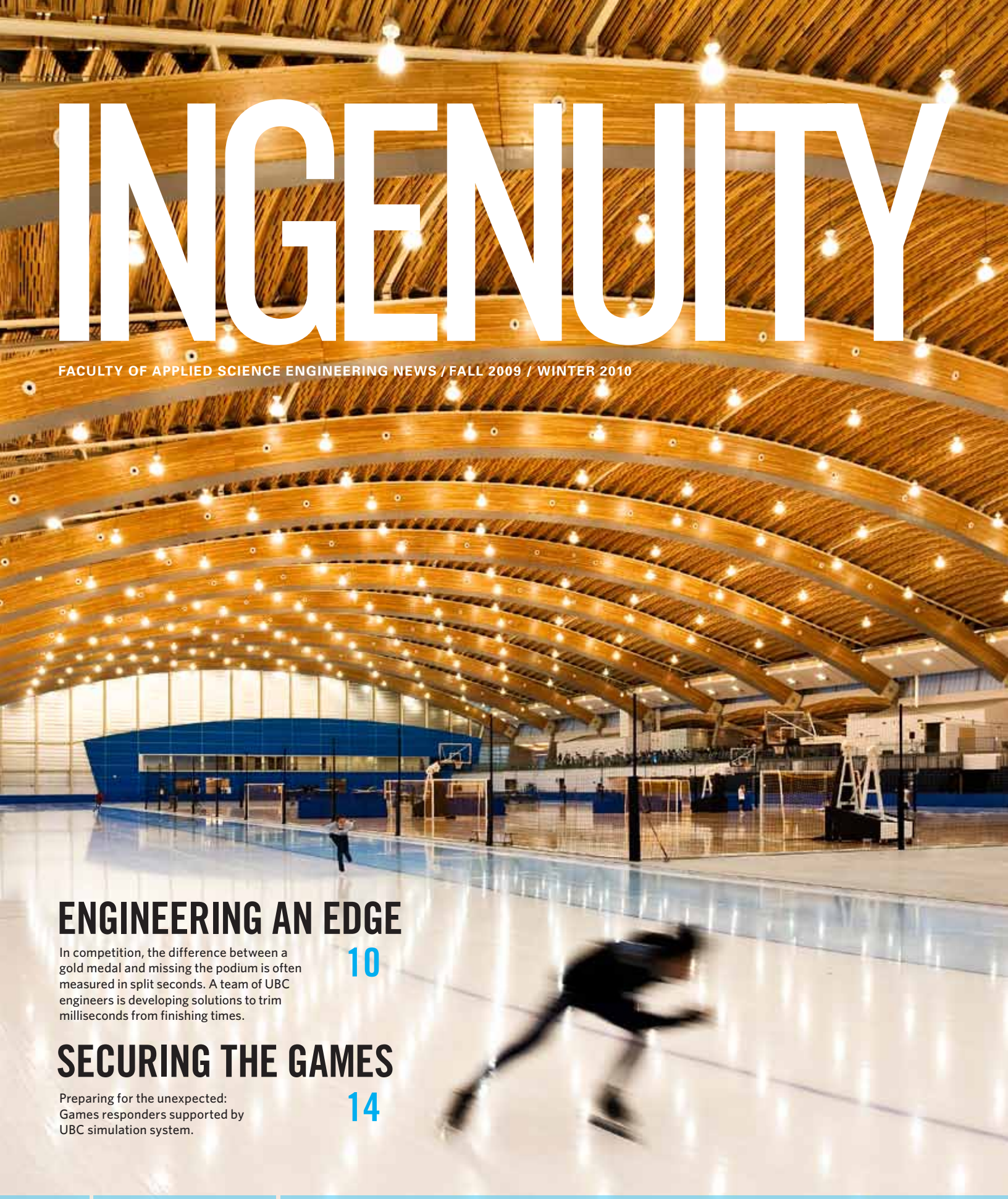
INGENUITY

FACULTY OF APPLIED SCIENCE ENGINEERING NEWS / FALL 2009 / WINTER 2010



ENGINEERING AN EDGE

In competition, the difference between a gold medal and missing the podium is often measured in split seconds. A team of UBC engineers is developing solutions to trim milliseconds from finishing times.

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SECURING THE GAMES

Preparing for the unexpected: Games responders supported by UBC simulation system.

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a place of mind

THE UNIVERSITY OF BRITISH COLUMBIA

Dean's Message

"As the spotlight of the world shines on Vancouver, it will highlight the great work of BC engineers, the vast majority of whom are amongst you, our UBC Engineering graduates."

Dean Tyseer Aboulnasr

Participating in the Olympic Games is a dream for every athlete. Aside from their sports significance, the Olympics are about bringing people together, even as they compete with one another. This is not a small human feat. Neither are the engineering marvels that the Olympic Games increasingly rely upon. From the Sea-to-Sky Highway to the Richmond Oval, engineers are providing the infrastructure for the Vancouver 2010 Olympic Games.

As a faculty, we are key partners in the success of the Olympics. Through our vast number of alumni and hundreds of Co-op students working on these projects, the researchers working with Own the Podium helping our athletes gain a competitive edge, and one of our own students vying for a spot on the Canadian snowboard cross team, we are contributing to a gold-medal performance.

As the spotlight of the world shines on Vancouver, it will highlight the great work of BC engineers, the vast majority of whom are amongst you, our UBC Engineering graduates. This issue of *Ingenuity* highlights but a few of our contributions to the Games. Seeing this impressive body of work, it is only natural to say, *I believe*!

Please feel free to email me at dean@apsc.ubc.ca.

Tyseer Aboulnasr, P. Eng.
Dean of Applied Science

ON THE COVER

The internationally recognized Richmond Olympic Oval is a multipurpose sports and recreation facility that will serve as the Long Track Speed Skating venue for the 2010 Winter Olympics. The one-of-a-kind 6.5-acre roof structure features hollow, triangular-shaped composite wood-steel arches, which span 310 feet and conceal mechanical ducts, electrical conduits and sprinkler pipes. Spanning between the arches are novel, prefabricated "wood wave" panels consisting of pine beetle kill 2x4's and plywood. The roof structure not only provides an economical design solution but also a striking aesthetic quality and enhanced acoustic performance. It has won numerous awards, including a gold medal for engineering excellence from the Institution of Structural Engineers.

The Oval was designed by Fast + Epp, led by UBC Engineering alumni Paul Fast (BASc CIVL'81) and Gerry Epp (BASc CIVL '81, MEng '83).

Photo by: Hubert Kang

Engineering

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School of Engineering

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Learn about new funding that enables our people to better serve society and how one new student team recently won gold. Discover how Engineering Co-op students are contributing to the 2010 Games and get the latest from the Applied Science news desk.

FACULTY

NSERC Chair in Design Engineering established with the support of industry

Professor Philippe Kruchten, Senior NSERC Chair in Design Engineering

Professor Antony Hodgson, Associate NSERC Chair in Design Engineering

In July 2009, the Faculty of Applied Science established the NSERC Chair in Design Engineering with the appointment of Professors Philippe Kruchten (ECE) as Senior Chairholder and Antony Hodgson (MECH) as Associate Chairholder. This Chair follows the first NSERC Chair in Design Engineering, which was awarded to UBC in 2002 and was held by Professor Peter Lawrence.

The primary focus of the NSERC Design Engineering Chair is to eliminate barriers between engineering disciplines and enhance connectivity between engineering and other fields—particularly medicine and commerce—to better serve society. The Chair will initially focus on interdisciplinary design of innovative intelligent equipment to improve treatment and quality of life for people with debilitating diseases or disabilities. In future, the Chair's focus will expand to address solutions in areas such as energy and sustainability.

"In addition to the interdisciplinary design experience students will receive, the Chair will play a significant role in enhancing the profile of design activities at UBC and in the broader community," says Kruchten. "Our industrial partners will be involved in sponsoring student design projects and mentoring senior students in their critical final year and will benefit from graduates trained with an interdisciplinary perspective."

The Chair is valued at $2 million over five years. This NSERC Chair was contingent on additional industry support; contributions made by Jeppesen Sanderson, WorleyParsons Westmar, ALS Society of BC and Ensemble Systems ensured the success of the NSERC application.

The Faculty extends its thanks to the industry supporters who are helping to ensure the availability of high-quality research and progressive teaching within Applied Science. ▪

STUDENTS

New UBC team wins gold for building "traffic light" inside cell

PHOTO CREDIT: ERIC LAGALLY

A team of UBC undergrads won a gold medal for their biosensor technology at the International Genetically Engineered Machine (iGEM) competition held at the Massachusetts Institute of Technology (MIT) in November. This is the first time a team from UBC has participated in the contest, which draws more than 100 teams internationally.

"I am extremely impressed by our students' performance," says Eric Lagally, Assistant Professor of Chemical and Biological Engineering as well as founder of the team and its faculty advisor. "After forming just a few months ago, the team has demonstrated remarkable cohesiveness, dedication, maturity and ingenuity."

After more than 7,000 hours of research work over the summer, the team produced the E. coli "Traffic Light," a biosensor signaling mechanism operating in E. coli.

Traffic Light is a whole-cell biosensor—a machine built inside a single living cell—that measures concentrations of substances at finer levels than was previously possible. Students manipulated the DNA and RNA in E. coli cells to detect levels of a sugar added to the medium used to grow the cell. The technique causes the cell to fluoresce green in response to a low level of sugar, amber for a medium level and red for highest levels of sugar. Research problems included triggering the cell to fluoresce at the correct level and stopping nonrelevant colours from fluorescing so that the appropriate one would be clearly visible.

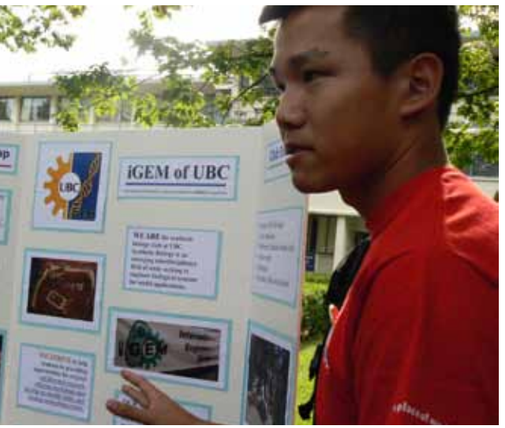
Lagally believes the work has the potential to be broadly significant—the research was entered in the iGEM category of "potentially fundamental advance." Applications for the technology include detecting heavy metals for environmental analysis or finding the earliest signs of cancer or other disease.

The team comprises UBC students in disciplines that include Chemical and Biological Engineering, microbiology and immunology and computer science. iGEM organizers give competitors a kit of genetic material that can be inserted into E. coli, a well-studied model organism for operating and designing genetic circuits.

"Through iGEM, i've gained a greater understanding of microbiology lab techniques and experiments," says Calvin Chan, third-year Chemical and Biological Engineering student. "In engineering labs, we often focus on data analysis, but with iGEM, the experimental result is the most important part."

iGEM, launched at MIT in 2003, is widely recognized as the leading undergraduate learning opportunity in synthetic or engineered biology. Projects have ranged from banana- and wintergreen-scented bacteria to an arsenic biosensor. This year, more than 100 teams from 20 countries participated, including 10 teams from Canadian universities.

"Students are hungry for real-world applications of research where they can get real results," says Lagally.



Calvin Chan, third-year Chemical and Biological Engineering student.

"They're eager to tackle a problem that has no immediate solution."

"There were a few times when we were having a lot of trouble getting things working that I had the urge to roll up my sleeves and dive in," says Paul Jaschke, graduate student advisor to the group. "But I'm glad I didn't—the students wouldn't have learned as much as they did if somebody else figured it out for them."

Jaschke says the iGEM team experience is similar to grad school, but with a twist: students have an opportunity to design and manage their project from the ground up, which many grad students don't get to do.

According to third-year Chemical and Biological Engineering student Heather Kempthorne, "iGEM throws you into an environment that inspires you to ask questions and think about creative new ways to solve problems. Rather than being a passive learner, you are encouraged to join the scientific community and find novel ways to use the technology that we now have to help society."

She adds that one of the most challenging aspects was coming to the realization that science is not an easy endeavour.

"Not everything is going to work the first time, or even the second, and it can be very frustrating," she says. "However, you learn from everything, and it is very rewarding once it does start to work."

The team was formed with a UBC Teaching and Learning Enhancement Fund grant of $36,800. The team has also been supported by Integrated DNA Technologies, an international DNA synthesis company, and by the Canadian Institutes of Health Research through a training program administered by the BC Transplant Society. ▪

STUDENTS

Co-op Students take part in Olympics

From left, Michael Brewer shows Regent Ma, Sheenagh Brooks and his VANOC supervisor, Pascal Poudenx, a transportation model of Whistler.

Competition is not just for athletes. Graduating students and companies are facing increasingly competitive landscapes, and the UBC Engineering Co-op Program is designed to help both.

In 2008 when Michael Brewer graduated with a degree in civil engineering, he had an advantage over some of his classmates. He had experience—relevant, practical experience. Not only that, he had someone in his corner—UBC Engineering Co-op Program Coordinator Sheenagh Brooks. After a particular job came across her desk, Sheenagh forwarded it to Brewer, and he applied.

As Brewer describes it, "In my last Co-op term, I did municipal design-type work. It helped me firm up my skills"—and gave him the edge he needed. Being a big sports fan, Brewer happily accepted the position as an analyst in Traffic Planning for the Vancouver Organizing Committee for the 2010 Olympic and Paralympic Winter Games (VANOC).

Brewer's days are now filled with traffic-impact studies and traffic-management plans for venues, bus depots and fleet facilities, as well as analysis of key routes and intersections integral to the Games' transportation network. Meeting with Olympic, city or TransLink officials, visiting venues, taking measurements and crunching numbers, Brewer says there is no such thing as a typical day. Although his unique position will come to an end when the Olympics do, he has already developed contacts through VANOC partner companies—sharpening his competitive edge.

Brewer is not the only member of the Engineering Co-op family fortunate enough to be involved in the 2010 Olympics. Co-op student Regent Ma was hired by the Transportation function for VANOC and has learned much about office life and teamwork. While editing the Games' transportation routes, he suddenly realized what an opportunity he'd been given.

"It hit me that these changes I am making will ultimately be influencing the Games. I am truly a part of the Olympics and have put my stamp on it," he says.

The Engineering Co-op Program estimates that during the past four years, over 120 students have been involved in projects that have added valuable, technical work experience to their résumés, and also allowed them to put their stamp on the Games. Work placements range from conducting geotechnical testing at the Richmond Olympic Oval, to working on the Sea-to-Sky Highway between West Vancouver and Whistler, to constructing the Canada Line and the Vancouver Convention Centre, to researching microscopic snow friction, to building a ski jump at Whistler.

Companies such as SNC-Lavalin, Siemens Canada Ltd. , Environment Canada and Peter Kiewit Sons', to name just a few working with VANOC, also benefit from the Co-op partnership. They hire short-term employees with fresh ideas, all of whom have been screened by the Co-op team to ensure that companies employ quality students.

Students learn valuable fieldwork skills, meaning they will be better prepared when seeking jobs. As Brewer describes it, by working during his Co-op terms he was able to "develop an appreciation of the difference between learning in the field and learning out of a textbook."

So, unlike the podium, with Engineering Co-op there is room for more than one winner. Students get the unique chance to gain valuable work experience and networking opportunities while learning. And employers get a cost-effective solution for short-term employment needs and a chance to start valuable relationships with potential employees.

"Our goal is to be recognized as the leading Engineering Co-op Program in Western Canada by being the first choice among students, employers and the university community," says Engineering Co-op Director Jenny Kagetsu.

Considering feedback from employers states that 98% would hire a UBC Engineering Co-op student again, it's an all-around gold-medal performance! ▪

Media Top Hits

The news items in this section represent a portion of UBC Engineering's media coverage in recent months. For complete listing, visit the News & Events section at www.engineering.ubc.ca.

Undergrad invents Landing Pad
"A lot of kids come to UBC because it's in the mountains," says Aaron Coret. "It's probably the most beautiful campus in the world."

Coret—featured this fall on the *Discovery Channel*—well knows the lure of the slopes. The 25-year-old was an avid snowboarder until a fall in 2005 left him paralyzed from the neck down. Back then, there was no way to perfect tricks before trying them out on hard snow. Coret used his accident as an inspiration to make the sport safer for others.

A fourth-year student in the Integrated Engineering program, he and classmate Stephen Slen designed the Landing Pad as a class project. The 15-by-27-metre inflatable pillow provides a cushion for snowboarders and skiers who can ride their trick out if they land properly, or fall safely if they don't.

"It's really about trying to make a change in the industry that we love," Coret says.

.....

Electric Car Club set for a global race
The Electric Car Club recently set out to convert a 1972 Volkswagen Beetle they bought on craigslist for $2,400 into an electricity-run masterpiece. The club—recently featured in the *Vancouver Sun*—hopes to showcase the vehicle in a trip to Whistler during the Winter Games in February, before replacing the home-made engine with a more powerful model that will propel them through the UN-sponsored Zero Emission Race in June 2010.

Pro-Neck-Tor: A helmet that really protects
A sports helmet dubbed Pro-Neck-Tor, invented by Mechanical Engineering Professor Peter Cripton, reduces direct impact to the neck by up to 56%. Preliminary tests were conducted on the helmet, which features a movable inner shell that guides the head to tilt slightly forward or backward in a head-on impact, allowing direct loads to dissipate to the cervical spine. The invention has been featured in *Popular Science* and *CBC News*.

Visit www.pronecktor.com to see how the helmet works.

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PowerTab™ featured in Olympic Athletes' Village
Energy management for buildings has never been smarter—or greener—thanks to PowerTab ES System, a product developed by Energy Aware, a UBC spin-off company that originated in course APSC 486, New Venture Design. As featured on the *Discovery Channel*, PowerTab ES System consists of a transmitter and a sleek, user-friendly monitor that displays usage data and costs, helping homeowners and building residents make better choices about their energy use. UBC Engineering alumni working for the company include co-founder Lauren Kulokas (MECH '06), Jon Hallam (ELEC '07) and Colby Gore (M.Eng MECH '06).

Students learn from industry experts
Third-year UBC Okanagan Engineering students got a primer in bricks and mortar when experts from Gracom Masonry of Kelowna and Bill McEwen, P. Eng, Executive Director of the Masonry Institute of B.C., shared their skills. Organized by Professor Solomon Tesfamariam, whose teaching interests include earthquake engineering and reinforced concrete design, this hands-on experience helped students put theory into practical application and was featured in UBC Okanagan media relations.

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UBC spin-off ranks in CleanTech 100
Ostara Nutrient Recovery Technologies, co-founded by Civil Engineering Professor Don Mavinic, has been listed in the *Guardian*'s (UK) first global Cleantech 100. The listing highlights companies with innovative low-carbon technologies. Ostara removes polluting nutrients from wastewater treatment systems and produces environmentally friendly fertilizers. Ostara was the only Canadian company to make the list.

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Engineering discoveries boost economy
In the *Vancouver Sun*, UBC President Stephen Toope cited a research project led by Professor James Olson (MECH) as an example of how the university boosts the economy. "We partnered with BC Hydro and Catalyst Paper on a five-year energy efficiency program to improve production and paper quality while reducing energy consumption. So far, the annual savings are $45 million and 1,000 gigawatt hours, enough to power 100,000 homes for a year."

FACULTY

Faculty Awards & Achievements

Applied Science's Manager of the Centre for Instructional Support **Jim Sibley** has received the 2009 UBC Spencer Award for IT Innovation.

Chemical and Biological Engineering Professor **Chad Bennington** and his co-authors—including Electrical and Computer Engineering Professor **Guy Dumont**—have received the Most Cited Author Award 2006–2009 from the Elsevier Journal *Chemical Engineering Research and Design* for their paper "Measuring flow velocity in pulp suspension mixing using ultrasonic Doppler velocimetry."

Chemical and Biological Engineering Department Head **Peter Englezos** has been elected Fellow of the Canadian Academy of Engineering.

Chemical and Biological Engineering Professor **James Feng** has had his Tier 2 Canada Research Chair in Complex Fluids and Interfaces renewed for an additional five years.

Chemical and Biological Engineering Professor **John Grace** has received the UBC Killam Award for Excellence in Mentoring.

Civil Engineering Professor Emeritus **Robert Sexsmith** has been elected Fellow of Engineers Canada.

Electrical and Computer Engineering Associate Professor **William Dunford** has been elected Fellow of Engineers Canada.

Electrical and Computer Engineering Assistant Professor **Sathish Gopalakrishnan**, along with his co-authors, have won the *IEEE Transactions on Industrial Informatics* 2008 Best Paper Award for their paper "ORTEGA: An efficient and flexible online fault tolerance architecture for real-time control systems."

Electrical and Computer Engineering Department Head **André Ivanov** has been elected Fellow of the Canadian Academy of Engineering.

Electrical and Computer Engineering Professor **Vikram Krishnamurthy** has had his Tier 1 Canada Research Chair in Statistical Signal Processing renewed for an additional seven years.

Electrical and Computer Engineering Professor **Philippe Kruchten** has been appointed Senior Chairholder of the NSERC Chair in Design Engineering.

Electrical and Computer Engineering Professor **David Pulfrey** has received two honours: the Award for Teaching Excellence in Engineering and Geoscience Education from the Association of Professional Engineers and Geoscientists of B.C.; and the Education Award from IEEE Electron Devices Society.

Electrical and Computer Engineering Professors **Robert Rohling** and **Tim Salcudean**, along with industry partner Ultrasonix Medical Corporation, have received an NSERC Synergy Award for Innovation.

Electrical and Computer Engineering Professor **Resve Saleh** has been elected Fellow of the Canadian Academy of Engineering.

Materials Engineering Professor **Anoush Poursartip** has received the 2009 Medal of Excellence in Composite Materials from the University of Delaware Center for Composite Materials.

Mechanical Engineering Professor **Elizabeth Croft** has been elected Fellow of Engineers Canada.

Mechanical Engineering undergraduate student **David Goosen** and co-authors **James Olson** (Associate Professor), and **Richard Kerekes** (Chemical and Biological Engineering Professor Emeritus) have received the Johannes A. Van den Akker Prize for Advances in Paper Physics from the Georgia Tech Institute of Paper Science and Technology for their paper "Role of hetero-geneity in compression refining."

Mechanical Engineering Associate Professor **Antony Hodgson** has been appointed Associate Chairholder of the NSERC Chair in Design Engineering.

Mechanical Engineering Associate Professor **Thomas Oxland** has been elected Fellow of the American Society of Mechanical Engineering.

Mechanical Engineering Professor Emerita **Martha Salcudean** has received an honorary doctor of engineering degree from the University of Waterloo.

Mining Engineering Administrator **Malcolm MacLachlan** has received a 2009 Just Desserts Award from the UBC Alma Mater Society.

Mining Engineering Associate Professor **Marcello Veiga** has been named one of the Top 25 Immigrants in Canada by *Canadian Immigrant* magazine.

School of Engineering Assistant Professor **Jonathan Holzman** has made the UBC Okanagan Teaching Honour Roll.

School of Engineering Instructor **Ray Taheri** has received the school's Pioneer's Award for Teaching Excellence.

ENGINEERING RESEARCH

ENGINEERING AN EDGE

In international competition, the difference between a gold medal and missing the podium is often measured in split seconds.

A team of UBC engineers is developing solutions to trim milliseconds from finishing times with the goal of providing a competitive edge for Canadian athletes.

The research is funded by Own the Podium (OTP), a winter-sport technical program that is a partnership of Canada's 13 winter national sport organizations, the Canadian Olympic Committee, the Canadian Paralympic Committee, Sport Canada and the Vancouver Organizing Committee for the 2010 Olympic and Paralympic Winter Games (VANOC). Research being done for the OTP program is providing innovative new performance tools and knowledge to Canada's winter-sports teams to help improve performance during the 2010 Games, although some of the technology will be implemented with an eye toward the 2014 Games.

The UBC engineering research focuses on improving speed on snow and ice by minimizing friction—the force that causes an object in motion to slow or stop.

Working closely with Canada's snow and ice sport national teams—alpine skiing, cross-country skiing, snowboard, biathlon, speed skating and luge—UBC experts have been investigating ways to reduce friction at both the microscopic and macroscopic levels.

PHOTO CREDIT: MARTIN DEE

The lotus leaf's superhydrophobic surface structure enables water to bead and roll off.

Inspired by the lotus-leaf: creating super low-friction surfaces

Taking a lesson from nature, UBC engineers have mimicked the structure of the lotus leaf to create an edge for our athletes.

When a drop of water falls on a lotus leaf, it beads and rolls off the superhydrophobic—or super-water-repellent—surface. The lotus' surface structure, composed of a unique nanopattern that, under an electron microscope, looks like a field of cone-shaped pom-pom balls [pg 13, bottom], creates minimal friction and allows the droplet of water to maintain a perfect bevel or roundness. With minimal friction, optimal glide exists, allowing the bead of water to roll off.

"We have mimicked nature to create a low-friction surface on various metals and polymers," says Professor Savvas Hatzikiriakos. "We've copied the nanopatterns of the lotus leaf to engineer materials that reduce friction on both snow and ice."

Led by Hatzikiriakos, the microscopic-friction team includes co-investigator Professor Peter Englezos and PhD students Anne Kietzig—who specializes in metals—and Christos Stamboulides—who focuses on polymers—all from the Department of Chemical and Biological Engineering.

In the case of metals, the team engineered a new material, laser-structured stainless steel, using the laser facilities in the UBC Department of Physics. "We were extremely surprised to find out that the laser-irradiated metallic surfaces turn superhydrophobic after a few days," says Hatzikiriakos.

Compared with the traditional steel used in skates, the new material has a much greater contact angle, which means that a bead of water stays more rounded on the surface and rolls off more easily. The new material drastically reduces friction and essentially repels water, whereas the surface structure of the traditional material absorbs a bit of each droplet, creating friction that slows motion.

"The greatly increased hydrophobicity of the laser-structured steel increases the slider's ability to 'float' upon the ice, rather than become wetted into it," explains Hatzikiriakos. "This research enables the development of new skate bases with smaller friction coefficients, compared with the existing bases. With less friction, they simply go faster."

Hatzikiriakos and his team have also been developing ways to reduce friction associated with polymers—which are used for ski bases—on snow.

Using a plasma (ionized gas) treatment method to increase the level of water repellency, the researchers developed a new base modification for skis. With the plasma treatment, low-friction molecules attach to the exposed surface of the ski base, which renders the material nearly superhydrophobic.

Like the newly engineered steel, the plasma treatment for skis also increases the contact angle of a droplet of water, reducing friction by up to 25 per cent compared with that of previously used polymers.

Beyond the Olympics, these innovative materials can have broader applications. Essentially self-cleaning, superhydrophobic metals could improve surgical instruments and implants. The extremely water-repellent properties can also be applied to paper, offering a sustainable alternative to plastics.

Reducing friction by understanding snow conditions

In-depth knowledge of local snow and weather conditions at the venues could prove a home-field advantage for Canada in the upcoming Olympics.

Mechanical Engineering Professor Sheldon Green and Research Engineer Dan Dressler (MASc '06) have studied drag-reduction at the macro (snow-surface) level, creating tools to assist athletes and ski technicians in making the most informed decisions when selecting which materials—skis, snowboards, waxes and grinds (the base structure of skis)—will perform best.

Through their comprehensive analysis of snow properties and conditions, the engineers have discovered ways to minimize friction at the ski-snow interface, enabling athletes to go faster.

Green and Dressler have worked extensively with Canada's Olympic-bound teams at the Olympic venues—Whistler Blackcomb, Callaghan Valley and Cypress Mountain—to implement various tools for the teams to use for selecting the best materials.

One such tool is a database that includes variable conditions like air and snow temperature, wind speed and humidity. By entering the race-day conditions into the database, technicians and coaches will be able to obtain information on which materials will work best. For example, if the current snow is old and crystal-like, a hard wax will best reduce friction, helping to overcome the abrasiveness and slowing properties of this type of snow.

The team's research has also led to the development of a new approach for measuring the hydrophobicity of skis. Through the use of a portable high-resolution imaging system combined with image-processing software, tests can be done on-site at a fraction of the cost of other systems. The test includes measuring the contact angles of a water droplet on a ski surface. The greater the contact angle, the less friction. This information is especially useful for selecting materials for distance racers, who depend on the longevity of a wax for optimal performance.

"Snow is an incredibly complex substance whose structure is dependent on temperature, relative humidity, stresses and a host of other factors. It is amazing how little was, and still is, known about the fundamental science of snow friction," says Green, an expert in fluid mechanics.

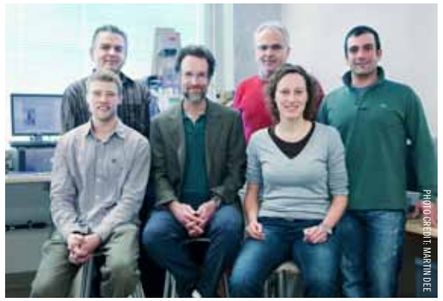


PHOTO CREDIT: MARTIN DEE

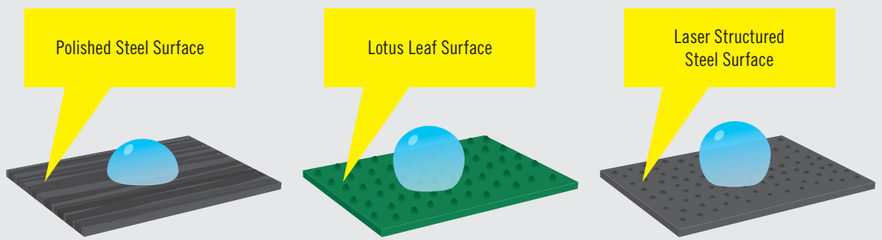
From left, (back) Profs. Savvas Hatzikiriakos and Peter Englezos (front) Research engineer Dan Dressler (MASc '06), Prof. Sheldon Green and PhD students Anne Kietzig and Christos Stamboulides

Many are hopeful the Own The Podium research will help Canada's athletes shine during the Winter 2010 Games and beyond.

"Our friction research and new materials could have a significant impact in racing that measures in split seconds," explains Hatzikiriakos. "It could be the difference between fourth and first place for Canadian athletes in the next decade." ▪

HOW IT WORKS

Hydrophobicity–The Lotus Effect: Superhydrophobic surfaces, such as the leaves of the lotus plant, have surfaces that are extremely difficult to wet. The contact angles of a water droplet exceeds 150°, and the roll-off angle is less than 10°. This is referred to as the Lotus Effect.



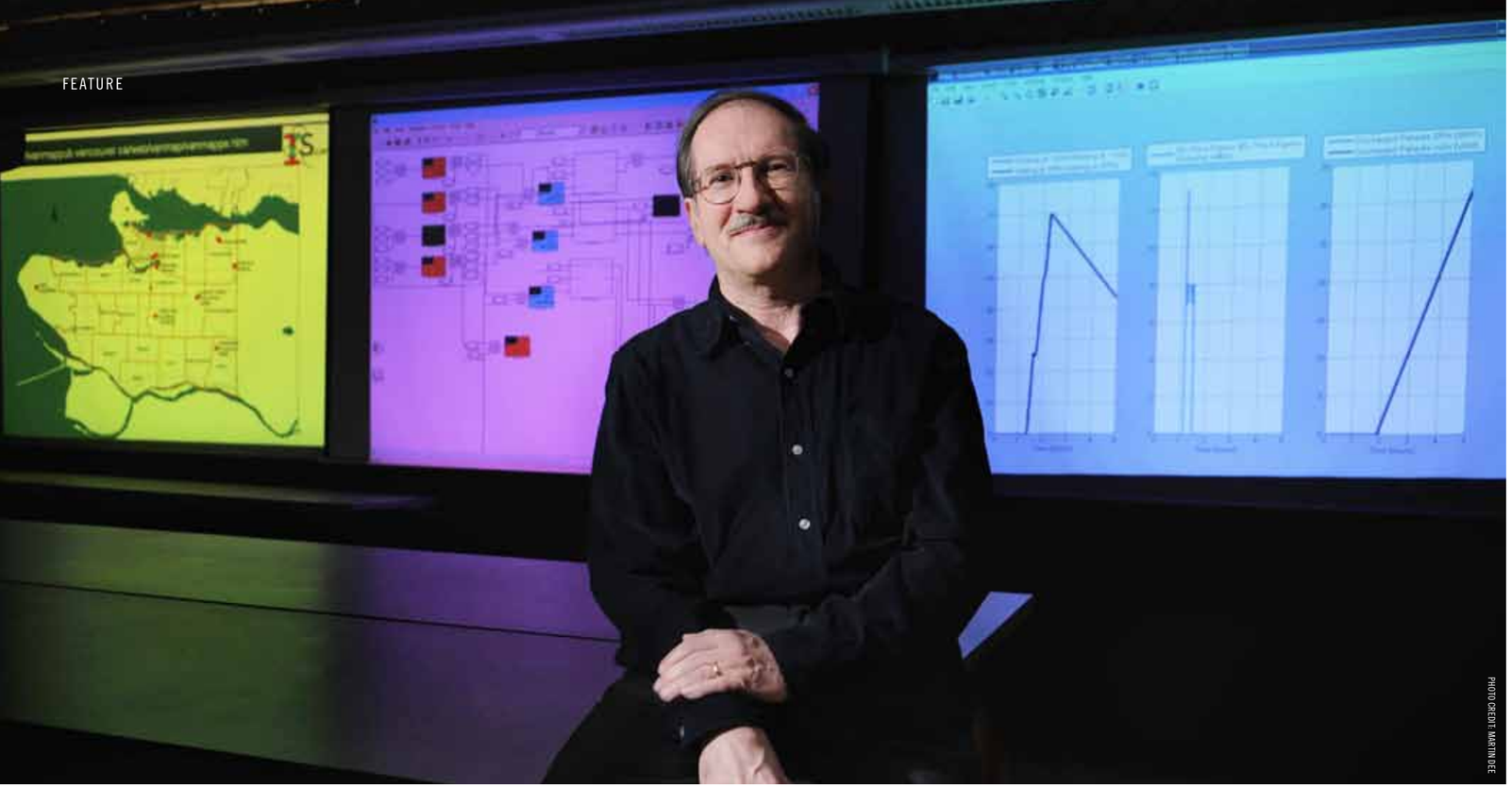


PHOTO CREDIT: MARTIN DEE

Professor José Martí with models created using I2Sim

ENGINEERING RESEARCH

SECURING THE GAMES

Preparing for the unexpected: Games responders supported by UBC simulation system

Imagine it's the final minute of the gold-medal match, and Team Canada scores a goal. GM Place starts to shake. You think it's the excitement of the packed arena and the reverberations of the applause—but it keeps shaking—and you realize it's an earthquake.

Will there be a power outage? How will the facility be evacuated? Where will injured people be taken?

A UBC team is imagining just such a scenario during the upcoming 2010 Olympic Games and answering these questions using software that models essential services and utilities during a disaster. Led by UBC Electrical Engineering Professor José Martí, the Infrastructures Interdependencies Simulation (I2Sim) team aims to minimize human suffering, should a disaster occur.

I2Sim was chosen by Defence Research and Development Canada to assist in planning and real-time decision support for the Vancouver 2010 Olympic Games. Adapted specifically for downtown Vancouver, I2Sim's role includes modeling utilities, responders, venues and hospitals; running simulations with public data; and assisting responders.

Developed by a team of experts from electrical and computer engineering, civil engineering, computer science, geography, commerce and psychology, I2Sim models the interaction of infrastructure systems—the things we rely on for normal city life—food, water, safety and order, healthcare, finance, electricity, telecommunications, transportation, government and defense. I2Sim simulates and predicts how a disaster may compromise any one or several of these systems, and allows for planning and real-time human decision-making support during a dynamic crisis scenario.

For example, if an earthquake rocks GM Place during a game, the software immediately models the dynamic situation and advises managers of essential workers—such as paramedics, doctors, engineers and transportation managers—how best to proceed to minimize human suffering.

"The Olympics in Vancouver provides specific challenges," says Martí. "In developing exit strategies, you must consider that many fans may not speak English. There is one hospital downtown, and it is on a peninsula, so bridges must be safe for travel to other hospitals. Many factors must be modeled at the same time."

With key input measures in place, the software can immediately evaluate the evacuation needs of GM Place, the availability of beds at St. Paul's Hospital and the best route to get there, and provide contingency if St. Paul's is damaged or full.

Martí explains that, on one level, the project is about combining engineering skills with human needs, and on another, about decision-making when resources aren't sufficient.

"The overriding question is, how do we balance needs in critical decision-making situations?" says Martí. "It's essentially an optimization problem with the goal of ensuring human lives and minimizing impact."

The I2Sim tool assigns value to limited resources and allocates them to the most essential areas, helping curtail a cascading collapse of infrastructures and escalation of an emergency, thus optimizing what resources are available at any given time. Understanding the interdependencies of critical infrastructures is essential to mitigating the impact of a crisis, and is at the core of I2Sim's effectiveness.

UBC Engineering faculty members have played essential roles in the project. Principle Investigator Martí understands the capability of the simulation tool and the expertise of the team. Civil Engineering Professor Carlos Ventura contributes a keen understanding of structural damage and extensive experience in earthquake engineering. Electrical and Computer Engineering Professor KD Srivastava provides expertise from his years of organizational experience. The team employs two professional engineers: one for programming and one for project management.

The I2Sim team also includes 12 graduate and undergraduate students.

"It has been tremendously motivating to work on I2Sim," says Hugón Juárez García, a Civil Engineering PhD candidate. "Certainly being part of the Olympics is exciting, but ultimately, this is a tool that can be employed in any area of the world in the event of a disaster. It can save lives. What greater reward could there be?" ▪

OUR PEOPLE

Profiles

Meet a few of Applied Science's outstanding people—alumni, faculty and students—and learn how they contribute to society. Whether developing assistive technologies, training for the Olympics or fostering the spirit to engineer, learn how a few UBC Applied Science stars employ their time and talents.

PHOTO CREDIT: VARUN SABAN

Gary Birch

Improving the lives of those living with disabilities—engineer named Officer of the Order of Canada, recognized by UBC Alumni Affairs

Electrical Engineering Adjunct Professor and alumnus Gary Birch (BASc '83, PhD '88) has been appointed Officer of the Order of Canada—the highest honour that Canada can give its citizens—in recognition of his outstanding achievements and lifetime of service to the country and humanity at large.

Birch is honoured for his contributions to the Neil Squire Society, which develops programs, services and assistive technology for people with physical disabilities, and for his determination and ingenuity in helping Canadians with disabilities achieve a higher quality of life. Birch is the executive director and director of research and development for the society.

His accomplishments, already impressive by any standard, are even more remarkable considering a serious car accident rendered him a quadriplegic and threatened to short-circuit his electrical engineering career.

"I hung on to the dream," Birch explains.

Occupational and physiotherapists who helped with his rehabilitation told him that anything was possible, and Birch bought into it.

While undergoing therapy at GF Strong Rehabilitation Centre, he noticed technology designed to assist people and thought more could be done; he soon aspired to developing assistive technologies.

But the path to his goal still remained unclear in his third year of engineering studies. Until, that is, robotics engineer Bill Cameron spoke to his class and mentioned he was helping his nephew, Neil Squire—a high-level quadriplegic—use a computer.

"Pow," says Birch. "I shot down at the end to tell him I would love to get involved."

Birch and a fellow student eventually taught Squire to communicate by computer. Upon Squire's death in 1984, Cameron incorporated the Neil Squire Society, and Birch joined the society full-time after completing graduate school.

During his first year of graduate studies, Birch had begun work on a brain-computer interface (BCI) project using electroencephalogram (EEG) signals. Under Professor Peter Lawrence's supervision, Birch focused on a novel approach to processing EEGs and the ability to create finger movement via the signals.

"The biggest barrier to technology for people with disabilities is finding a way for them to control it," says Birch.

Twenty years later, the BCI research team is on the threshold of creating a prototype but still faces hurdles. Further testing is needed, and the electrode-fitted skullcap currently worn by test subjects is neither user-friendly nor practical for long-term use. A wireless and cosmetically appealing alternative must be designed before the technology can advance. Useful BCI technology is still five to 15 years away.

"Anything that claims to be commercially available right now doesn't work in any practical fashion," says Birch.

Recently, under Birch's leadership, the society has shifted its research focus away from product development and toward industry lobbying. Birch explains that the shift came about in equal parts from hope in new technology and frustration over the rapid advancement of emerging technology.

"No sooner do we develop concepts for the use of products by quadriplegics then the manufacturer will do something innocent, like change their operating system. All our work becomes obsolete," says Birch.

Birch says current industry and future designers must understand that accessible technology needs to be considered at the design stage, when it is easier and less expensive to incorporate.

The accessibility of technology notwithstanding, Birch says the real work that remains is to improve the attitude and awareness of society towards those living with disabilities.

"It's changing," he says, "but we still have a long way to go." ▪

"The biggest barrier to technology for people with disabilities is finding a way for them to control it." Gary Birch

From left, David Cunliffe, BASc Civil 1978, Ray Cunliffe, BASc Civil 1949, Graham Cunliffe, BASc Electrical 2006, Harold Cunliffe, BASc Civil 1973

Ray Cunliffe and Family

Problem solving is the zen of three generations of UBC engineers

The photos of six members of the Cunliffe family, representing three generations of engineers, hang on the walls of the UBC Faculty of Applied Science hallways. But according to Ray Cunliffe (CIVL '49), the family's predisposition towards engineering and problem solving goes back even further. Ray's father and grandfather both apprenticed as engineers after emigrating from England to Vancouver in 1907.

Ray and his brother Joe (CIVL '50) often traveled with their father to job sites and saw a lot of construction machinery in action. Their interest grew because, says Ray, "we were just around it all the time."

Both of Ray's sons, Harold (CIVL '73 and DULE [Commerce] '82) and David (CIVL '78) tell similar tales of family holidays punctuated by interesting side trips to sewage-treatment plants, highway-construction sites and bridge-building projects.

"Engineering was always a part of my life," says David. "I don't remember making a conscious decision to go into it. It just kind of occurred."

Both Harold and David agree there was never any question about whether they would go to university—the operative word was when.

"My dad told me that he didn't care what I did, as long as I got a basic education," says Harold. "But to him, a basic education meant studying civil engineering."

David's son Graham (ELEC '06) remembers being influenced early by both his father and grandfather.

"They would analyze everything and get to the root of the problem in the most practical sense. Even something silly like dinner not being ready on time would be solved like an engineering problem," says Graham. And although his family would never refer to it this way, problem solving is, according to Graham, "the zen of the family."

Graham has carried on the family tradition, despite trying to avoid going into engineering for as long as possible. "I studied business at first but didn't like it. When I started taking physics classes, I realized I thought that way and understood problems from the physics perspective."

For Ray's 60th class reunion in September 2009, the entire family was asked to reflect on their time in UBC Engineering. Memories of friendly and accommodating faculty members taking the time to stop what they were doing to help them out, camaraderie enjoyed with fellow students and friendships they maintained after graduation are mutually shared.

The Cunliffes all agree that teamwork was one of the most important skills they learned. It not only helped them get through the incredible workload in the program, but it has also proven to be invaluable throughout their professional careers.

"Engineering is not the type of education you can achieve independently," says David. "It wasn't only encouraged but mandated that you learn to work as a team."

In his current work as a land developer, David coordinates projects and a broad range of professionals from a variety of backgrounds. "You've got to bring everyone together with a common focus if you're going to succeed," he says.

Harold, also in land development, credits his engineering degree with teaching him how to problem solve and quickly analyze anything.

"In my later career, I've had lots of consulting engineers working for me, and I've needed to analyze their designs quickly and correct them if necessary," he says.

Ray believes that the ability to problem solve is the single most important thing an engineering student will learn.

"That's what engineers are. We're problem solvers," he says. ▪

Matt Tunnicliffe

Engineering a place on the Olympic team

PHOTO CREDIT: MARTIN DEE

Matt Tunnicliffe holds close to his dream of making the 2010 Olympic team

Thriving on challenges, Matt Tunnicliffe (BASc '09 MTRL) is not only working on his master's thesis, he's aspiring to make the 2010 Olympic snowboard cross team.

"Training, coupled with the demands of the engineering curriculum, forced me to develop efficient habits and learn the dynamic skill of prioritizing," says the recent graduate.

Overcoming injury and surgery, Tunnicliffe will find out in mid-January whether he's made it.

Debuting at the 2006 Winter Olympics in Torino, Italy, snowboard cross is making its second appearance at the upcoming Games in Vancouver.

Tunnicliffe describes it as "motocross on snow," with boarders racing in excess of 60 kilometres per hour, navigating hairpin turns, jumps and banks while racing against each other and the clock.

Fortunately for Tunnicliffe, UBC Engineering professors support students pursuing passions outside the classroom. After finishing his undergraduate degree this past spring, Tunnicliffe had a heart-to-heart with Department Head Warren Poole about his future.

"I told Professor Poole that I wanted to see how far I could take it with snowboarding, and he encouraged me to pursue grad studies because it would allow a relatively flexible schedule," he says.

Tunnicliffe currently studies corrosion engineering on a project funded by NSERC and Xstrata Zinc, under the supervision of Professor Akram Alfantazi. He is attempting to address corrosion issues of lead anodes used worldwide in zinc-extraction plants. These anodes are costly to replace, so Tunnicliffe investigates ways to extend their life.

"With snowboarding, I like the challenge to surpass those ranked above me. My master's thesis is another type of challenge—to solve the problem with respect to zinc processing."

Tunnicliffe thrives on challenges, and he has faced some tough ones. After placing 13th in the 2007 World Cup in Switzerland and realizing his Olympic trajectory, he required surgery in December 2008 due to a previous injury.

"Any experience—even ones that seem negative at the time—can make you stronger," he says.

After months of rehab and training, he feels stronger than ever.

"My happiness is dependent on the process more than the outcome. In sports, most people are not happy if they don't win. For me, I'm happy for how I've progressed."

And how is he feeling regarding his prospects of making the Olympic team?

Confident in his training—another skill UBC Engineering helped him acquire.

Tunnicliffe points to an exam format that was particularly useful. Half the exam was allotted to individual test work and the other to defending the answers within a group.

"It helped me build confidence in my thought process, the confidence to stand behind my decision—an extremely important skill that I will use throughout my life as an athlete or engineer. Whenever I do something in sports or academics, I need to be sure it's the best thing for my performance."

The 24-year-old from Gananonque, Ontario, would be overjoyed to make the 2010 Olympic team. But ultimately he'll be satisfied with a lifelong journey spent bettering himself and helping those around him—not to mention elevating the reputation of his sport.

"Right now, I think I could leave a legacy for snowboard cross as putting a brain to the brawn. As an engineer, I think I can step up the reputation of snowboard cross as a respectable sport," says Tunnicliffe. ▪

Matt is the recipient of UBC scholarships. If you would like to support Applied Science scholarships for students, please contact the Development Office at: 604.822.8335.

Alumni Updates

The fall brought foliage, football and friends together. Enjoy the highlights of recent UBC Engineering events and mark your calendar for upcoming spring events. We hope to see you!

A Message from the Director of Development and Alumni Relations

Andrea has been with Development and Alumni Relations on campus since 2000, and was most recently Director of Development for the Faculty of Dentistry.

In the five months since I joined the Faculty of Applied Science as Director of Development and Alumni Relations, I have been consistently impressed and delighted to find myself part of a faculty with such vibrancy, vision and a sense of its place in the world. Our faculty, students and alumni embody the ideal of making the world a better place through their profession, and as such this is an inspiring place to be.

One of my goals as director is to meet as many of our alumni as possible—we're working hard to ensure that this is a place you are proud of, a place you want to come back to and share your accomplishments. In this issue of *Ingenuity*, we've highlighted for you not just the faculty's accomplishments but a few stories of how you in the community are helping us reach our goals.

We've also had a tremendous year of alumni interaction—more of you have been coming back to campus than ever before—and we hope that this year and the years following will see many more of you getting involved, playing a part and ensuring that the Faculty of Applied Science at UBC, your alma mater, is the best it can possibly be.

We've introduced a new section in this issue, Alumni Notes, where you can share your achievements, accomplishments and life changes. Please let us know your story — we'd love to hear from you.

Andrea Wink, BA (Hon.), CFRE

Director, Development and Alumni Relations
Faculty of Applied Science
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Event Highlights

CIVL '49—60TH REUNION (1)
SEPTEMBER 16, 2009

Alumni and guests of the Civil Engineering Class of 1949 celebrated 60 years since graduation and announced the bursary the class is creating. The luncheon included an update from Professor Alan Russell, former department head. CIVL '49 meets annually.

MECH '59—50TH REUNION (2)
SEPTEMBER 26, 2009

The Mechanical Engineering Class of 1959 gathered for a day-long event, beginning with a UBC tour and informal presentation from Department Head and Professor Sheldon Green. The day ended with an evening of catching up at the home of class member Robert Pedersen. For Robert this was, "All in all a grand day. The chance to meet classmates, some after many years, was a real treat for all of us."

MAKING A DIFFERENCE SPEAKER SERIES
SEPTEMBER 29, 2009

Applied Science welcomed alumnus Ossama Hassanein for a lecture in partnership with the Vancouver Student Entrepreneurship Association on September 29, 2009. Alumni and students learned from Dr. Hassanein's experiences as an entrepreneur and venture capitalist.

ENGINEERING OPEN HOUSE
NOVEMBER 7, 2009

The annual Engineering Open House is a great way for high-school students and others to learn about careers in engineering and see laboratories and student teams. If you know someone who is thinking of attending UBC Engineering in the future, have them come to next year's event! And we would be delighted to have alumni participate—who better to tell about the life of an engineer than those living it? If you'd like to get involved, please call us at 604.822.9454 or email tracey.charette@ubc.ca.

UBC ALUMNI ACHIEVEMENT AWARDS 2009
NOVEMBER 10, 2009

Two Engineering alumni were recognized at the 2009 Alumni Achievement Awards. Gary Birch, (EECE BASc'83, PhD '88) was awarded the Global Citizenship Award for his commitment to the development of assistive technologies for Canadians with physical disabilities. Parisa Bastani (MECH '09) was awarded the Outstanding Future Alumnus Award for showing exceptional potential in the automotive industry. Congratulations for your exceptional achievements.

CONNECT TO THE FUTURE TORONTO
NOVEMBER 13, 2009

Applied Science hosted an alumni reception at the InterContinental. Alumni came out to meet Dean Aboulnasr and hear Professor Malcolm Scoble, Norman B. Keevil Institute of Mining Engineering, speak about the benefits of a pilot project to connect rural communities, engineering students and mining companies. Attendees enjoyed the evening and reminiscing about their days at UBC. We look forward to seeing you the next time we're in Toronto.

CONNECT TO THE FUTURE CALGARY
NOVEMBER 19, 2009

Applied Science hosted an alumni event in Calgary at the Westin Hotel. The event's topic was Global Citizenship and Social Responsibility with guest speakers Professor Annette Browne, School of Nursing, and alumna Nalaine Morin (METL '02), member of the Tahltan Nation, and Technical Advisor in Resource Development to First Nations. We'll be back in Calgary again soon and look forward to connecting with even more of you next time.

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Going green...

The Faculty of Applied Science and UBC Engineering are dedicated to going green and becoming more sustainable in our practices.

If you would like to receive notification of *Ingenuity* electronically rather than in print, please send an email—including your full name, mailing address and Engineering program and year if applicable—to: ingenuitydistribution@apsc.ubc.ca.

Engineering | ALUMNI

Alumni Notes

UBC Engineering alumni are everywhere and doing some really great things! Over the past few months, we've heard from several of you about your exciting achievements, and we want to hear more. We've added this new feature to *Ingenuity*, where you can write in and tell us about achievements, new directions and professional accomplishments that you want to share with fellow alumni. Send your stories to alumni@apsc.ubc.ca. And watch this space!

Parisa Bastani *(BASc '09 MECH)* was recently awarded a W.L. MacKenzie King Memorial Scholarship. She was also the recipient of the Outstanding Future Alumnus Award at this year's Alumni Achievement Awards at UBC.

Anthony Chan *(MEng '87 CLEN)* received the Excellence in Teaching and Research Award from BCIT Alumni Association in September. Currently Chan heads the BCIT Biomedical Engineering Technology program and is completing his PhD at UBC.

Mike Currie *(BASc '82 CIVL)* was awarded the D.C. Lambert Professional Service Award from APEGBC, for his service to professional organizations throughout his career.

Jack Gin *(CIVL '83)* has been selected to carry a 2010 Olympic torch.

Daniel Lambert *(BASc '50 EECE)* was honoured by APEGBC which named their professional services award this year in his honour, for his many contributions towards APEGBC and the professions.

Brent King *(BASc '96 MECH)* was recently awarded the Manning Innovation Award for inventing the SPIDER Limb Positioner, a unique device that accurately and securely positions a patient's limb during surgery. King is Vice President of Operations, Co-owner, and an engineer with TENET Medical Engineering Inc., the Calgary company that designs, assembles, and packages the SPIDER.

Patrick M. Pilarski *(BASc '04 EECE)* recently launched his first full length collection of poetry, *Huge Blue*. In addition to being an internationally active author and literary editor, Patrick is currently completing his PhD in Computer Engineering at the University of Alberta. *Huge Blue*, published by Leaf Press, is a collection of poetic interpretations of Western Canada.

Monty Raisinghani *(BASc '07 CHML)* has been selected to carry a 2010 Olympic torch.

Garry Stevenson *(BASc '73 GEOE)* was awarded the Meritorious Achievement Award from APEGBC for his contributions to engineering and to the community.

Jonathan Tippett *(BASc '99 MECH)*, **Leigh Christie** *(BASc '04 ENPH)*, and **Charlie Brinson** *(BASc '04 ENPH, MEng '07 MECH)* took their "Mondo Spider" creation to the invitation-only event Gadgetoff, held in New York in September 2009. The "Mondo Spider," a rideable mechanical walking machine, was inspired by the Vancouver Junkyard Wars and was a funded art installation at Burning Man 2006.

APPLIED SCIENCE ALUMNI ACHIEVEMENT AWARDS

The Faculty has recently established its very own Alumni Achievement Awards, and we're calling for YOUR nominations! We'll be awarding in three categories: Lifetime Achievement, Young Alumnus and Future Alumnus. Nominations will require a nomination form, letters of reference, and the candidate's CV. To nominate someone, visit: **www.engineering.ubc.ca/alumni/awards**.

Update your contact information with us

There's lots going on in Engineering at UBC, and we want to be sure you know about it. Stay connected with your alma mater, no matter where you are—you never know when we'll be in your neighbourhood. Update your contact information at **www.apsc.ubc.ca/alumni/contact** or email **alumni@apsc.ubc.ca**.

Upcoming Events

Reunions are but one way to reconnect with classmates and your alma mater. In addition, this winter and spring we invite you to attend our thought-provoking lectures, receptions and Old Red New Red. Hope to see you soon!

UPCOMING EVENTS

ICICS—DISTINGUISHED LECTURE SERIES
JANUARY 21, 2010

Join ICICS—Institute for Computing, Information, and Cognitive Systems—for the Distinguished Lecture Series, featuring academic and industrial leaders in the forefront of their fields to present innovative research. Professor Rahul Sarpeshkar, Massachusetts Institute of Technology, will present, "Bioelectronics."
For more information, visit: *www.icics.ubc.ca*

NEW YORK ALUMNI RECEPTION
JANUARY 28, 2010

UBC Engineering together with Columbia University present *Energy, Sustainability and the City in New York*. Dean Aboulnasr will host a panel discussion featuring UBC Professor John Grace, Canada Research Chair in Clean Energy Processes, alumnus Dr. Stewart Smith, Dean for Research, Princeton University, and Dr. Klaus Lackner, Director of Lenfest Center for Sustainable Energy, Columbia University. Please join us for an evening of stimulating conversation about sustainable energy and reminiscing about your days at UBC. Everyone welcome!

OLD RED NEW RED
FEBRUARY 4, 2010

This year's Old Red New Red event will be held February 4, 2010, at Cecil Green Park. The Engineering Undergraduate Society (EUS) and the current UBC Engineering student body would love the opportunity to spend an evening with you, the experienced and accomplished engineering alumni of UBC. Please save the date and watch your email for more details. Contact us if you are not on our email list to ensure you get your invitation to this event and others.

CELEBRATE RESEARCH WEEK 2010—FREE PUBLIC LECTURES

For details on the following events visit:
www.apsc.ubc.ca/celebrateresearch

MONDAY MARCH 8, 2010

"Small (mining) is Beautiful—Engineering to Alleviate Global Poverty"
Learn from the entertaining and engaging Mining Engineering Professor Marcello M. Veiga. The talk focuses on: How can engineering help alleviate global poverty? The findings are a result of a six-year project sponsored by the United Nations.

TUESDAY MARCH 9, 2010

"Four Ways to Combat Climate Change"
Presented by Mechanical Engineering Professor Robert L. Evans, Founding Director of the Clean Energy Research Centre and author of *Fueling Our Future: an Introduction to Sustainable Energy*. This talk focuses on energy use and its impact on the environment—one of the most important technical, social and public-policy issues facing humanity today.

WEDNESDAY MARCH 10, 2010

"Amazing Paper: The History and Art of Papermaking"
Most people take paper for granted. Learn from Chemical and Biological Engineering Professor Mark Martinez paper's rich history and its impact on society, and understand the manufacturing process with emphasis on sustainability.

WEDNESDAY MARCH 10, 2010

"From Toy Trains to Airplanes: Are we serious about safety?"
From the onset of the Industrial Revolution until a few decades ago, safety was a topic of great importance. But in recent years, we have become complacent—that is until a tragedy occurs. Explore issues of public safety with Materials Engineering Professor Anoush Poursartip.

THURSDAY MARCH 11, 2010

"Making a Difference in Our World"
Presented by: Applied Science graduate students
Format: Applied Science poster session
Learn how graduate students make a difference through their leading-edge research in a wide variety of exciting fields.

FRIDAY MARCH 12, 2010

"Inkjet printing—From Document Printing to Tissue Engineering"
Explore with Electrical and Computer Engineering Professor Konrad Walus the innovative concepts in inkjet microfabrication and the rapidly emerging possibilities.

NOTICES

ALUMNI WEEKEND—MAY 2010

Mark your calendars; this year's UBC-wide Alumni Weekend will be held May 28–30, 2010. We'd love to see you back on campus! UBC Engineering will be hosting its annual Engineering Reunion Reception for special anniversary classes. We invite the classes of 1950, 1960, 1970, 1980, 1985, 1990, and 2000 to save the date for Saturday May 29th, 2009. New this year will be a special event for all Applied Science graduates.

For more information visit: *www.engineering.ubc.ca/alumni.*