



THE
UNIVERSITY OF
BRITISH
COLUMBIA

ingenuity

Faculty of Applied Science
Engineering News

Wood pellets—

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Nuggets of green energy

As temperatures dive and natural-gas costs soar, perhaps you are considering the purchase of a wood-pellet stove. But you wonder, is this an environmentally friendly choice?

The answer is yes.

According to Chemical and Biological Engineering Professor Xiaotao (Tony) Bi, wood pellets are the best choice for residential heating.

“In an isolated environment, when only the emissions from the burning fuel are analyzed, natural gas appears to be a cleaner option,” says Bi. “But when you factor in the entire life cycle of natural gas—a fossil fuel—with that of engineered wood pellets, which come from a renewable resource, the pellets are a far better environmental choice. They’re clean, and they’re sustainable.”

Environmentally speaking, wood pellets are an ideal fuel for industry and district heating.

Waste-wood materials, such as sawdust, are bound into pellets in a high-temperature pelletization process; no additives or glues are used. No new trees are cut down to create pellets, and pelletization is a beneficial use of trees killed by the mountain pine beetle.

Engineered pellets have a uniform size and moisture content and can be cleanly burned in specially designed automatic pellet furnaces, unlike wood logs or wood residues in traditional wood furnaces. Wood pellets have been endorsed by the U.S. Environmental Protection Agency and are one of the cleanest-burning and most renewable energy sources on Earth.

Bi, an expert in fluid-particle systems and multiphase reactors, is part of UBC’s Biomass and Bioenergy Research Group (BBRG), a multidisciplinary team that collaborates with industry and government to meet the needs of the emerging bioeconomy. Over the past five years, the BBRG has grown from three members to



Tony Bi reflects upon engineered wood pellets.

15. The group collaborates extensively with the Wood Pellet Association of Canada (WPAC) to engineer a better pellet.

Bi conducts life-cycle analyses—evaluations of the environmental and social impacts of a given product or services caused by or required for their existence—to investigate the health and environmental concerns of pellet burning and improve the environmental performance of pellet making, transportation and distribution.

His research team works to quantify net carbon dioxide emissions and investigate the gases that pellets emit during storage and transportation, to help prevent fires and ensure good air quality for workers exposed to pellets. In addition, the group works to improve the energy density and durability of pellets, using various multiphase processes to produce

Message from the Deans



Welcome to the fall issue of *Ingenuity*.

As a Materials Engineering alumnus, a long-standing faculty member and a former Department Head, I have had the opportunity to be involved with UBC for more than 25 years. And despite my experience and the various roles I've held here, never before did I fully appreciate the breadth and depth of activities within Applied Science until serving as Dean *pro tem* and Acting Dean of Applied Science from July 1 to October 31 this year.

In those months, I have learned about fuel-cell research and our collaboration with government and industry; Engineers Without Borders' students working in Malawi and Zambia; interdisciplinary bio-fuel research taking place in the Michael Smith Laboratories; and Nursing and Architecture students helping people in Vancouver's Downtown Eastside.

These are but a few of the many activities within our Faculty that I have recently discovered, and, quite frankly, they inspire me.

It has been my pleasure to serve in this capacity during the recent leadership transition, and as I continue to serve Applied Science in the role of Senior Associate Dean, I will do so with renewed pride, working within an organization that is dedicated to the betterment of society by providing remarkable opportunities for learning and a supportive environment for research.

As we end this academic term and look ahead to the future, please join me in welcoming Tyseer Aboulnasr as Dean of Applied Science. She brings with her a wealth of experience, a commitment to ensuring UBC and Applied Science's success, and the enthusiasm and energy necessary to steward the Faculty to attain its greatest potential. I look forward to working with her for many years to come.

Steve Cockcroft
Senior Associate Dean



I am honoured to be entrusted with the leadership of UBC Applied Science and delighted to be part of a Faculty with such a rich and impressive history.

While I fully expected a vibrant and exceptional community of professors, students, staff, alumni and supporters, I was certainly impressed by the collective dedication, creativity, drive and excitement to push Applied Science even further in truly making a difference in the future of our world.

My predecessor, Dean Michael Isaacson, has left the Faculty in great shape, making my job so much easier. I was also very fortunate to have the support of Dean *pro tem* Steve Cockcroft, who carried an excessive responsibility throughout the transition, thereby ensuring the continued quality and consistency of education and research in Applied Science over the past several months. Steve was kind enough to agree to continue to serve as Senior Associate Dean, providing continuity and insight from his wealth of knowledge and experience. His support has been truly valuable and is sincerely appreciated.

In this issue of *Ingenuity*, there is an underlying theme of UBC Applied Science individuals—people like you and me—working diligently to make a positive difference in our society and indeed in our world: engineering efficient and sustainable energy systems, developing solutions for waste management, and working to eliminate global poverty. This is what we are all about: creating real solutions for real problems.

To those of you I have had the opportunity to meet, thank you for your kind welcome. I look forward to meeting and working with many more of you to ensure that we in Applied Science do our part to fulfill UBC's vision of educating global citizens who promote the values of a civil and sustainable society and conduct research to benefit British Columbia, Canada and the world. As one of the world's premier institutions, this is not just our vision; this is our responsibility.

Tyseer Aboulnasr
Dean
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To view past issues of *Ingenuity* and learn more about Applied Science, visit our website at <http://www.engineering.ubc.ca/publications>.

Engineering student works to end global poverty

Equipped with three years of mechanical-engineering study, and after extensive preparation by UBC's chapter of Engineers Without Borders (EWB), Florin Gheorghe flew to Zambia in May expecting to work in the fields alongside local farmers.

Before he arrived in Zambia, his overseas EWB position had been described to him as work in collaboration with the Denver-based International Development Enterprise (IDE) in Livingstone, helping local villagers with farming supply-chain logistics—acquiring seeds and technology for crop production and bringing crops to market.

“Before going,” Florin explains a few weeks after returning from his four-month placement, “I thought I'd be most helpful directly on the ground; but shortly after arriving, I found my greatest opportunity for impact was in trying to build capacity in the locally staffed IDE office through coaching.”

When Florin arrived in Livingstone, he met with interesting challenges in the office of three—one staff member had been sent to hospital the day before with tuberculosis, and another's funeral was to be held the following day.

“It was a shock when the Country Director pulled me into his office and said, ‘Florin, here's what happened: I need you to go pull this team back together,’” says Florin.

Relying on a paper

flip-chart, markers and his keen and sensitive mind, Florin helped the local IDE office plan, set goals, communicate and ultimately support local farmers in achieving success through a more efficient organizational structure.

Take, for example, how Florin's work to streamline the organizational structure helped 27-year-old Harrison Sikala. The year before he first met Florin, Harrison had a crop of roughly 1,000 tomato plants. However, working with a more efficient IDE, Harrison was able to obtain a loan and purchase a diesel pump, which enabled him to plant up to 11,000 tomato plants, valued at roughly \$15,000.

The dollar value may seem fairly inconsequential to Canadians, but considering most in Zambia live on less than \$1 per day, Harrison's tomato crop was worth more than 41 times the average annual income. The Bill Gates of his community, Harrison has since convinced others to become farmers; according to Florin, Harrison has taken his whole village forward.

One might think commerce or agriculture students would be better equipped to face such organizational challenges, but according to Florin, engineering students develop a systematic thought process—an adeptness for problem-solving on the basis of hypothesis testing—that transcends a specific industry.

Applying his scientific hypothesis to improve the economic well-being of local villagers, Florin created an organizational structure to enable individuals to do their best.

“I realized I could have a much greater impact on the well-being of the entire community this way than by delivering specific agricultural items,” says Florin. “When provided with an opportunity to transcend poverty, each individual can make a difference in his own economic well-being and share his success within his community. I believe this is a scalable model for alleviating global poverty.”

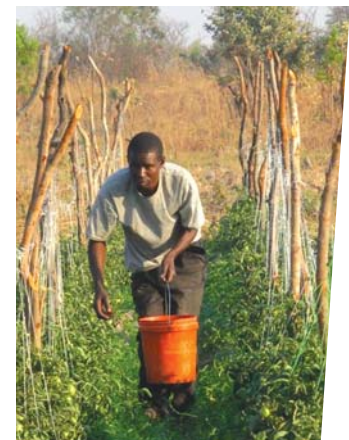
Unlike relief programs that provide immediate aid in the forms of food or money, EWB focuses on long-term human development, creating opportunities for people to improve their economic status and enabling independence so that they can make sustainable progress.

“Engineers Without Borders has by far been my greatest experience at UBC—even before my overseas placement,” says Florin. “Aligning with impassioned, motivated people has inspired me to be the same. It has broadened my perspective of how I can use my education to help make the world a better place.

“I believe it is our role, and privilege, as Canadian engineers to effect human development by promoting



EWB student Florin Gheorghe in Zambia.



Harrison Sikala tends his bumper crop of tomatoes.

social responsibility not only in our workplaces but also in our households, with regard to the decisions we make and awareness of ourselves in a global context. I hope others will join me in driving this positive change.”

To learn more about Florin's experience in Zambia, visit his blog at www.mudhutmadness.com.

To learn more about Engineers Without Borders, visit www.ewb.ca.

Engineering a better world

Introducing Dean Tyseer Aboulnasr

Tyseer Aboulnasr (pronounced: ah-BOOL-na-sur) was appointed Dean of the Faculty of Applied Science September 1, 2008. In this role, she leads the Schools of Architecture and Landscape Architecture (SALA) and Nursing, as well as all Engineering activities at the Vancouver campus and the School of Engineering at the Okanagan campus. Together with more than 700 faculty and staff, she oversees the education of more than 4,000 undergraduate and 1,400 graduate and professional students.



Dean Tyseer Aboulnasr

Janis Franklin

An electrical engineer, Dean Aboulnasr received the Bachelor of Engineering degree from Cairo University, Egypt, and MSc and PhD degrees from Queen's University. From 1998–2004 she served as Dean of the Faculty of Engineering at University of Ottawa (U of O) and chaired the Council of Ontario Deans of Engineering from 2001–2002. The recipient of the Ottawa-Carleton YWCA Women of Distinction Award (Education) in 1999, Dean Aboulnasr is Fellow of the Engineering Institute of Canada and Fellow of the Canadian Academy of Engineering. She was named one of the 100 most influential people in Ottawa in 2001. She received her highest honour when she was named a recipient of the Order of Ontario in 2004.

On the personal side, Dean Aboulnasr is actively involved with several community organizations working to foster social harmony, mutual respect and understanding amongst Canadians of various cultural and religious backgrounds as well as advocating for Canada's traditional values of respect for civil liberties and human rights. She is a mother of three young adults, a first-degree black belt in tae kwon do and a motorcyclist.

Q & A with Applied Science's 11th Dean

You've lived in Ottawa for 27 years and previously served as a Dean—why were you interested in moving and taking on a similar role?

I was so deeply rooted in the Ottawa community, I had no interest at all in moving—not even to beautiful Vancouver and UBC with its impressive record! What piqued my interest were the sentences of UBC's mission that reflected a truly solid commitment to serving society—with excellence in education and research seen as tools to achieve this goal rather than a goal in itself. Upon meeting the university leadership, it became clear that this commitment is a sincere and real one.

What did you enjoy most about your previous role as Dean at U of O?

To me, the key value was being in a position where I could make a difference and truly have an impact on achieving the collective goals of the Faculty. I also appreciated the “big picture” perspective that I did not have as a professor.

Applied Science comprises SALA and Nursing as well as Engineering and is substantially larger than Engineering at U of O. How has your experience prepared you for this scale?

Indeed, Applied Science is about twice the size of U of O Engineering and has a much broader spectrum of programs.

Q & A with Applied Science's 11th Dean

Still, the affinity between architecture and engineering worldwide is very strong. Today's health care relies so heavily on technology, so there are exceptional opportunities for very close interaction between UBC Engineering and Nursing. All programs in Applied Science are professional programs that are entrusted with one responsibility: serving and ensuring the well-being of society.

In Ottawa, I managed the Computer Science move from the Faculty of Science to Engineering at a time when tensions were very high. I believe that this has given me considerable experience in building a cohesive unit while respecting the built-in identities of the various disciplines.

What are your goals and vision for Applied Science?

Anyone leading UBC Applied Science must begin from a position of deep respect for its world-renowned record. How do you improve on that? I hope to position Applied Science as a key player in fulfilling UBC's commitment to be of meaningful service to society through a truly comprehensive education of our future generations and a continued tradition of excellence in generating knowledge that produces real solutions to the world's real problems.

How do you plan to implement this vision?

By articulating our goals clearly to all our stakeholders, ensuring that students, staff, faculty and collaborators take ownership of these goals and work together to achieve them and building alliances within the Faculty and UBC, as well as outside the university and throughout the world, to deliver on our commitment.

What new initiatives would you like to introduce?

It is critical that everyone involved sees Applied Science's vision as their own. Thus, we first need to work together on articulating that vision. I have a lot to learn about the Faculty before I can start introducing initiatives. I am a firm believer that if you have a well-articulated shared vision, put the right people in place and create a supportive environment, there will be no shortage of ideas, initiatives or people willing to make the vision a reality.

What do you anticipate will be your greatest challenge?

I am fortunate to have inherited the Faculty in great shape thanks to my predecessor. The challenge for me will be to quickly learn the culture of UBC and start building the connections, internally and externally, that will enable us to achieve our goals.

What do you see as your greatest opportunity?

Given UBC's exceptional record and its clearly articulated commitment to serving society, I believe we are uniquely positioned to truly offer an alternative paradigm for higher education in Canada—one in which service to society is the goal, and excellence is the tool necessary to achieve that goal.

Do you have a personal philosophy or guiding principle?

My mother instilled in me a deep sense of responsibility, justice, integrity and unquestioned belief in honouring one's commitments. I was always taught that whatever you do, you must do to the best of your abilities.

I believe each and every one of us will end up making a difference in this world by the time we leave it, whether through something we did or something we could have done and did not do. We have no choice about that. The only choice we have is about the nature of the difference we will make.

In attempting to make that positive difference, I have been told that I am very persistent, but I also take pride in my ability to listen, compromise and learn from failure. I constantly remind myself with Michael Jordan's quote: "I have failed over and over again....That's why I succeed."

How would you describe your leadership style?

I'll leave it to others to describe what my leadership style really is, but what I aim for is accountable "service-leadership" that is based on a foundation of absolute integrity and fairness.

I believe it was Helen Keller who said that the only thing worse than being blind is having sight but no vision.

A true leader has to have the capacity to see far into the future, to build a shared vision and to articulate this vision to his or her constituents in a way that allows them to see what he or she sees and feel just as passionately about that vision. It is the leader's responsibility to make sure the constituents share in the same vision and believe it is achievable. It is the leader's responsibility to create the right environment, motivate people to make things happen and reinforce their drive during the tough times.

Anyone can drive people with fear, but it takes a true leader to drive them with vision and passion. This is what I see as the leader's responsibility. Once a leader succeeds in engaging people and transferring ownership of the vision to them, then there are no leaders and no followers; rather it is "a shared leadership". A true leader never forgets that what really matters is the difference they will be remembered as having made, long after they are gone.

I do not know how people will judge my leadership style, but I do know that this is the style I aim for.



Dean Aboulnasr listens intently to Dan Gelbart, Co-founder, Creo Products, Inc. and Adjunct Professor, UBC Department of Mechanical Engineering.



Dean Aboulnasr helps Engineers Without Borders' Duncan McNicholl and Sophia Toft Moulton flip pancakes for the Fair Trade Breakfast.

Faculty development

Supporting students and research

I am pleased to be the Acting Director of Development. Having been Manager of Development with the Faculty of Applied Science for the past three years, I am familiar with the Faculty and I am very much looking forward to working with our Development team—and our engineering community—in support of UBC Engineering.

First of all, I would like to say thank you to our many donors from the past year. In fiscal year 2007–2008, the Faculty of Applied Science was the beneficiary of an all-time high of \$18.8 million in support!

We could not have achieved this significant milestone without the

generous support and involvement of alumni and the engineering community. Thank you very much!

The Development Office is very pleased to join our colleagues in the Faculty in welcoming Tyseer Aboulnasr as the new Dean of the Faculty of Applied Science.

The Development team is looking forward to working with Dean Aboulnasr in continuing our successful fundraising programs and facilitating support for Applied Science from alumni and the engineering community. We anticipate these pages will showcase exciting news over the coming years!

In this issue of *Ingenuity* we highlight for you a few of our newest engineering-related initiatives

in Applied Science.

Professor Emeritus Charles Laszlo has generously made a contribution to transform the professorship he previously established in his name into the Charles A. Laszlo Chair in Biomedical Engineering.

Dolby Canada has established a professorship in the Department of Electrical and Computer Engineering.

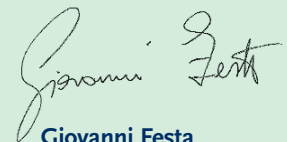
Sierra Wireless has donated test equipment to a research laboratory in Electrical and Computer Engineering.

We also highlight a scholarship in memory of alumnus Martin Sikes that was established by friends and family following his untimely passing, and we hope that you might wish



to join the community in donating to the scholarship.

If you have any questions about our fundraising programs or want to get involved and make a donation, please do not hesitate to contact me at 604-827-5625 or gio.festa@ubc.ca.



Giovanni Festa

Acting Director of Development

Family and friends honour the life of Martin Sikes

Martin Sikes, BAsC 1992 (Electrical Engineering), passed away unexpectedly on Christmas Eve 2007 at age 39.

During his time at UBC, Martin was president of the Electrical Engineering student club. He went on to a successful and prosperous career in the video-game industry, beginning as a founder of the highly regarded game-development studio Black Box Games.

Martin lived life to the fullest and had a particular talent for building communities. In addition to his work at Black Box, he was a prominent disc jockey and the prime mover of the Soundproof music collective.

He had a passion for trains and traveled extensively to exotic places like Easter Island and the Antarctic, as well as to visit friends in Australia, Africa and South America.

Martin's enthusiasm and drive in everything he touched would draw people in and get them involved. The enduring connections formed in these

communities are one of his significant legacies.

Martin's family, friends and colleagues are seeking to establish an award in his honour at UBC. It is expected that the Martin Sikes Memorial Award will support third-year UBC undergraduate students in good academic standing who have demonstrated leadership through active involvement in professional societies, student government and/or campus and community activities.

To make a donation in memory of Martin, visit www.supporting.ubc.ca or mail your gift to UBC Annual Giving 500-5950 University Boulevard, Vancouver, BC V6T 1Z3. For more information, please contact Maryn Ellis at 604-822-5345.



Martin Sikes 1968-2007

Sierra Wireless supports research at UBC

Sierra Wireless, the Richmond-based developer and manufacturer of wide-area wireless modems, has recently strengthened its support for wireless research at UBC through a generous gift of equipment to Professor David Michelson's Radio Science Laboratory in the Department of Electrical and Computer Engineering (EECE).

The in-kind donation, which was arranged with help from Agilent Technologies, includes over \$100,000 worth of wireless test and measurement equipment, including signal generators, spectrum analyzers and wireless-communications test sets. Sierra Wireless previously donated a gift of equipment valued at more than \$62,000 to EECE last year.

According to Bill Dodson, Senior Vice President of Operations at Sierra Wireless, "Sierra Wireless recognizes the value of the propagation and channel modeling work that Professor Michelson and his students are undertaking, and we are glad to support it by making a substantial donation of wireless test and measurement equipment to the Radio Science Lab."

As users of personal wireless devices are all too aware, wireless signals can be severely distorted and impaired by the environment as they travel from a transmitter to a receiver. The echoes, fading and reverberations that are often superimposed on the signal can dramatically lower both the reliability of the link and the quality of reception. Characterizing the radio-wave propagation environment is a vital step in the process of developing methods for making wireless communications more reliable.

"The equipment provided by Sierra Wireless will help us collect more data more quickly. That's key in this type of research, so we're extremely grateful," said Michelson.

Although much of the equipment will be used in Michelson's research program, some will also be used in undergraduate labs and senior-level project courses involving wireless communications. EECE looks forward to continuing its partnership with Sierra Wireless in the fields of information and communication technology.

Laszlos commit additional \$1.5m to Biomedical Engineering

Electrical and Computer Engineering Professor Emeritus Charles Laszlo recently committed to make a major gift of an additional \$1.5 million in support of the Faculty of Applied Science to transform the Charles A. Laszlo Professorship in Biomedical Engineering into the Charles A. Laszlo Chair in Biomedical Engineering.

Professor Laszlo and his wife, Dr. Doreen Laszlo, first established a professorship two years ago through their CalDor Foundation with a gift of \$500,000 announced on September 7,

2006, at the launch of UBC's new Biomedical Engineering Program.

According to the appointed Chairholder, Professor Tim Salcudean, "The Charles A. Laszlo Chair in Biomedical Engineering will help support a wide range of existing and new activities in Applied Science. It will help expand the support role that the Professorship has played in our Biomedical Engineering Program and will provide a boost to our research and teaching in several clinically relevant areas."

Laszlo joined UBC in 1974, when he became the first biomedical engineer to receive a National Health Scientist Award. In 1980, he went on to become a Professor of Electrical Engineering as well as the first Director of the Clinical Engineering Program.

For 13 years, Laszlo led the program, which initiated the bridge between engineering principles, the life sciences and clinical applications in order to improve human health.

"I am grateful to Charles and Doreen Laszlo

for their generous support and to Charles for his positive role in creating and supporting valuable linkages with hospitals and the biomedical engineering industry in British Columbia," said Salcudean.

The Faculty of Applied Science and Biomedical Engineering are proud and honoured to have a Chair in Professor Laszlo's name and express the deepest gratitude to the Laszlos for their exemplary support.

Alumni update

Keep in touch!

UBC Engineering is committed to providing services and opportunities to you, our alumni, to ensure that you have the opportunity to connect with and stay connected to your university, your Faculty and your fellow graduates. Please help us add value to your UBC experience by keeping in touch with us and keeping us apprised of your interests, achievements and plans.

To maintain UBC's top marks for sustainability initiatives, we would like to communicate with you electronically when appropriate. Please send us your email address and help us get greener; we promise not to share your information.

Do you have an alumni story to share, someone to nominate for an Alumni Achievement Award or a reunion you want to promote? Please let us know by getting in touch with Tracey Charette, Alumni Relations Manager, at 604-822-9454 or at alumni@apsc.ubc.ca

Event Highlights

UBC Engineering Alumni Weekend— May 23–24, 2008

UBC Engineering welcomed back the classes of '58, '68, '78, '88 and '98 to a reception at the Point Grey campus during Alumni Weekend 2008. Dean Isaacson gave a presentation highlighting recent UBC Engineering achievements, taking alumni down memory lane with his Now and Then slideshow. Alumni became increasingly nostalgic for their UBC days when he surprised them with a pop quiz on the history of the Deans of Applied Science.

Want to test yourself? Check out this quiz online at: <http://www.apsc.ubc.ca/alumni/deanquiz.php>.



Reds—old and new—
share stories and laughs.



Class of 2029—
looking forward to the future!

MECH '68—40th Reunion— May 23–24, 2008

In connection with Alumni Weekend 2008, the Mechanical Engineering Class of 1968 celebrated with an informal get-together at Cecil Green College for grads and spouses. Vel Laur (MECH '68) captured the event and everyone's sentiments by videoing a comment from all in attendance! On Saturday, grads enjoyed supper, an update on those who were unable to attend and a brief tribute to classmates who have passed away.



Ryan Baker

The Class of 1958 tours UBC Engineering.

BASc '58—50th Reunion— May 23–24, 2008

The Class of 1958 returned to campus this spring to celebrate its Golden Anniversary. Weekend highlights included a reunion luncheon, departmental tours, wine and cheese reception at the University Golf Club and a reception with Dean Isaacson. The Saturday evening banquet was the climax of the reunion with Russ Fraser (MECH '58) emceeding the event which featured a comedy performance by Jim Oliver (MECH '58); a keynote address from Henry Wakabayashi (CHEM '58); and an Ode to H.C. Gunning, written by Dean Gage and read by Gunning's son, Don Gunning (METL '58). With over 75 graduates in attendance from all over the world, the reunion was a great success. Special thanks to the Reunion Committee, who started planning over a year in advance to make it happen!

MECH '68 celebrates 40 years.



MECH and ELEC '49 Luncheon— December 5, 2007

A group of Mechanical and Electrical Engineering alumni from the Class of '49 enjoyed a luncheon at Earl's Restaurant in West Vancouver on December 5, 2007. The grads meet several times a year and welcome others from the Class of '49 to join. Contact Steve Slinn at sslinn@uniserve.com or telephone at 604-926-9225. Submitted by Bill McCorquodale (ELEC '49).



MECH and ELEC alumni meet regularly to celebrate the Class of 1949!

EECE Alumni BBQ—August 19, 2008

EECE Head Andre Ivanov hosted the 9th annual summer gathering of EECE alumni. More than 100 grads and faculty enjoyed a departmental update and celebrated the first EECE student award created from a class gift. Gary Wong (EECE '71) presented the Graduating Class of Electrical Engineering 1971 Service Award to its first EECE student recipient Aryan Navabi, and gave encouragement for other classes to consider a similar initiative. To inspire further donations and class gifts, James McEwen (BASc '71, PhD '75) spontaneously announced that he would personally match any donations to a maximum of \$25,000. The challenge has begun EECE Alumni! Please contact alumni@apsc.ubc.ca for more information or to take advantage of this matching opportunity.

EECE '88—20th Reunion— August 28, 2008

EECE Class of '88 gathered on campus for a festive evening of activities in celebration of its 20th anniversary, with some classmates travelling from as far away as Panama. The evening started with a tour of the Fred Kaiser Building (the new home of the department since 2005) led by Professor David Michelson. The tour was followed by a slideshow in the Kaiser lounge, which featured 20-year-old photos of the class engaged in engineering campus antics, social events and field trips.



CIVL '49 stays connected for 59 years.

CIVL '83—25th Reunion—September 5, 2008

The Civil Class of 1983 celebrated its 25th Anniversary with the Five for Twenty Five Alumni Affair. Spearheaded and conceived by Jack Gin (CIVL '83), this event invited third- and fourth-year students to have lunch and hear brief presentations of alumni career highlights. CIVL '83 enjoyed seeing the new developments in the department such as the Civil Design Studio, and students benefited from connecting with accomplished alumni. The event ended in true engineering style with beers in hand at the pub!



CIVL '83, still making wise cracks after 25 years.

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Email alumni.association@ubc.ca with your first name, last name, degree and year. Then sit back and wait for the good stuff.

Showcase of superior mettle—

Profile of UBC Engineering alumnus Bob Waldron

Sitting in his warehouse in Richmond, surrounded by recent wreckages under investigation, Dr. Bob Waldron takes a moment to reflect on his student days at UBC—but first can't resist noting a pile of twisted metal that was once a helicopter. "After doing this work for so many years, I sure am careful as to what I fly in," he says solemnly.

An expert on the forensics of helicopter and small-aircraft crashes, Waldron (Metallurgy BSc '65 and PhD '70) founded R. J. Waldron & Company, a Richmond-based consulting firm. He was awarded the prestigious Transport Canada

Aviation Safety Award in 2003 for his contributions to aviation safety.

Now semi-retired and living in the Vancouver metro area, Waldron lives an enviable lifestyle as a result of his successful career, balancing golf and fitness with an active social life and a few consulting cases.

Recalling his days as a student, he credits both his university education and social life for his success.

"When I came to UBC and was unsure of my career path," Waldron says, "I studied engineering because I didn't know what else to do."

He struggled financially as a student and was offered a free apartment at

one time. It was there that he met the Honorable Donald (Don) Brenner, who is now B.C. Supreme Court Chief Justice and a close friend of Waldron's. Brenner, who was going to law school and flying for Canadian Airlines at the same time introduced Waldron to aviation and airplanes, and thus began Waldron's lifelong passion for aviation safety, which has involved the investigation of hundreds of aircraft failures.

As the social coordinator of the Engineering Undergraduate Society in the early 1960s, Waldron was part of some of UBC's wild parties, including an event at the Scottish Hall that caused him to be reprimanded by a smiling Walter Gage.

Sporting the grin of a good-hearted yet mischievous engineering student, Waldron also confirmed another UBC legend. He and his friends once created a master key that could open almost any UBC building. Waldron confirms that it was used responsibly, and that upon their graduation, it was destroyed.

"The key sure came in handy when I ran out of money and slept in the Civil Engineering building, but we destroyed it because we didn't want it to fall into the wrong hands," said Waldron.

When it came time to think about graduate school, Waldron did not have high enough grades to qualify, but he completed a special exam and was granted entry. He went on to earn a PhD, and his career has taken him all over the world.

For several years Waldron served as a member of the UBC Materials Engineering advisory council, and he is glad to still see some well-rounded, generalist students graduating from UBC—especially those who combine engineering training with commerce, because they are well-suited to the country's largest employer, the small-business sector.

"The best thing my career has done is to introduce me to plenty of enjoyable, interesting people, many of whom we still enjoy seeing," said Waldron, "and that all started at UBC."



Alumnus Bob Waldron pictured in front of helicopter wreckage.

Alumni Update (continued)

Three generations of engineering graduates

Ken Henderson (UBC CHML '49), right, and his son-in-law Ernie Beisser (UWO BESC '81), left, were proud and honoured to co-present granddaughter/daughter Kristen Beisser with her Iron Ring last year upon her graduation from McMaster University. An added bonus for Henderson was to be reunited during the ceremony with a mentor from his UBC student days, Dr. Les Shemilt (far right), Professor Emeritus of Chemical Engineering at McMaster, Honorary Warden of Camp 13 and faculty member at UBC from 1947-60.



Iron rings for three generations.

Mark your calendars! Upcoming Alumni Events

- Mining Industry Dinner— January 31, 2009
- Old Red New Red— February 5, 2009
- Engineering Open House— February 27–28, 2009
- MECH '84— May 2009
- Alumni Weekend 2009— May 22–24, 2009
- GEOE '59— May 23–24, 2009

For event updates, please visit: www.engineering.ubc.ca/alumni

Dolby establishes professorship in Electrical and Computer Engineering

With a generous gift of \$400,000 to the Faculty of Applied Science, Dolby Laboratories, Inc. has established the Dolby Professorship in Digital Multimedia in the Department of Electrical and Computer Engineering (EECE).

EECE Associate Professor Panos Nasiopoulos has been named the inaugural holder of the endowed professorship, which will support his research into devices capable of capturing, compressing and delivering high-dynamic-range (HDR) images.

With hundreds of small light-emitting diodes, HDR technology replaces the single backlight in a typical LCD screen and provides contrast up to 500 times greater than that of the most advanced LCD and plasma TVs currently on the market.

HDR was invented at UBC and led to the establishment of BrightSide Technologies, which was recently acquired by Dolby.

“The multimedia and entertainment sectors depend heavily on highly qualified personnel, such as the students who will work on state-of-the-art HDR technologies in our labs,” says Nasiopoulos.

“Our close collaboration with Dolby Canada will give us a distinct competitive advantage and provide industry with a growing pool of scientific talent.”

In addition to the Dolby Professorship, Dolby Canada also recently established a term research Chair in Computer Science in the UBC Faculty of Science.

On October 20th, Dolby representatives joined members of the UBC administration, as well as students, faculty and staff, at a celebratory event to recognize Dolby’s generous support of UBC.

“We are grateful for Dolby’s recognition and support of UBC’s leadership in this eye-opening technology,” said John Hepburn, UBC Vice President, Research.

“The partnership will accelerate the development of HDR for industry and consumers.”

“Dolby aims to provide customers with technologies that improve the overall entertainment experience—whether it’s with the highest quality audio or image technology solutions,” said Steve Forshay, Senior Vice President, Research, Dolby Laboratories. “We’re eager to see the innovation that results from our support of education and collaboration with the University of British Columbia.”

Dolby is the global leader in technologies that are essential elements in the best entertainment experiences. Founded in 1965 and best known for high-quality audio and surround sound, Dolby innovations enrich enter-

tainment at the movies, at home or on the go.

The UBC Department of Electrical and Computer Engineering is honoured to hold a professorship in

Dolby’s name and looks forward to continuing the partnership in the fields of multimedia and entertainment technology.

From left: Steve Cockcroft, Applied Science Acting Dean; Lorne Whitehead, University Leader of Education Innovation, Professor and 3M Chairholder; John Hepburn, UBC Vice President Research; Steve Forshay, Senior VP Research, Dolby Laboratories; Helge Seetzen, Director, HDR Technology, Dolby Canada; Kevin Stec, Senior Director, Image Technology Research, Dolby Laboratories; Bill Aiello, Professor and Head, Department of Computer Science; Andre Ivanov, Professor and Head, EECE; Simon Peacock, Dean, Faculty of Science.

Seated from left: Wolfgang Heidrich, Associate Professor, Department of Computer Science and Dolby Research Chair in Computer Science; Panos Nasiopoulos, Associate Professor, EECE and Dolby Professor in Digital Multimedia.



Dolby Professor in Digital Multimedia Panos Nasiopoulos.

Educational enhancement

Mech 2 receives national curriculum award

Mech 2 received the 2008 Alan Blizzard Award for its “collaboratively designed and delivered program,” presented at the 28th Annual Society of Teaching and Learning in Higher Education (STLHE) conference.

Established to encourage, identify and publicly recognize exemplary collaborations in university teaching that enhance student learning, the award seeks to make visible and disseminate scholarship of teaching and learning, based on values and practices of collaborative teaching.

Mech 2, the mandatory second-year program for UBC Mechanical Engineering undergraduate students, aims to develop analytical, practical and design skills.

A radical departure from the conventional curriculum, Mech 2 incorporates content from 15 previously disparate courses into four main courses taken consecutively. These four courses include thoughtfully integrated lectures,

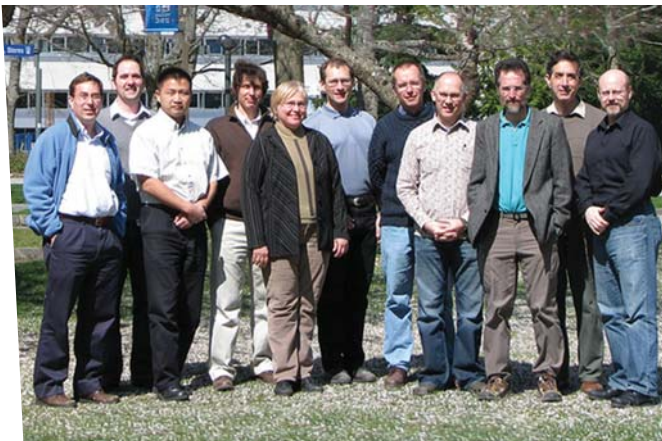
tutorials, labs, design projects, presentations, field trips and other activities. Integration, coordination and collaboration take place within courses as well as across the entire program.

Mech 2 students work closely with other students, 14 core faculty, over 50 teaching assistants and six technicians, ensuring good communication within the student teams and between the teams and administrators.

Student performance in senior-year courses has greatly improved following the introduction of Mech 2, and students have indicated a strong preference for the Mech 2 format over the conventional approach. Nearly 500 students have experienced Mech 2 since it began in 2004. The Alan Blizzard Award is the third major award Mech 2 has received in the last three years; it has also received the American Society of Mechanical Engineers Curriculum Innovation Award and the UBC Alfred Scow Award.

“I extend congratulations and appreciation to the Mech 2 team,” says UBC President and Vice-Chancellor Stephen Toope.

“The STLHE 2008 Alan Blizzard Award recognizes and applauds the Mech 2 team and project in the Faculty of Applied Science for outstanding innovation in collaborative teaching and learning. The words of one of the students succinctly capture the outcome: ‘Programs like Mech 2 make better students, better engineers and better people.’”



Mech 2 team from left: Warren Poole, Peter Ostafichuk, Joseph Yan, Steve Rogak, Tatiana Teslenko, Philip Loewen, Markus Fengler, Martin Davy, Sheldon Green, Gary Schajer and Antony Hodgson (missing from photo: Elizabeth Croft, Michael Schoen and Brian Wetton).

Achievements

Chemical and Biological Engineering Professor Emeritus **Richard Kerekes**, Mechanical Engineering Professor **James Olson** and Mechanical Engineering BSc graduate **David Goosen** won the prize for best paper 2007 in the *Journal of Pulp and Paper Science*.

Chemical and Biological Engineering Professor **David Wilkinson** has been elected Fellow of the Chemical Institute of Canada.

Civil Engineering Professor **Jonathan Fannin** has received the 2008 Award for Teaching Excellence from the Association of Professional Engineers and Geoscientists of B.C.

Civil Engineering Professor **Michael Isaacson** received the ISOPE Award at the 2008 International Offshore and Polar Engineering Conference.

Civil Engineering Professor Emeritus **Ken Hall** has received the Murray A. Newman Award for Aquatic Conservation from the Vancouver Aquarium.

Civil Engineering Professor **Greg Lawrence's** Tier I Canada Research Chair in Environmental Fluid Mechanics and Aquatic Systems has been renewed for an additional seven years.

Civil Engineering Professor **Alan Russell** has received two honours: he received (along with co-authors P. Tawiah, and S. De Zoysa) the Stephen G. Revay Award from the Canadian Society for Civil Engineering for best paper in the area of project management; and he was appointed the Tan Swan Beng Endowed Visiting Professor at the Nanyang Technological University of Singapore.

Electrical and Computer Engineering Associate Professor **Juri Jatskevich** has been appointed Associate Editor of the journal *IEEE Transactions on Power Electronics*.

Electrical and Computer Engineering Professor **Peter Lawrence** has been elected Fellow of the Canadian Academy of Engineering.

Electrical and Computer Engineering Professor **Victor Leung** has been elected Fellow of the Canadian Academy of Engineering.

Continued on page 16

Micro research with enormous potential

Tiny machines—smaller than the head of a pin—perform tremendous tasks in many fields, ranging from healthcare to the automotive industry.

Welcome to the intriguing world of micro-electro-mechanical systems (MEMS).

MEMS marry mechanical components such as actuators and sensors with micro-electronics, providing a virtually invisible tool for a vast array of purposes.

Electrical and Computer Engineering Professor Kenichi Takahata has recently been named Canada Research Chair in Advanced Micro/Nanofabrication and MEMS. As the Tier 2 Chair, he will work to ensure that these

tiny devices meet their enormous potential.

“We are focusing on bridging the gap between advanced engineering materials and the current design and fabrication of MEMS to bring innovative new ideas to this field,” says Takahata.

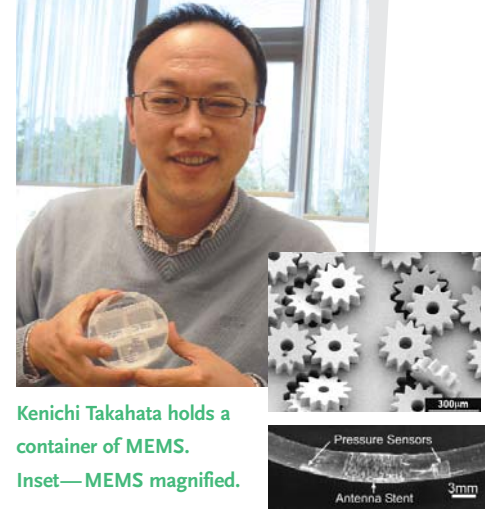
Historically made using semiconductor-manufacturing technology and a narrow range of materials, the mechanical abilities of MEMS have been limited.

Silicon, the material typically used for MEMS, tends to be delicate and functions best in a controlled, clean environment—obviously not optimal for use in biomedical implants.

An expert in micro-/nano-fabrication and devices, Takahata has developed novel fabrication techniques that can effectively diversify the materials from which MEMS are made.

His research has shown that “smart” implants can be made using micro-machined stainless steel, which is both strong and compatible with biological material. Used in cardiac stents, these smart micro-implants allow doctors to monitor blood flow and pressure at local sites wirelessly and better detect heart disease than with previous methods.

The Canada Research Chairs (CRC) Program is



Kenichi Takahata holds a container of MEMS. Inset—MEMS magnified.

designed to attract the best talent from Canada and around the world, helping universities achieve research excellence in natural sciences and engineering, health sciences, and social sciences and humanities.

This research and relevant infrastructure have been supported in part by Natural Sciences and Engineering Research Council of Canada (NSERC) and Canada Foundation for Innovation, along with the CRC program.

New rotor design brings reams of benefits

Technology saves energy equivalent of 15,000 homes

The pulp and paper industry, one of Canada’s largest manufacturing sectors, consumes more energy than any other industrial sector in British Columbia—nearly 20% of all the electricity produced in the province.

Pulp screening, an essential process that removes debris during paper making, consumes a significant proportion of this energy.

Imagine that we could halve the amount of energy consumed. Imagine the environmental and economic benefit. Imagine no longer...

UBC Engineering Professors James Olson, Carl Ollivier-Gooch

(Mechanical) and Mark Martinez (Chemical) are bringing this vision to reality.

Partnering with Dr. Robert Gooding of Advanced Fiber Technologies (AFT), they have helped develop an advanced screen-rotor technology that dramatically reduces the amount of energy needed in the pulp-screening process.

The novel rotor design decreases drag and operates at much lower speeds than conventional rotors. The uniquely-shaped hydrodynamic elements of the rotor provide an intense negative-pressure pulse that allows high capacity

even at low rotational speeds. The reduced rotor speed provides substantial power savings. The socioeconomic benefit of large-scale energy reduction could be substantial.

Approximately 30 mills and 100 new rotors in Canada have demonstrated energy savings of 40% to 50% over current state-of-the-art rotor technology—savings that also reduce greenhouse-gas emissions significantly and decrease the environmental load of the pulp and paper industry. If implemented in all Canadian mills, the new rotor technology has the

potential to save approximately \$20 million per year.

“Widespread industrial adoption of the new technology is the true measure of its success,” says Olson.

As a result of the success in the mill trials, the research team has won BC Hydro’s “New Technology of the Year” award (2007), NSERC’s Synergy Award for Partnership and Innovation (2007), and British Columbia Innovation Council’s Lieutenant Governor’s Award (2008).

This research has been enabled in part by NSERC, BC Hydro, AFT and Canfor Pulp Limited Partnership.

School of Engineering

New research

What's new this fall at the UBC Okanagan School of Engineering?

Six new faculty members investigating a broad range of topics, from power electronics to fluid dynamics, construction productivity to rock mechanics and environmental engineering. See bottom of page 15 for the complete list of new appointments. Here's one of the exciting topics currently under investigation...

Creating affluence from effluence

Joining the School of Engineering from the University of Ottawa in August 2008 is Assistant Professor Cigdem Eskicioglu.

Eskicioglu develops innovative biological treatment processes for the production of cleaner wastewater effluents. She also focuses on anaerobic digestion processes for turning organic residues—manure, food-processing waste, sewage and organic portions of garbage bags—into methane to generate heat and/or energy and produce nutrient-rich fertilizer.

“Disposal of these types of waste is already an economic burden on municipalities and industry and is getting more and more difficult because of increasing limitations on agricultural use, landfill disposal, incineration and ocean disposal,” says Eskicioglu. “Creating renewable energy from these wastes through anaerobic digestion will be beneficial.”

Eskicioglu has discovered that a specific electromagnetic pretreatment method—microwave irradiation at 2.45 GHz frequency—enhances methane production and the anaerobic decomposition of municipal biosolids, leading to less residual biosolid material being returned to landfills or agricultural land than with traditional processes.

In addition, microwave irradiation inactivates the pathogenic organisms transferred to food crops and leaching into groundwater. Eskicioglu recently received a five-year National Science and Engineering Research Council of Canada (NSERC) Discovery Grant to support her research on minimization of municipal biosolids.

Eskicioglu is also working with an industrial partner to examine mesophilic (moderate temperature) and thermophilic (warm temperature) digestion processes for methane production from bioethanol plant residues in an attempt to make existing and new bioethanol facilities fossil-fuel-free or energy self-sufficient.

“Renewable energy sources will shape the future of the world. Fossil-fuel dependency is not



Cigdem Eskicioglu conducting environmental engineering research.

sustainable, and because of its enormous environmental, economic and strategic advantages, renewable energy from biowaste should be a big component of the global energy strategy,” says Eskicioglu.

If this project is successful, methane from the anaerobic digester will power the bioethanol plant, and the organic by-products from the plant will be used in turn to generate the plant's own energy in an efficient and sustainable manner.

“As an environmental-process engineer, having opportunities to work on full-scale treatment projects has been extremely educational; however, my vocation lies in academia,” says Eskicioglu.

“I am enamored with discovering knowledge in the laboratory and sharing it in the classroom. I hope to help students understand that it takes very little effort to contaminate the environment and a tremendous amount of time, effort, innovative technology and money to make it safe again.”

This research has been enabled in part by NSERC, BIOCAP Canada, Environmental Waste International and Genesys Biogas Inc.

Nuggets of green energy... Continued from page 1

torrefied-wood pellets—pellets dried by heat to expel easily degradable, volatile ingredients—and steam-exploded pellets—pellets treated by steam to break fiber-wall structure and enhance lignin-binding strength.

B.C. is the centre of wood-pellet production in North America and roughly 90% of B.C.'s wood pellets are exported, including more than 500,000 tonnes to Europe. The B.C. wood pellet industry has grown by 20% each year over the last five years. More than 11,500 biomass (biological matter that can be used as fuel) installations in the European Union have generated over 260 million tons of CO₂ credits, valued at over €5 billion. The E.U. currently produces 4% of its electricity from biomass sources and intends to double its output by 2010 through the initiatives outlined in the E.U. Biomass Action Plan.

So why are wood pellets so popular in Europe and yet underutilized here in Canada? Bi lists, in order, the various

factors that influence decision making with regard to energy: economy, society and the environment.

“Canada needs to offer financial incentives, like Europe,” he says. “Residents there get green-energy credits for using wood pellets to heat their homes and run their factories. So not only is it the environmentally right thing to do, it's economically viable too.”

Bi teaches Green Engineering and Sustainability, one of the first green-engineering courses in Canada, focusing on multiscale engineering approaches to sustainability. The course involves life-cycle analysis and exposes students to industrial-ecology practices through presentations from local experts and hands-on projects related to community sustainable development.

Students have performed life-cycle analyses of electrical, diesel and biodiesel fuels for UBC campus utility vehicles; plastic versus china dining ware in food service;



Tony Bi (front row, third from left) gathers with BBRG group members in front of the the pilot-scale wood pellet storage test facility.

greenhouse-gas reduction options for the campus boiler house; and solvent recovery and recycling for Plant Operations. Bi hopes to develop the class into a core UBC Engineering course, applicable not only to chemical engineers but to all engineers.

“As a professional engineer and an educator, I feel that we should take the challenge to develop engineering solutions by inventing environmentally friendly technologies and green products so that the ecological ‘footprint’ of the technology and product

can be minimized,” says Bi.

“At the same time, I feel obligated to equip future engineers with green- and sustainable-engineering design skills so they can continue the current effort to develop transforming technologies for solving the seemingly unstoppable global-warming problem facing future generations.”

This research has been enabled in part by NSERC, BIOCAP, Agriculture and Agri-Food Canada (AAFC), BC Ministry of Forests and Range, and Wood Pellet Association of Canada.

Appointments

UBC Okanagan School of Engineering

Wilson Eberle was appointed Assistant Professor on July 1. His research specialty is the field of power electronics, particularly the development, simulation and modeling of improved switching power converters for low and medium power applications.

Cigdem Eskicioglu was appointed Assistant Professor on August 1. Her research interests in environmental engineering include microwave pretreatment for minimization of municipal biosolids, anaerobic digestion for biowaste

to energy, and computer modeling of wastewater and sludge treatment.

Kasun Hewage was appointed Assistant Professor on July 1. His research focuses on construction productivity improvement, human factors in the information technology in construction and risk management in construction.

Bahman Naser was appointed Assistant Professor on July 1. His research expertise is on environmental fluid dynamics, transient flow, water quality in distribution systems, sediment transport and computational fluid dynamics.

Dwayne Tannant was appointed Professor on July 1. His expertise is in rock mechanics, geotechnical engineering and engineering geology, with emphasis on applied research associated with surface and underground excavations in rock for civil and mining applications.

Claire Yu Yan was appointed Instructor I on July 1. Her research expertise is in the field of CFD (computational fluid dynamics), heat and mass transfer in multi-component fluid mixtures and thermal diffusion (thermophoresis).

New faculty at the School of Engineering, from left: Bahman Naser, Dwayne Tannant, Cigdem Eskicioglu, Kasun Hewage, Claire Yu Yan and Wilson Eberle.



Achievements

Continued from page 12

Electrical and Computer Engineering Associate Professor **Shahriar Mirabbasi** has received a UBC Killam Teaching Prize.

Electrical and Computer Engineering Professor **Resve Saleh** has received the Quality Award of the International Society for Quality Electronic Design.

Electrical and Computer Engineering Professor **Rabab Ward** has received the YWCA Woman of Distinction Award in the Technology, Science and Industry category.

Materials Engineering Professor **David Dreisinger** has received the Inco Medal of the Canadian Institute of Mining, Metallurgy and Petroleum.

Mechanical Engineering Professor **Yusuf Altintas** has received two honours: he has been reappointed the NSERC/Pratt & Whitney Chair in Virtual High-performance Machining and he has received the Pratt & Whitney Canada Research Fellow Award.

Mechanical Engineering Professor **Clarence de Silva** has been elected Fellow of the Royal Society of Canada.

Mechanical Engineering Professor **Robert Evans** has received two honours: he was shortlisted for the Donner Prize for his book *Fueling Our Future: An Introduction to Sustainable Energy*; and he received the 2008 Editorial Award from the Association of Professional Engineers and Geoscientists of B.C. for best article in its magazine *Innovation*.

Mechanical Engineering Associate Professor **Steve Feng** has been appointed the NSERC/Pratt & Whitney Associate Chair in Virtual High-performance Machining.

Mechanical Engineering Professor Emeritus **Philip Hill** has received the 2008 R.A. McLachlan Memorial Award from the Association of Professional Engineers and Geoscientists of B.C.

Mechanical Engineering Senior Instructor **Jon Mikkelsen** has received a UBC Killam Teaching Prize.

Mechanical Engineering Associate Professors **James Olson** and **Carl Ollivier-Gooch**, Chemical and Biological Engineering Associate

Professor **Mark Martinez** and VP of Technology at Advanced Fiber Technologies **Robert Gooding** have received the 2008 Lieutenant Governor's Technology Innovation Award from the British Columbia Innovation Council.

Mining Engineering Professor Emeritus **Janusz Laskowski** received the Lifetime Achievement Award at the International Mineral Processing Congress.

Mining Engineering Professor **Malcolm Scoble** has been elected Fellow of the Canadian Academy of Engineering.

UBC Okanagan Engineering Assistant Professor **Jonathan Holzman** made the UBC Okanagan's 2008 Teaching Honour Roll.

UBC Okanagan Engineering Assistant Professor **Mina Hoorfar** has received Pioneer's Award for Teaching Excellence from the UBC Okanagan School of Engineering.

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The Faculty's engineering activities include the following:

Departments and Programs

- Biomedical Engineering
- Chemical and Biological Engineering
- Civil Engineering
- Electrical and Computer Engineering
- Engineering Physics
- Environmental Engineering
- Geological Engineering
- Integrated Engineering
- Materials Engineering
- Mechanical Engineering
- Mining Engineering
- UBC Okanagan Engineering

Office of the Dean

- Business & Development Office
- Centre for Instructional Support
- Centre for Professional Skills Development
- Engineering Co-op Office
- Engineering Student Services

The Faculty participates in several research centres and laboratories including:

- Advanced Materials and Process Engineering Laboratory (AMPEL)
- Clean Energy Research Centre (CERC)
- Centre for Environmental Research in Minerals, Metals, and Materials (UBC-CERM₃)
- Institute for Computing, Information and Cognitive Systems (ICICS)
- Michael Smith Laboratories
- Pulp and Paper Centre

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