIVAZ became Assistant Professor in the Department of Electrical and Computer Engineering this summer. He received his BSc from Sharif University of Technology, Iran, holds an MSc from University of British Columbia, and earned his PhD at Johns Hopkins University. His research is on medical imaging and image processing, which has resulted in several high impact publications and patents. He is also interested in signal processing, machine learning, computer vision, statistics, optimization and linear algebra.

KRZYSZTOF SKONIECZNY is joining the Department of Electrical and Computer Engineering as an Assistant Professor and is nominated for a Canada Research Chair Tier II in Aerospace Robotics. He has a BASc and MAsc from the University of Toronto and a PhD from Carnegie Mellon University. His research expertise is in space robotics, especially rovers. He was principal investigator on a NASA-funded program on lightweight robotic excavation, and has also worked with space technology company MDA on control systems for space robots.

INTERVIEW WITH AMIR ASIF

The new Dean talks about his educational background and the need for further strengthening the relationships between students, alumni and industry.

Thinking back to your own studies, what are some of the most memorable moments that helped shape how you think about engineering research and education, not to mention the social and community side of the profession?

The most memorable day from my college and university life was my PhD graduation that was a culmination of my academic achievement. As we all know, an engineering degree at any level (undergraduate, master's, or PhD) is a lot of personal hard work and labour, and so was it for me. I realized early in my studies that working by oneself in a closed room will not help and will probably drive me insane! To complete my degree successfully, I needed support from my classmates, mentorship from alumni, and career counseling from my professors. The relationships that I developed as a result of my collaborations are precious, and are perhaps what I cherish the most from my education.

How do you think universities' relationships with alumni are changing? Do you notice differences from these relationships as they are today versus when you graduated?

There has been a major shift in the relationship between universities and their alumni and friends. Traditionally, universities only approached alumni at the time of hospitality or fundraising activities. The onus was primarily on universities to maintain a strong connection with alumni. This responsibility of staying in touch with each other has become more balanced now. Alumni nowadays want to play a strong role in the future of their departments, faculties, and universities. They have pride in the institutions they attended. They want to see their alma mater grow and prosper. After graduation, they visit their campuses often, follow the news of their universities, and share their views and ideas with their

former teachers and faculty collaborators. They help and guide aspiring students in their education. They serve on various university committees. They share hiring opportunities with their former universities.

Institutions look forward to the increasingly positive role that alumni have started to play. They recognize the importance of alumni as student mentors, ambassadors, and in outreach activities that raise the profile of the institution.

How do you want our Faculty's relationships with alumni and industry to evolve over the next five years, ten years, etc.?

In the coming weeks, our Faculty will be making a consistent effort to further strengthen its alumni relations program. We are looking at implementing a three-prong alumni engagement plan.

One, we will better use modern techniques to enhance our ability to communicate with alumni. Such communications will include invitations to participate in University and Faculty events such as Homecoming, the Concordia Shuffle, Convocation, and important inaugurations. We have 14,000 email addresses of our engineering and computer science alumni in our database and we want to connect a little more often this way. We will share this magazine, Concordia Engineering News, with them through postal mail and electronically.

Two, we are looking at the establishment of the Faculty of Engineering and Computer Science Alumni Association Board, which prominent alumni will be invited to organize. Members of my team and I will work closely with the board to look for alumni volunteers to participate in student life, provide mentorship, serve on Faculty advisory committees and board and on a variety of other campus initiatives. One of our long-term goals is to match every active student with an alumni mentor.

Three, we are in the process of hiring a director of development, whose mandate will include alumni relationships. In the next five years, we hope to strengthen and grow our alumni community, which will enrich the student experience through mentorship, help us raise funds for student activities through outreach, and foster new academic initiatives.

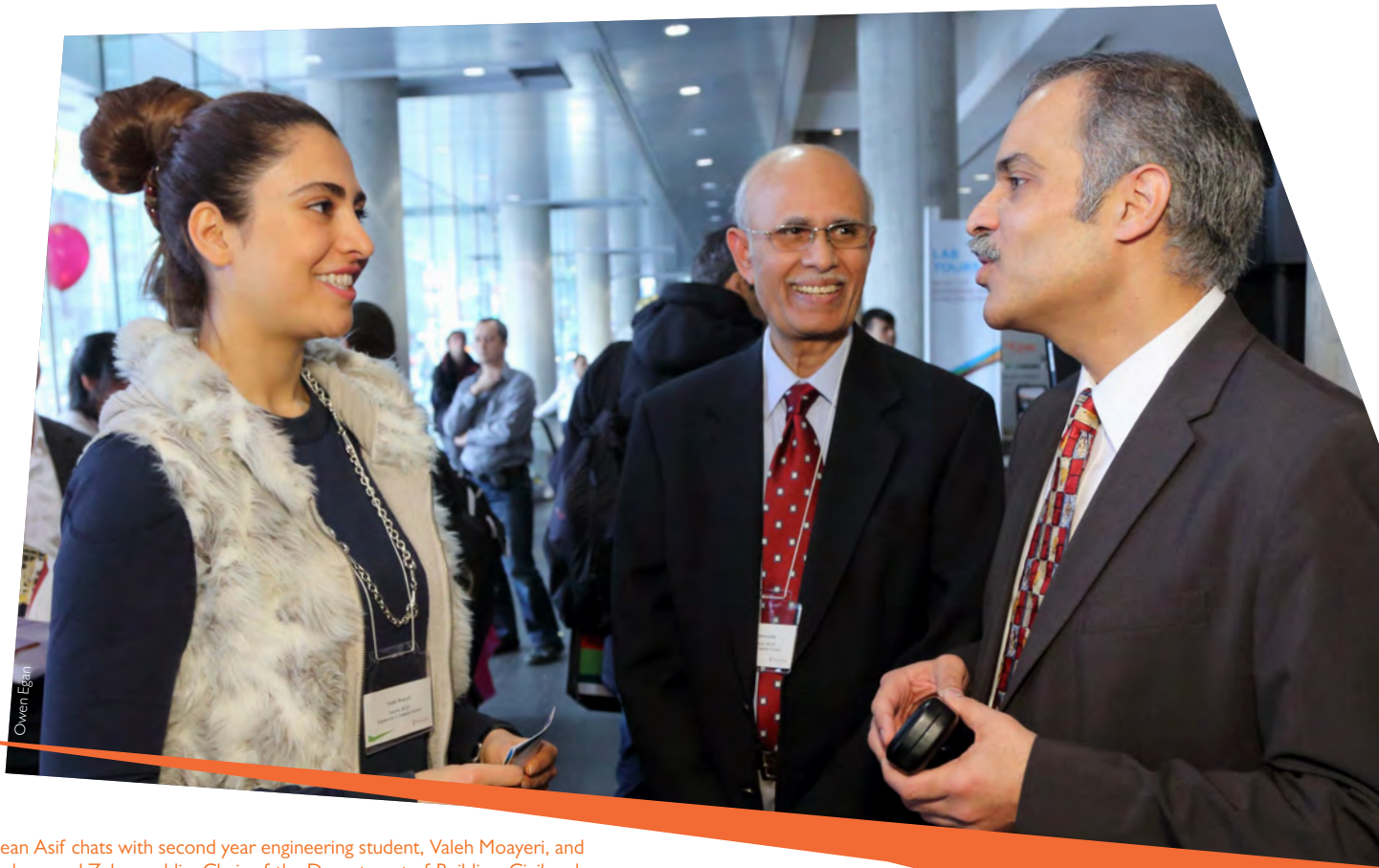
In ten years, I'd like to think we'll be seeing tangible benefits of the work we're starting now.

How do you think students can benefit more from engaging with alumni and industry?

Students will benefit a lot from engaging with those who have graduated ahead of them. Students often need personal direction and mentorship during their studies. This is where student-alumni engagement is most effective. Alumni help students with their selection of courses in pursuit of a career.

I believe we must also further enrich the student experience through the work placements offered by the Institute of Cooperate Education (Co-op) and the Concordia Institute for Aerospace Design and Innovation. These organizations really understand the needs of industry very well and our students generally come back from those work experiences feeling very positive and with a better focus on what they want to do professionally.

I strongly believe that the professional connections that are accessible to Concordia students are just as important as the classroom and lab learning, and will help them to thrive throughout their entire lives.



Dean Asif chats with second year engineering student, Valeh Moayeri, and Mohammed Zaheeruddin, Chair of the Department of Building, Civil and Environmental Engineering, at Open House, held November 8, 2014.

Virginie in the mechanical room at the top of the John Molson School of Business, the control centre for the sophisticated SolarWall, a hybrid technology that combines solar air heating and photovoltaic electricity in one building-integrated system.

VIRGINIE GAUVIN:
BUILDING A GREENER FUTURE

BY MALCOLM MCLEAN

Virginie Gauvin knew a long time ago that she wanted to build things. "My dad was in construction," she explained. While her CEGEP studies focused on business, she realized that engineering would allow her to mix business and science, and would also let her be involved in building things. Engineering also attracts her for another reason: "I like detail. I like accuracy. I like it when things work!"

Concordia's building engineering program caught her eye. "This is a unique program in Canada, combining aspects of mechanical and civil engineering into one program focused on buildings," she explained.

However, Concordia presented other challenges to her. "I was afraid of coming here, because I didn't speak English." A meeting with Martine Fachena, student recruitment officer for the Faculty of Engineering and Computer Science, encouraged her to see Concordia in her future and identified scholarship opportunities. Now in her third year, Virginie speaks confidently in fluent English, and describes how Concordia has been a portal to bilingualism and wider opportunities. "This gives me opportunities to go to the United States, British Columbia… so many places."

Virginie's passion is for green buildings: "net zero energy, net zero water, LEED, living building, this is the way we have to build now." She got involved in the Solar Decathlon: "a wonderful project building a full scale house that has to produce as much energy as it consumes." In passing, she observes with satisfaction that the EV Building is LEED Gold rated.

As a member of Concordia's Institute for Cooperative Education (Co-op), Virginie did an internship with PCL Constructors in Vancouver, and had the opportunity to work on a project that has a nine-acre green roof. "One mall and a few other buildings all together, put the same amount of ground on the roof as was taken away by the development: they have rooftop restaurants, a dog park, lots of services that were desired in the area… but didn't have space."

The internship experience was a crucial passage for her. "After my first year, I didn't quite grasp how the information I was acquiring in the classroom was applicable to engineering as a profession, and I was excited to finally be able to apply my knowledge usefully. I was working with engineers and project managers who trusted me, gave me responsibility that I still couldn't imagine for myself. That gave me more confidence, confirmed that I could push myself and succeed."

The experience of working in BC cemented her confidence in speaking English. It also gave her a new perspective on another aspect of engineering: how to succeed in engineering as a woman. She was entered in a contest last year called *Chapeau les filles*, intended to provide recognition of women studying in male-oriented professions. "I think it is a great contest, but sometimes I wonder: why do we still need this?" She agrees that more women need to take an interest in fields like engineering, but adds: "I don't want to get any job because I'm a woman, but because I'm an engineer. Because I deserve it."

CHRIS WILLIAMS

A HANDS-ON ENGINEER

BY MALCOLM MCLEAN

Chris Williams, a graduate student in electrical engineering, was the first in his family to go to university. When he finished high school, "I took a shot in the dark. I went to Dawson College's electrotech program. I thought I would get a diploma, and go to work."

Dawson helped him develop a practical approach to technology: "My teachers instilled a method of troubleshooting that takes into account real-world situations… also an intuition for circuit design and testing."

After Dawson, Chris found that the jobs he came across were not stimulating enough. "They were about implementing specific, narrow tasks. I wanted to look deeper."

But the path from technology to engineering was not smooth. "When I started my first year at Concordia, I hit a wall, going from completely hands-on work that I excelled at to more theoretical courses that I didn't have the math for." Discouraged, he was ready to quit and become an electrician, but over the summer he became immersed in reading physics. "Particle physics lit the fire again. I went back into my second year strong, near the top of the class, understanding the material and enjoying it."

"Coming from a technical program, I found labs to be my strength. Those from the pure and applied sciences have this perspective that electronics is mathematics in action, a view that I began to appreciate." Chris thrived in his second year and never looked back. While still an undergraduate student, he had the opportunity through Concordia's Institute for Cooperative Education to participate in the summer Industrial Experience (INEX) program, completing an internship at Microbridge Technologies Inc.

In his third year mini-Capstone project he was the hardware designer for a sumo robot project. He then met Glenn Cowan, associate professor of electrical engineering, "a charismatic teacher who made learning fun." Cowan suggested a Capstone project dedicated to designing, fabricating and assembling an integrated circuit FM receiver, a difficult task for the eight month project. "That was the high point of my undergraduate program."

Cowan suggested a master's degree, and Chris once again "took a shot in the dark". In fact, he finished his master's early, with a method for dynamically trading off power and noise in a phase-locked loop for variable data rate applications. "We implemented that in 65nm technology. It was very awesome, we had to use a high powered microscope just to see its outline." As a teacher's assistant, unsurprisingly, Chris feels most at ease as a lab demonstrator.

For his PhD, Chris is working with Odile Liboiron-Ladouceur, assistant professor of engineering at McGill and Canada Research Chair in photonic interconnects, who is his co-supervisor with Cowan. With a major scholarship from the Fonds de recherche du Québec - Nature et technologies and support from the Canadian government's NSERC SiEPIC program (Silicon Electronic-Photonic Integrated Circuits), he is working on short-reach optical receivers for communication, merging the areas of integrated photonics and electronics.

On a roll with his PhD program, and freshly back from an internship at Tyndall National Institute in Ireland designing high-speed analog circuits, Chris reflects that he never planned or expected to get this far in university. "I'm having fun! I don't like to leave at the end of the day."

Concordia University

YOUR NEXT DOCTOR IS AN ENGINEER

TECHNOLOGY ACCELERATES THE THIRD REVOLUTION IN THE HEALTH SCIENCES

According to a modern-day analysis of the 10-year Trojan War, which was waged sometime between the 11th century and 12th century in ancient Greece (and immortalized by Homer's famous poem The Iliad), the death rate from arrow wounds was 42 percent, slingshot wounds, 67 percent, spear wounds, 80 percent, and sword wounds a staggering 100 percent. Many injuries were nothing less than a death sentence. Centuries later in the Vietnam War, the mortality rate for American soldiers who had suffered abdominal wounds was only 4.6 percent. By this point in history, any conventional army was typically followed by a second, smaller army as well versed in saving lives as their counterparts were in destroying them. Doctors, nurses and surgeons benefited from the latest medical equipment, and helicopters could rapidly convey the wounded from the battlefield to the bed.

From antiquity to the 20th century, a huge array of technology advances had radically altered, not just war medicine, but all of the health sciences. Engineers were behind many of the improvements. We are now on the verge of what has been described by Nobel Laureate Phillip Sharp as a "third revolution" in the life sciences, in which interdisciplinary collaboration among engineers and physical and computational scientists promises to unleash yet more innovations. Concordians are playing their part.

BONE SCAFFOLDING

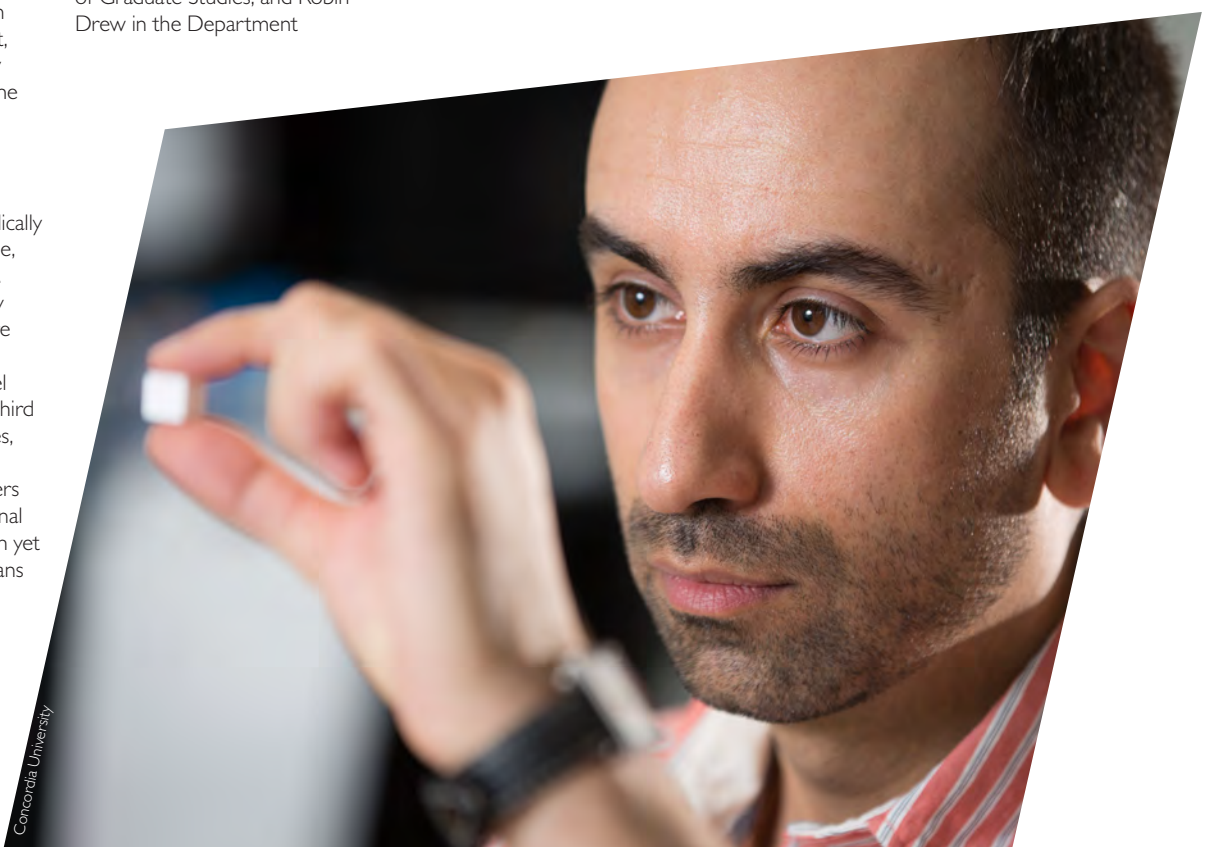
The fate of Americans in Vietnam is a reference point for Ehsan Rezabeigi, an Iranian-born international student who came to Concordia to work on his doctorate. The war saw the widespread use of bone substitutes, he explains. These were typically metal bars, inserted into the body to help heal broken limbs. This practice is still the norm today, but it has numerous disadvantages. The surgery required is highly invasive, and the metal prostheses are heavy and cumbersome.

Under the supervision of professors Paula Wood-Adams, who is also Concordia's Dean of Graduate Studies, and Robin Drew in the Department of Mechanical and Industrial Engineering, Rezabeigi is hard at work on a technology that could revolutionize the treatment of bone fractures. He is developing in three distinct phases a lightweight implant that can be surgically inserted into the body to support and promote bone regrowth.

Phase one involved synthesizing bioactive glass particles that are capable of feeding bone cells and helping them to grow. In phase two, he developed a novel technique of creating a highly porous polymer foam (a polymer is a structure made up of many molecules in a long chain). This polymer foam has high-performing mechanical properties: it's strong, and it can be used in load-bearing parts of the body like the shoulders and knees. The third phase of Rezabeigi's research consists of combining the bioactive glass particles with the polymer to make a brand-new composite material: a bone scaffold.

"The ideal scaffold has the same properties as bone. This is the goal we're striving toward," Rezabeigi says. The scaffold must be highly porous to allow for vascularization — the formation of blood vessels. This is, in part, what allows for bone growth. Meanwhile, small pores in the scaffold allow for cell attachment.

One of the most astonishingly futuristic properties of the bone scaffold is that it's bio-reabsorbable. In other words, it can safely dissolve into the body over time once it has completed its mission.



Concordia University

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SIMULATED SURGERY AND TOUCH

Operating on a patient is one of the most difficult and painstaking skills required for a medical practitioner. From the patient's standpoint, it can be an ordeal: recovery from surgery can take weeks, even months, and opening up the body introduces the risk of infection. It's no surprise, then, that what is called minimally-invasive surgery has become popular. This involves making keyhole incisions in the body and performing the operation using laparoscopic tools, which are long rod-shaped devices of only five millimetres in diameter or less, equipped with some form of visualizing device that allows the surgeon to remotely view what she is operating on. Increasingly, minimally invasive surgeries are carried out with the help of robots, whose artificial appendages can be even more precise and dependable than a surgeon's hands.

Minimally invasive surgery is Javad Dargahi's specialty. Not the surgery itself, but the refinement of devices and techniques to help. The mechanical engineering professor has devoted a lot of his research to haptic feedback — bringing the human touch back to robot surgery.

"What is missing with robot surgery is tactile feedback," Dargahi explains. "Haptic feedback involves collecting tactile information such as texture and hardness, and kinesthetic information about certain forces from the limbs, and then playing this back to the surgeon."

Among numerous projects, Dargahi has helped to devise and test sensors integrated into a catheter that can be inserted into a patient's body. The sensors relay information about the hardness and softness of tissues. The information helps a surgeon to determine where to place the anchor required for a complete mitral valve replacement during heart surgery. The sensors have so far proven successful in a simulated environment

Dargahi has also made great strides forwards in the related field of surgery simulation. What kinds of movements does a skillful surgeon make? Surgeons in training can benefit from firs-hand knowledge of this, and Dargahi and his students are developing systems composed of cameras and sensors to measure surgeon's movements and compare them against those of trainees in a simulated surgery environment.

Emily Gan

LAB-ON-A-CHIP

Muthukumaran Packirisamy is also a mechanical engineering professor, but working in a radically different field. You'd need a powerful microscope to properly understand his diverse contributions to the life sciences. He has found multiple applications for what is call lab-on-a-chip technology. Nanotechnology has permitted complex experiments to be enacted on chips no bigger than your fingernail. It's a technology with diverse applications.

For example, Packirisamy developed a chip capable of detecting growth hormone in milk. Growth hormone is banned in Canada. Before lab-on-a-chip technology, a farmer's only option for identifying the hormone was to send samples to laboratories hundreds of kilometres away and wait days to get back results. Thanks to Packirisamy's patented kit, tests can be conducted right on the farm, getting results in minutes.

"The kit can trace hormone in quantities as minute as two nanograms per millilitre. Previously we could only measure 100 nanograms per millitre," Packirisamy explains. (A nanogram is one billionth of a gram.)

Packirisamy is currently working with Nahum Sonenberg, a microbiologist and biochemist at McGill University's Goodman Cancer Research Centre. This time Packirisamy's lab-on-a-chip technology is being applied to conducting tests on liver cancer cells. This kind of experimentation holds a lot of promise, since implanting cells in a chip can often be an alternative to implanting them in rats or other animals, and can also significantly speed up the testing time.

"The microfluidic environment inside the chip is for our purposes better than a Petri dish," he says. "You can simulate all sorts of environments. In a healthy environment, the cells grow; in a toxic environment, the cells die. We custom design the chip for each application — this definitely isn't a one-size-fits-all invention."

"SEEING" THE INVISIBLE

When you open up somebody's skull in order to operate, the brain can shift by as much as four centimetres. Known as brain deformation, it's one of the trickiest problems for neurosurgeons. A newcomer to Concordia, computer scientist Hassan Rivaz, has dedicated himself to solving this and several other complex problems in the field of medical image processing.

Rivaz says he was first drawn to medical applications of engineering because, as he puts it, "I wanted my research to have humane applications." He made a switch from mechanical engineering to computer science, and subsequently earned a PhD at Johns Hopkins University, largely out of an interest in elastography. This is a technique of mapping parts of the body using medical imaging, focusing on the elasticity of tissue, which provides clues as to possible disease. Finding very hard tissue, for example, can indicate the presence of a cancerous tumour that can be invisible in ultrasound.

To return to the open skull. When a neurosurgeon is operating, she will be referring to an MRI of the brain conducted earlier. But if the brain has now deformed, this map is no longer accurate. This is where Rivaz's algorithms can help point the way. During his postdoctoral fellowship at the Montreal Neurological Institute, Rivaz developed algorithms that would do image registration—this involves super-sophisticated math that can align the pre-operation image with the images produced during the surgery itself.

"This doesn't require any new hardware beyond ultrasound," explains Rivaz (ultrasound being the main mapping tool used in the operating room.) "You just need software, which is both convenient and inexpensive."

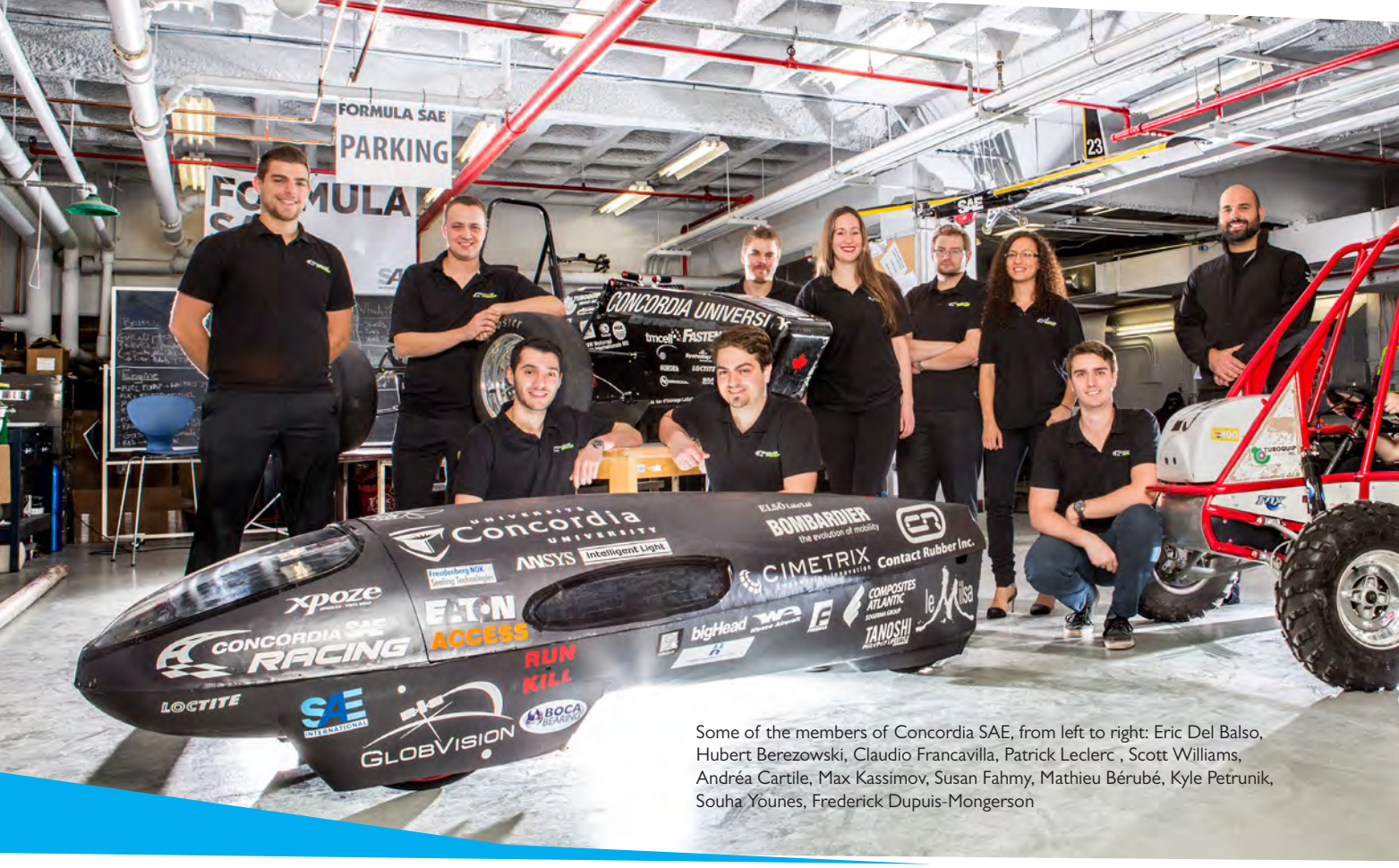
This is an example of an intervention—the use of Rivaz's research during an actual medical procedure. His research has also had applications in diagnostics, proving to be extremely powerful.

CONVERGENCE

"An individual who becomes educated in the current technical and biomedical world will have just a multitude of opportunities to use their education and their talents," Phillip Sharp said in an interview just a few short years ago. The fruitful collaborations at Concordia and beyond prove the power of convergence, the term Sharp uses to describe the happy marriage of engineering, physical and life sciences.

Rivaz's latest collaboration is with Paul Martineau, a sport medicine researcher at Concordia's PERFORM Centre. They'll be figuring out potential improvements for diagnosing muscle and tendon injuries. Packirisamy, meanwhile, has shipped one of his sensors to India where it has flown aboard a plane in order to detect harmful ammonia in urban areas. Dargahi continues his collaboration with colleagues at Montreal's Jewish General Hospital and is celebrating the publication of his third book. And Ehsan Rezabeigi, progressing with his PhD, is explaining his research to scholars around the world through recently co-authored publications in *Materials Science* and *Engineering and Polymer*, and has plenty more publications in store.

If Sharp's Third Revolution is indeed nigh, these four men are among the first at the barricades.



Some of the members of Concordia SAE, from left to right: Eric Del Balso, Hubert Berezowski, Claudio Francavilla, Patrick Leclerc , Scott Williams, Andréa Cartile, Max Kassimov, Susan Fahmy, Mathieu Bérubé, Kyle Petrunik, Souha Younes, Frederick Dupuis-Mongerson

CONCORDIA **SAE**:

BUILDING ON A BREAKTHROUGH YEAR

BY MALCOLM MCLEAN

After a year of success and strong showings in all categories, Concordia SAE (Society of Automotive Engineers) is hard at work in the bowels of the Hall Building, aiming to win more recognition for Concordia engineering: in the air, on track, in rough terrain, and at the frontier of energy efficiency.

One of the oldest student associations at Concordia, "SAE is attracting more students, giving them a chance to pick up a wrench and apply what they've been learning, and to work with others in teams on real-world engineering challenges," said Andréa Cartile, SAE President.

This year there is a sense of building on what has been accomplished, with solid transfers of information and documentation. "There's continuity, taking what works from the previous design and focusing on improving the rest," said Cartile.

The four Concordia SAE teams are: AeroDesign, Baja, Formula Racing and Supermileage.

Last year's big breakthrough came for Concordia Supermileage in April during the Society of Automotive Engineers World Congress and Exhibition in Detroit. The team won first place in the Student Exhibit Competition.

"We were evaluated on vehicle design, team management and presentation quality, among other things. The judges were from Chrysler, GM, Ford, NASCAR and others. This was the first time Concordia University participated at this event," said mechanical engineering student and Supermileage coordinator Patrick Leclerc.

At the SAE International Supermileage competition in Michigan in June, Supermileage finished 10th place overall with a fuel economy of 448 miles per gallon; the team's best result in over 15 years. It also won the Endurance Trophy for the most durable and reliable vehicle. In fact, the Concordia vehicle's many track runs the required the creation of an extra column on the results table.

In August, Supermileage sponsor NOK-Freudenberg invited the team to the Center for Automotive Research (CAR) Management Briefing Seminars in Michigan, where the Concordia team was featured in Autoline TV.

Concordia's Formula Racing team attended the Formula SAE Michigan competition in

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the summer, achieving 15th in the design component. The top ranked teams included Munich, Stuttgart and Concordia's neighbour, ÉTS. Much of last year's team is back and working on the 2014-2015 vehicle with high expectations. "We're taking a very serious engineering approach, where everything is validated, and changes are made only where it is clearly demonstrated why. That, along with the actual performance of their vehicles, is the notable feature of teams that win these competitions," noted Formula team member Cartile.

AeroDesign is gaining new members, and enjoying forward momentum. At the 2014 West competition in Fort Worth, Texas, a respectable 14th place finish was achieved by explaining to judges, very clearly, the reasons for and implications of a fatal electrical failure. This year, a new test plane is being developed, and the target is a top 5 ranking.

For the Baja team, where vehicle performance and durability are tested in an extreme environment, the results of the team's new data acquisition system, backed up by extensive validation and testing, is pointing the way to substantial incremental vehicle improvements. This has raised hopes of making the top 20 at the SAE competition and top 10 at the Quebec contest, Épreuve du Nord.

Concordia SAE is a chapter of SAE International, which challenges students to design, manufacture, test and compete a vehicle. These competitions draw more than 4,500 students from 500 universities around the world every year and provide students with the opportunity to fully experience engineering theory as applied to real applications.

"This kind of hands-on experience in aerospace and vehicular engineering does not come through courses alone," said Andréa Cartile. "People find this tremendously motivates them to learn, as they apply it to real-world engineering problems, cooperating intensely as a team, and competing keenly with the world."

Concordia's SAE teams do their work in The Cage, in the basement of the Hall Building, a facility set up with major support from Montreal-based company, Mechtronix.

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SPACE CONCORDIA:
MISSION UPDATE

Students Austin Hubbell and Nicholas Velenosi from Space Concordia's Aleksandr satellite project, David Saint-Jacques, currently-active Canadian astronaut, and Mehdi Sabzalian, team lead for Aleksandr. Photo courtesy of Space Concordia.

Space Concordia, the award-winning student association that works on satellites and rockets, is always on the move, and 2014 has been no exception.

Over the past four years, Space Concordia has been developing its first CubeSat (the name given for a shoebox-sized satellite typically used for research purposes), named ConSat-1, which was the winner of the 2012 Canadian Satellite Design Challenge. ConSat-1 now needs to be made launch ready. This is no small task. Alfred Ng, a space industry expert and a manager at the Canadian Space Agency, is on board to provide some mentorship.

"He has dedicated considerable time to giving us help and advice at each of our monthly meetings," says Svetlana Spitsina, the current team lead and a research associate at Concordia. "He is a remarkable man."

To be ready, the satellite must pass numerous safety and regulatory requirements. Also, a ground system will be set up from which the students can monitor its progress once it is in space. Spitsina and her teammates are hopeful that ConSat-1 will be aboard a rocket some time in 2015. Once in space, ConSat-1 will study the South Atlantic Anomaly, an area of high radiation activity off the coast of South America.

Meanwhile, Space Concordia's other satellite team is equally busy with their project, named Aleksandr, which has a very different mission. Aleksandr, with help from professor Suong Hoa, an engineering professor with decades of experience in the area of composite materials, is being readied for studying how self-healing material holds up against space debris.

More than 90 per cent of impacts in Low Earth Orbit are caused by micrometeoroids and orbital debris which can lead to damage and malfunctions. The self-healing process would use composites with healing microcapsules and a catalyst embedded within the resin.

When damage occurs, the microcapsules release a healing agent which rapidly solidifies throughout the fracture. While the process is well-documented on earth, it has yet to be tested in space. If results of this experiment are successful, future spacecraft could benefit from using a self- healing shield.

In November 2013, Space Concordia was successful in raising $15,000 toward this project via the online crowdsourcing platform, Kickstarter. Contributions came from hundreds of donors, including a large $3,700 gift from Nick in Russia, who was then asked to name the satellite. That's why the satellite bears

the name Aleksandr, in memory of Nick's late father. Aleksandr went on to place second in the 2014 Canadian Satellite Design Challenge, the final phase of which was adjudicated at Ottawa's David Florida Laboratory, part of the Canadian Space Agency. The results were announced May 30, 2014.

RUBBING SHOULDERS WITH THE SPACE ELITE

For the first time in its history, Space Concordia was invited this year to the prestigious International Astronautical Congress (IAC), which was held in Toronto, September 29 to October 3. They presented Aleksandr and explained the objectives of their project.

"IAC is the world's premier space event, where all major space players attend," said Mehdi Sabzalian, Aleksandr's team lead. This year, that VIP list included Canadian astronauts Chris Hadfield, Jeremy Hansen, David Saint-Jacques, Marc Garneau, as well as the former President of the Canadian Space Agency, General Walter Natynczyk, NASA's administrator, Charles Bolden, and European Space Agency Administrator, Jean-Jacques Dordain.

"It was a great opportunity for all of us to network and show this community Concordia University's presence in the space scene," says Sabzalian. Just a few weeks later, General Natynczyk visited Concordia to learn more about Space Concordia and the university's space-industry related facilities, research, and course offerings.

Space Concordia's faculty advisor, professor Nadia Bhuiyan, is delighted with the association's progress. "They are making great leaps forward in their understanding of how the industry works and how to work in teams on projects that are technically very rigorous and demanding," she said. "I sense a very bright future for these students!"

THREE MORE SPACE CONCORDIA PROJECTS TAKE FLIGHT

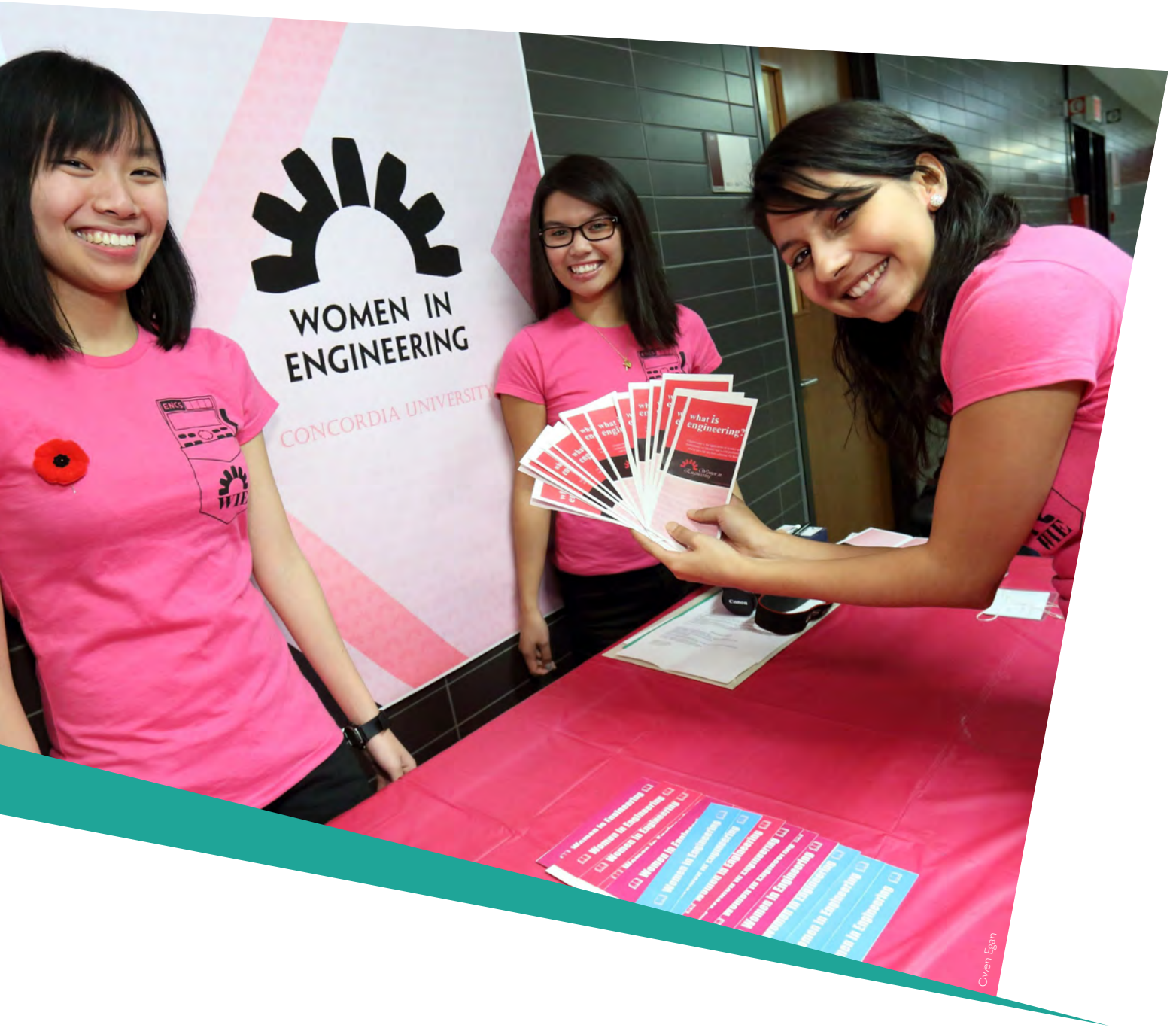
Modular Assembly Satellite Standard (MASS) – is a project that will provide other aspiring satellite builders with a platform where they can build their own CubeSats using open source design.

Intercollegiate Rocket Engineering Competition – a team is assembling a rocket to compete in Utah in the summer of 2015.

University Rover Challenge – students are working hard to finish building a Mars Rover, a tough all-terrain vehicle capable of travel and various mechanical functions on other planet. It too will compete in Utah in 2015.

WOMEN IN ENGINEERING:
A FORCE FOR CHANGE

BY MALCOLM MCLEAN



Owen Egan

"Students usually join the Women in Engineering (WIE) association because we provide a comfortable and nurturing environment as well as promote female equality and success through our events," observes Sarah Farahdel, President of Concordia's Women in Engineering association. "In engineering, there is still a preponderance of males, although it varies from program to program. It is still a field that few women even think of getting into."

WIE events include social frosh initiation, beach day, wine and cheese networking, workshops and seminars. "We try to incorporate as many men into our events as possible, certainly not excluding them. While on some campuses men are excluded and a women-only space is created, at Concordia WIE we've opted to encourage women into the mainstream, and support them in doing that. We attend other events and we encourage our members to join other societies. We support other associations, they support ours."

Farahdel thinks it's especially good to "get involved with hands-on societies, for example, SAE, to get out there and collaborate with others as you find them, because that's what you need to do in the real world." Learning how to get along with mixed groups, in teams and associations, is crucial preparation for the future, she adds.

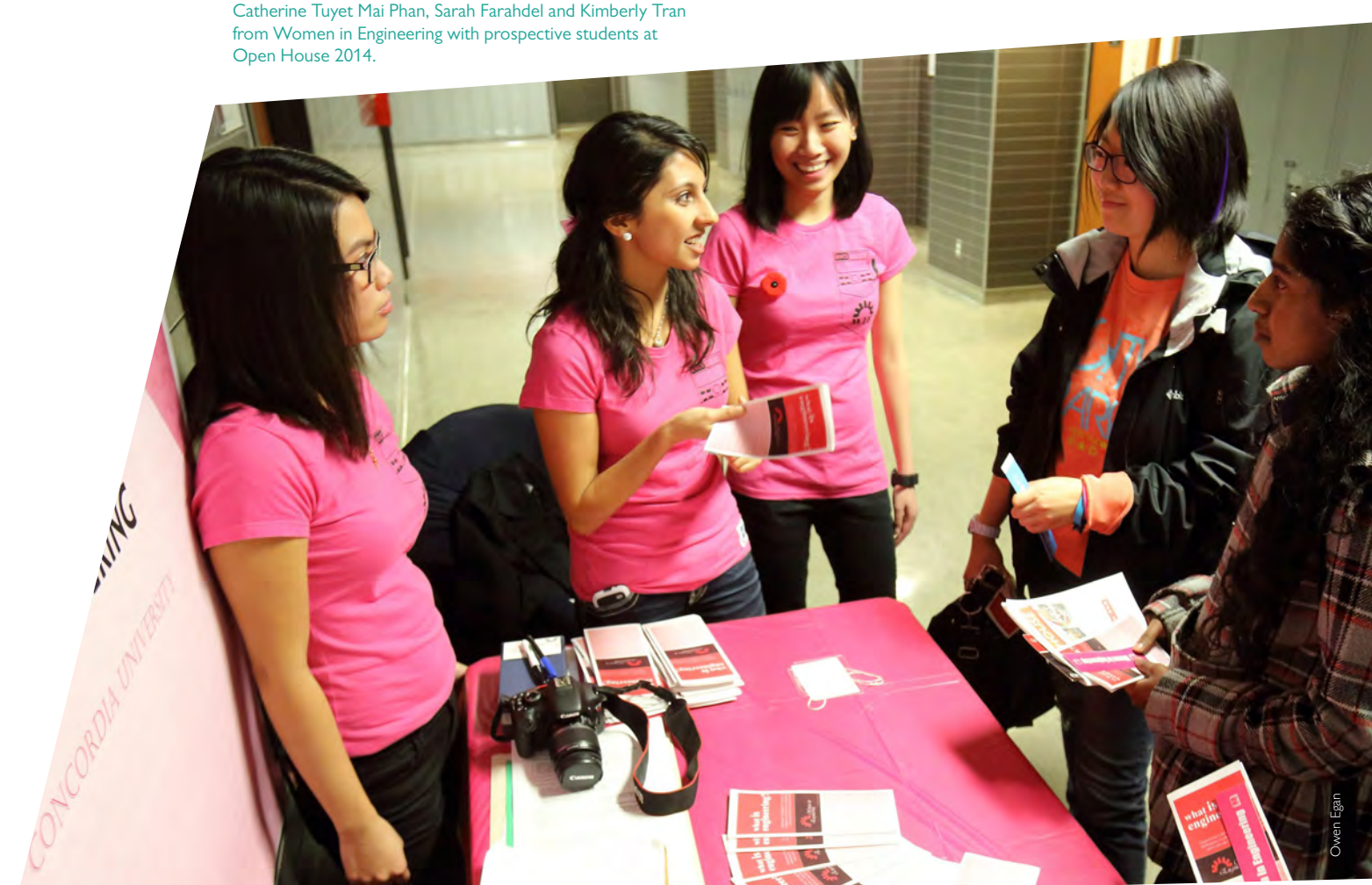
WIE works with engineering students to help them obtain academic and financial support from the university. It is also deeply involved in outreach activities. "We're talking to elementary schools, high schools, CEGEPs. For example we have a weekly program at Roslyn School in Montreal, with two or three people at each session. We do curriculum with hands-on activities, addressing girls and boys of a certain age in a particular classroom and encouraging them to pursue engineering. Girls respond strongly to this kind of encouragement. It opens the door of engineering in their minds; meanwhile, boys also have their minds opened by seeing women involved in engineering."

WIE also emphasizes bridge building. "Speaking very generally, there is a tendency for men to put their ideas forward more aggressively, while women tend to hold back. We are there to help them come forward and give their input." Girl/boy competitions are not their favourite approach, she adds, but cannot resist mentioning a boat-building competition, a challenge to apply knowledge of physics to make a boat from aluminum foil: "The girls won!"

WIE has begun working with the administration to develop a narrative to measure the progress of women in engineering at Concordia. "We need more reliable metrics, to get beyond observations and anecdotes," said Farahdel.

In the future, if engineering becomes more balanced and more women arrive, will there still be a need for the WIE? "That's still a long way from now. It will happen because WIE is helping women feel comfortable in this environment, helping them integrate into the university," noted Farahdel. "And if it does happen, there will still be a need for an organization assisting in this way."

Catherine Tuyet Mai Phan, Sarah Farahdel and Kimberly Tran from Women in Engineering with prospective students at Open House 2014.



Owen Egan

SPOTLIGHT ON RESEARCH

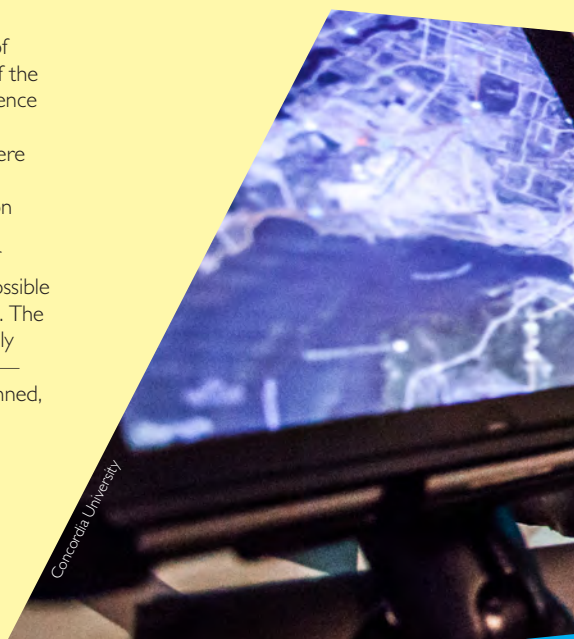
Concordia University

NEW RESEARCH FLIGHT SIMULATOR

What do you give a leading aerospace school that already has a state-of-the-art flight simulator? An even better flight simulator, of course. A collaboration with Marinvent Corporation, nurtured over the past two years through Concordia's Office of Research and the Faculty of Engineering and Computer Science, has made this possible, and so helps expand upon Concordia's existing strengths in this area.

"Aerospace education and research are of vital strategic importance, not only to Concordia, but to Montreal and Canada," says Robert Fews, director of the Concordia Institute for Aerospace Design and Innovation (CIADI). "With this new simulator, we're reaping the benefits of our strong industrial partnerships, and our students and researchers will greatly benefit as a result."

The new simulator, a loan from Marinvent, will live at the Control and Robotics Group, part of CIADI, on the 10th floor of the Engineering, Computer Science and Visual Arts Integrated Complex (EV Building). There it will be of particular help to researchers who work on control systems for aircraft — for example, the kind of technology that makes it possible for a jet to go on auto-pilot. The new simulator can accurately model any existing aircraft — whether manned or unmanned, fixed or rotary wing.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LEAN IS KEY TO AEROSPACE INDUSTRY IN CANADA

Ten years ago, consulting firm KPMG ranked Canada's aerospace industry number one in the world for cost effectiveness. However, with increased global competition, Canadian companies must find ways to become even more efficient. That's where a brand new $1.3 million grant for Concordia and its university and industry partners comes into play.

The Natural Sciences and Engineering Research Council (NSERC) has provided $680,000 and collaborating companies Bombardier and Bell Helicopter gave the other half to help launch a project called Lean Aerospace Value Streams, with Concordia's Nadia Bhuiyan as the principal investigator. The other collaborating universities are École de technologie supérieure, École Polytechnique, as well as the Consortium de Recherche et innovation synergétiques en aérospatiale (CRIAQ).

Over 170,000 Canadians work in the aerospace sector, and universities graduate around 3,000 qualified aerospace workers every year. Harnessing this know-how to the maximum benefit of the domestic industry is crucial. With new rivals emerging, among them China and India, Bhuiyan and her colleagues propose an innovative approach to keep Canada among the world leaders. The research will identify ways of applying lean principles, made famous by Toyota and other automotive companies, to the aerospace sector, where they have never before been widely implemented.

"Most aerospace companies are trying to be leaner," explains Bhuiyan, "whether the principles are applied to manufacturing processes or non-manufacturing processes, including product development."

Lean describes a systematic approach of eliminating waste — anything that does not add value to the customer. It has been estimated that only about 5 percent of work in a company actually adds value. An additional 35 percent of work is considered necessary to the normal functioning of the organization, while a staggering 60 percent is waste, defined as things such as excess inventory, redundant tasks and rework.

The scope of the lean aerospace project is broad, encompassing a wide spectrum of industry activities, right from the very beginning of any given aircraft project. When planning a new aircraft, a company must start by capturing customers' requirements and effectively linking these into the development of the new product. This information must flow effectively for the project to be a success.

"I am particularly interested in how lean principles can be applied to the design process," says Bhuiyan. "Engineers formulate an idea or concept, build a prototype, and it typically takes many years to get a final product or service to market. A lot of engineers' time is wasted during this phase and we want to see how to speed everything up and still deliver the best possible product to the customer."

Research will also be conducted in lean management, the supply chain, human resources, and, of course, the manufacturing process itself. Several of Bhuiyan's colleagues in the Faculty of Engineering and Computer Science are participating in the various investigations, including Yong Zeng and Kudret Demirli.

Beyond the potential applications of the new research, Bhuiyan is also happy that Concordia students will receive highly relevant new training under the project.

"Graduate and undergraduate students will be learning how to apply lean principles in local aerospace companies," she explains. "It's a win-win situation: improved efficiency in industry and unparalleled experience for our future graduates."

GINA CODY:
CLIMBING TO GREAT HEIGHTS

Gina Cody, MEng 81, PhD 89, came to Montreal in 1979, not to study at Concordia but, in fact, McGill. Something changed her mind. What was it?

"My brother did a bachelor's of engineering in civil engineering at Concordia," she says. And so the day after her arrival, Cody had a chance to meet the late Cedric Marsh, one of the founding members of Concordia's unique building studies program. "It was such a family atmosphere," Cody recalls. "For a person who has just come from another country, that's nice."

Having obtained an undergraduate degree in her native Iran, Cody went on to finish her master's and doctorate at Concordia, at one point working on an emerging technology, friction dampers, which protect buildings during earthquakes. Cody studied how to apply this invention, invented by fellow Concordian Avtar Pall, to steel and concrete buildings.

At the time, women were uncommon in engineering, especially in the construction industry. In 1989, she was the first woman to earn a PhD in building engineering. But Cody believes her gender has never inhibited her career.

"It was rewarding, because I was an anomaly – people remembered me," she says.

Once in the workplace, one of her earliest responsibilities was inspecting cranes in Toronto. She would climb great heights and inspect them joint by joint. That's a fitting symbol for her subsequent career trajectory. Cody is now co-owner of Ontario-based CCI Group Inc., overseeing some 150 engineers, building scientists and technologists who test building materials and inspect structures. She has been named by Profit W100 magazine as one of Canada's top woman entrepreneurs, is the past chair of the Professional Practice Committee of Professional Engineers Ontario, and former president of the Canadian Condominium Institute (Toronto and Area Chapter).

She is also a very active member of the Concordia community, sitting on the university's Board of Governors and chairing the Industrial Advisory Council, which helps set the direction for the Faculty of Engineering and Computer Science.

"I owe my success to Concordia," she says. She is pleased to see the ongoing evolution of her alma mater. "It's got great programs, niches of excellences, and is very welcoming, especially to foreign students and to locals."

Vincenzo Pietropaolo

CORINNE CHARETTE: CANADA'S "CONVENER" IN CHIEF

Office of the Chief Information Officer

Her official title is Canada's Chief Information Officer, but in explaining her job, Corinne Charette, BSc 75, LLD 11, calls herself a "convener." It's clear that the social side of the job, gathering people from many different departments and figuring out strategies and solutions together, is what truly makes her tick. She's been in the job since 2009, responsible for 180 staff, but with an influence that extends across all of government. Information management, information technology, security, access to information and privacy are among the hot-button policy areas that she must help determine for all of the civil service and governmental departments.

"My education prepared me well for this role," she says, on the phone from Ottawa, early in the morning. "Engineering is a problem-solving discipline. That framework has been a great benefit to me. The government is a complex ecosystem of legislation and policies supporting program and service delivery for Canadians. You have to take a broad look to do what's required—to take an integrated approach."

She sees numerous benefits to the widespread adoption of technology. "Cost efficiency and speed," are the top two she cites. For example, seniors can now be proactively enrolled in old-age security programs, a far better state of affairs than waiting to manually make these updates.

But there are downsides. The federal government's systems and information stores are often targeted by cyber-attacks. Charette must ensure the government can handle the threats of malicious viruses, of which Heartbleed and Shellshock are but two recent examples.

Charette, while noting that she had to learn a lot about policy when taking on this new role, was nevertheless perfectly suited to it. Her education, combining digital architecture and telecommunications, was ideal, and was followed by decades of experience, including as Deputy Director and Chief Information Officer of the Financial Transactions and Reports Analysis Centre of Canada, and many years in the private sector, notably with the Canadian Imperial Bank of Commerce, Transat A.T., KPMG, and IBM Global Services.

"I loved my time at Concordia," she reminisces. "I was on the Loyola campus. We were a small and focused group of electrical engineers, led by the department head [the late] Stanley Kubina. We were a close-knit community and had a strong cohort of professors who would roll up their sleeves and help us however they could."

It was a lot of hard work, which inevitably left little time for outside pursuits, but when she did leave the campus, she was an outdoor sports enthusiast, a passion which remains to this day. "In winter, I used to ski a lot more than I do today. I went to Mont Tremblant, which was very different then. You took a chair lift, covered in blankets to stay warm. It was very frosty."

Charette remains deeply attached to her alma mater, having been a very generous donor, and actively participating in a campaign to restore the old Loyola refectory. "The Loyola campus is lovely," she says "I am so glad Concordia has invested in maintaining and improving it."

CONCORDIA

SMALL PLANET BIG THINKING

TAKING THE AEROSPACE INDUSTRY TO NEW HEIGHTS

BE PART OF THE THINKING

Help Concordia students think big and reach new heights.
Give to the Faculty of Engineering and Computer Science by contacting Sarah Kenny, from Concordia's Advancement and Alumni Relations, at 514-848-2424, ext. 7026, or **sarah.kenny@concordia.ca.**

concordia.ca/alumni-giving

MECHANICAL AND INDUSTRIAL ENGINEERING