THE CANADIAN SOCIETY FOR MECHANICAL ENGINEERING
LA SOCIÉTÉ CANADIENNE DE GÉNIE MÉCANIQUE
SPRING/PRINTEMPS 2016

BULLETIN

SPECIAL ISSUE ON

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SPRING 2016

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COVER PHOTO: DR. MATHIEU PICARD IN HIS LABORATORY (UNIVERSITÉ DE SHERBROOKE)

Editor's Letter

I AM DELIGHTED TO INTRODUCE THIS SPRING 2016 ISSUE OF THE CSME BULLETIN. I feel privileged to be the new Editor-in-Chief, happy to embark on this new adventure. This issue would not have happened without the contribution of the editorial team members, Prof. Pouya Rezai, the associate editor, and Profs. Amy Bilton and Brendan MacDonald, the technical editors, and without help from Prof. David Sinton who served as Editor-in-Chief for the last two years, Prof. Ali Dolatabadi and Mr. Guy Gosselin. Of course, I do not want to forget Nina Haikara, our new art director, who simply does magic by transforming a collection of texts and pictures into this colourful *Bulletin*.

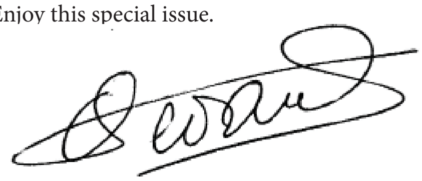
A big "thank you" to all our article contributors who made my task much easier than what I initially thought. We managed to have a good selection of different articles spanning a wide range of mechanical engineering activities from different places in Canada. In the next few issues, we will continue to feature articles showing the great diversity of the mechanical engineering discipline.

This special issue is on Mechanical Engineering (ME) research. For the sake of selection, we decided to focus on recent NSERC Discovery Accelerator Supplement (DAS) grantees, Prof. William Altenhof from the University of Windsor, Prof. Soo Yeon from the University of Waterloo, Prof. Jason Olfert from the University of Alberta and Prof. Liying Jiang from the University of Western Ontario. The recent DAS mandate is to promote novel research on the rise to the international level.

In this issue, you will find the Chair's Corner prepared by Prof. Zuomin Dong, University of Victoria, some excellent Research Highlights selected by Profs. Bilton and MacDonald, the new faculty spotlight series focused on Quebec with Profs. Batailly, Bégin-Drolet and Picard, and Alumni Q&A with Eldon Pierce. It is nice to see all the student chapter reports compiled from the University of Alberta, British Columbia Institute of Technology (BCIT), McGill University, Memorial University of Newfoundland (MUN), University of British Columbia – Okanagan, and University of Western Ontario. In particular, I want to give a warm welcome to the new student chapter additions, BCIT and MUN.

Unfortunately, we have to report the passing of Prof. Hugh McQueen, a Distinguished Professor Emeritus at Concordia University, whose obituary has been prepared by Prof. Martin Pugh, Chair of the Department of Mechanical & Industrial Engineering, Concordia University.

Enjoy this special issue.



CÉCILE DEVAUD, PhD, PEng, MCSME
Editor-in-Chief CSME Bulletin
Associate Professor, Department of Mechanical & Mechatronics Engineering
University of Waterloo

Je suis ravie de présenter ce numéro printemps 2016 du bulletin SCGM. Je me sens honorée de servir comme éditrice en chef, contente de commencer cette nouvelle aventure. Ce numéro n'aurait pas été possible sans la contribution des membres de l'équipe éditoriale, Pr. Pouya Rezai, éditeur associé, Prs. Amy Bilton et Brendan MacDonald, éditeurs techniques, et sans l'aide de Pr. David Sinton qui fut l'éditeur en chef ces deux dernières années, Pr. Ali Dolatabadi et M. Guy Gosselin. Bien sûr, je ne peux pas oublier Nina Haikara, notre directrice publication, qui sait user de sa magie pour transformer une collection de textes et images en ce *Bulletin* tout en couleur.

Un grand "merci" à tous nos contributeurs d'article qui ont rendu mon travail beaucoup plus facile que prévu. Nous avons réussi à avoir une bonne sélection de différents articles couvrant un vaste éventail d'activités en génie mécanique de partout au Canada. Dans les prochains numéros, nous continuerons à mettre en avant des articles montrant la grande diversité de la discipline, génie mécanique.

Ce numéro spécial est sur la recherche en génie mécanique. Pour faire une sélection, nous avons décidé de se concentrer sur les nouveaux récipients du CRNSG programme de supplément à la découverte, Pr. William Altenhof de l'Université de Windsor, Pr. Soo Yeon de l'Université de Waterloo, Pr. Jason Olfert de l'Université d'Alberta and Pr. Liying Jiang de l'Université de Western Ontario. La récente mission du supplément à la découverte est de promouvoir de nouveaux thèmes de recherche pour atteindre un niveau international.

Dans ce numéro, vous trouverez l'article "le coin du directeur" préparé par Pr. Zuomin Dong, de l'Université de Victoria, d'excellents articles de recherche sélectionnés par Prs. Bilton and MacDonald, une nouvelle série sur des nouveaux professeurs au Québec avec Prs. Batailly, Bégin-Drolet et Picard, et Questions-Réponses avec Eldon Pierce. Cela fait plaisir de voir tous ces rapports des chapitres étudiants provenant de l'université d' Alberta, l'Institut de Technologie de Colombie Britannique (ITCB), l'Université McGill, l'Université Mémorial de Terre-Neuve (UMT), l'Université de Colombie Britannique – Okanagan et l'Université de Western Ontario. En particulier, je souhaite chaleureusement la bienvenue aux nouveaux chapitres étudiants, ITCB et UMT.

Malheureusement, nous devons rapporter le décès de Pr. Hugh McQueen, un professeur éminent émérite de l'Université Concordia dont la nécrologie a été rédigée par Pr. Martin Pugh, directeur du département génie mécanique et industriel, Université Concordia.

Appréciez ce numéro spécial,

President's Message

IT HAS BEEN AN HONOUR TO SERVE AS CSME'S PRESIDENT for the last two years, where I had the pleasure of working with dedicated board members, technical chairs, and talented mechanical engineers in our society.

During the past two years, CSME has continued to progress in various fronts. While several new student chapters have been established, our national design competition has been instrumental in providing mechanical engineering students across Canada the opportunity to engineer, build and assemble their designs. For the benefit of many Canadian industries, we have been successful in inspiring Codes and Standards activities in our society.

Our Bulletin is now recognized as an efficient communication tool to connect mechanical engineers by highlighting and promoting innovation, research, and technical accomplishments among our members. I would like to take this opportunity to thank Dr. Sinton and his team for their hard work and brilliant ideas in the past two years and welcome our new enthusiastic editors Drs. Devaud and Rezai. I wish them and their dynamic team all the best.

I would like to congratulate Dr. Rosen for receiving the Stirling Medal and four of our high caliber members, Drs. Amirfazli, Behdinan, Janabi, and McPhee who were inducted fellow of the Engineering Institute of Canada (EIC) at the 2016 EIC awards gala for their significant contributions to the engineering profession. In addition, we have honoured our award recipients for their efforts in representing mechanical engineering profession at the highest levels. Three well-deserved CSME members at various stages of their careers received medals. We also inducted eight new CSME Fellows.

I am grateful to 2016 CSME Congress co-chairs, Drs. Najjaran and Hoorfar for their hard work and hospitality. Also my sincere thanks are given to Guy Gosselin (Executive Director) and Mohammud Emamally (Administrative Officer) for their endless support and devotion.

For the next two years, I will continue to serve CSME as the Past President and Chair of Awards and Ceremony Committee. As always, we welcome your comments and suggestions at any and every level. I strongly believe that with the continuous support of Board Members, Technical Chairs, and all of you dedicated members, we will only get better.

Sincerely yours,

ALI DOLATABADI, PhD, PEng, FCSME
Professor and Concordia University Research Chair –Tier I
Department of Mechanical & Industrial Engineering
Concordia University

Message du président

Ce fut un honneur pour moi de servir à titre de Président de la Société canadienne de génie mécanique (SCGM). Au cours des deux dernières années, j'ai eu le plaisir de travailler avec des membres du conseil et des directeurs techniques dévoués ainsi que des ingénieurs en mécanique talentueux. La SCGM a continué de progresser dans divers secteurs d'activités au cours de ces deux dernières années. Pendant que plusieurs nouveaux chapitres étudiants ont été établis, notre concours national de design a permis aux étudiants en génie mécanique à travers le Canada de machiner, construire et assembler leurs projets de conception. La section sur les codes et normes de la SCGM a permis d'aider plusieurs industries canadiennes.

Notre bulletin est maintenant reconnu en tant qu'outil de communication permettant de mettre en contact les ingénieurs en mécanique en soulignant et en faisant la promotion de projets de recherche techniques et innovateurs parmi nos membres. J'aimerais profiter de l'occasion pour remercier le Professeur Sinton et son équipe pour leur excellent travail et leurs brillantes idées et souhaiter la bienvenue à nos nouveaux éditeurs enthousiastes, les Professeurs Devaud et Rezai. Je leur souhaite la meilleur des chances.

J'aimerais aussi féliciter le Professeur Rosen pour avoir reçu la médaille John B. Stirling ainsi que quatre de nos membres de haut calibre, les Professeurs Amirfazli, Behdinan, Janabi et McPhee qui ont été élu au titre de « Fellow » de l'Institut canadien des ingénieurs (ICI) pour leurs contributions importantes à la profession d'ingénieur lors de la remise de prix de l'ICI 2016. De plus nous avons honorés nos récipiendaires pour avoir représenter la profession d'ingénieur à des niveaux supérieurs. Trois membres de la SCGM ont reçu des médailles bien méritées à divers moments de leurs carrières. Je me dois également de mentionner que huit membres ont été élus au titre de « Fellow » de la SCGM. Je suis reconnaissant envers les co-présidents du Forum de la SCGM 2016, les Professeurs Najjaran et Hoorfar pour leur excellent travail et leur hospitalité. Je tiens également à remercier Guy Gosselin (Directeur exécutif) et Mohammud Emamally (Agent administratif) pour leur soutien continu et leur dévouement.

Je vais continuer à servir la SCGM à titre d'ancien président et président du Comité de la cérémonie d'attribution de prix. Comme toujours, il nous fait plaisir de recevoir vos commentaires et suggestions sur tous les sujets. Je crois fermement qu'avec le soutien continuel des membres du conseil, des directeurs techniques et vous tous chers membres dévoués, nous continuerons à nous améliorer.

Sincères salutations,

CHAIR'S CORNER: PROFESSOR ZUOMIN DONG

A SYSTEMATIC APPROACH TO EXPERIENTIAL LEARNING AND ITS BENEFIT TO AN ACADEMIC PROGRAM

ZUOMIN DONG, PhD, PEng, FCSME. *Zuomin earned his BASc from Beijing University of Technology in 1981, received his PhD from the State University of New York at Buffalo in 1989, and immediately joined the faculty of University of Victoria. He has been the Chair of Mechanical Engineering at UVic since 2005.*

OVER MANY YEARS, the benefits of experiential learning have been widely discussed and successfully demonstrated by many leading education programs in Canada and worldwide. To some degree, experiential learning is a concept and practice more relevant to engineering and to Mechanical Engineering in particular. On the other hand, considerable efforts are still needed to find out how we could effectively incorporate this wonderful concept into the actual delivery of the Mechanical Engineering program to improve the learning experiences of our students.

Learning through experience and "learning through reflection on doing" is an effective path to allow students to play a more active role in learning to excel in a challenging environment. To systematically adopt experiential learning in the regular curriculum, and enrich it through broad and widely participated extra-curricular activities will add the needed challenges and excitement to the program, draw the attention from students in the program and beyond, and unlock their drive and imagination. We generally agree that the success of the research and education programs of an academic department largely depends upon how successful the unit can attract high-quality students, and motivate these students to reach their full potential. Experiential learning is a tool to facilitate the reach of these goals.

High-quality academic programs with balanced coverage of fundamentals and cutting-edge technologies, supported by up-to-date teaching laboratories and equipment, form the backbone of an excellent learning environment. Exposure to modern industrial applications and recent advances of research also play an essential role in engineering education. Experiential learning, in addition, brings life to theories from the book and inspiration to the routine experimental work. Most importantly, an excellent experiential learning environment can create some excitement and more challenges in an academic program, attract high-quality and passionate students to the program, and motivate students in the program to thrive beyond the normal expectation of a traditional academic setting.

Didactic learning still has its role in engineering education in providing students with the required theoretical knowledge on fundamentals in the early years of university education. Experiential learning, on the other hand, can be incorporated into the program starting in second and third year. Although embedded in a Mechanical Engineering program by nature, the degree to which experiential learning activities are embraced may vary dramatically. Conscious efforts to incorporate experiential learning activities with thoughtful design and implementation will pay off when these activities cover a broad scope and reach sufficient intensity.

Experiential learning can be fused into an academic program, and more effectively incorporated through various co- and extra-curriculum activities. Wide adoption of the open learning concept in the middle and upper-level courses will nurture an academic atmosphere that encourages students to play a more active role in learning, and to go beyond the normal assignment-and-exam template. Self-chosen and open-ended project motivate high-quality and innovative work.

Mandatory co-op programs associate classroom learning with day-to-day engineering practice, and implant learning naturally in hands-on practice. Co-op experiences in industry and research laboratories allow students to better appreciate the connection between university training and engineering practice. The first-hand experiences also demand the academic program to be more up-to-date in technology advances and industrial relevance.

Participation in the department's research programs through technical projects, co-op work terms, and honor theses provides students with essential research training, and prepares them for future graduate studies.

With enough diversity and high-quality co- and extra-curriculum activity programs, a more positive atmosphere can be formed to facilitate wide student participation due to the excitement of the work with the student teams, valuable training experience, and conceivable career opportunities. With the more competent and passionate students attracted to the program, the student teams have better chances winning various national and international competitions, adding to the reputation and excitement of the program, and accomplishing the goals of attracting high-quality students and motivating students to reach their full academic and leadership potential.

These high-quality, well-motivated and well-trained students also naturally feed to the department's graduate program and faculty members' research teams. Experimental learning, properly implemented, can very positively contribute to the success of the research and education programs of an academic department.

In our relatively small Department of Mechanical Engineering at the University of Victoria, faculty members have initiated and advised a broad scope of award-winning extra-curriculum student teams, including, a) Formula SAE race car competition and Formula Hybrid (EcoCAR previously) hybrid electric vehicle competition (on land); b) autonomous and remotely operated submersible vehicle competition (in ocean); c) SAE aeronautic competition of remotely controlled aircraft and international collegiate rocket engineering competition (in air); and d) Canadian satellite design challenge (in space). The department's teams were also the top award winners of a hydrogen re-filling station design competition in North America and the Electric Mobility Canada's student design competitions.

The broad scope, intensity and excellence of these programs boosted wide participation of students from all levels. One contributing factor to the successes of these teams is the close connection between the student teams to our research programs. The research programs bring expertise of the faculty members, leading-edge research knowhow, modern design and modeling tools, and industrial connections to the teams' work, adding more content to these experiential learning activities beyond the scope of the competitions. With proper encouragement and recognition, and better access of high-quality and well-trained incoming graduate students, faculty members enthusiastically initiated and advised these student teams with additional time commitment regardless of their heavily loaded research and teaching activities. Along the same line, the time and resource commitments from the department are well rewarded with more competent and motivated students. We can better achieve our goal and fulfill our responsibility to provide an exciting and rewarding learning experience to our students through a more dynamic academic program with improved excellence, innovation, and industrial relevance.

University is a place to educate the next generation, and engineering is the discipline to produce makers and leaders of the future for industry as well as research and academic institutions. Making the people involved, students, staff and faculty members alike, excited, encouraged and proud forms the foundation of success. Experiential learning is the tool to bring leading-edge research, industrial practice, and advanced technology into the classroom.

The following multifaceted approach tested in our Mechanical Engineering program has been largely successful:

- A wide-selection of technical electives that cover a wide variety of new subjects in addition to the traditional courses, such as hydrogen fuel cells, wind power, ocean energy, green vehicle technology, aircraft design, electron microscopy, sustainable energy systems, MEMS, bio materials and tissue engineering, etc.
- Getting undergraduate students into our research labs and programs through special lectures and course projects, co-op work terms, research projects, and honor theses with team work and public presentations.
- Award winning co- and extra- curricular activities in the form of student teams, advised and initiated by faulty members in the areas of their research, as well as mentored and led by graduate students with relevant thesis research.
- Mandatory co-op program with high -quality professional jobs at leading industrial companies and research institutions in Canada and worldwide.
- Opportunities to continuously work on research projects in the following graduate program with exciting career opportunities in leading technology companies.

These experiential learning activities serve as motivation for individuals, students and faculty, and binding force of the team to encourage excellence, innovation, high standard work and competitive spirit; and better prepare our students for their engineering career in the increasingly competitive international environment.

The success in embracing experiential learning depends upon the collective efforts of the academic unit with everyone contributing in their own ways. The healthy competition and hard-earned recognition make people motivated, excited, encouraged and proud. Mechanical engineering naturally forms a platform for experiential learning and team work. With effective incorporation of this open learning concept, we can improve the learning experience of our students, attract more competent and passionate students, and better prepare them for a successful career in the future.

PHOTO: SHUTTERSTOCK

The University of Windsor and NSERC make an 'impact' on novel and lightweight structural safety devices

Dr. **WILLIAM ALTENHOF,** P.Eng., *is a Professor within the Department of Mechanical, Automotive and Materials Engineering at the University of Windsor. Since 1999 Altenhof has focused his research efforts on material deformation typically dealing with safety applications. His areas of interest include, but are not limited to, automotive crashworthiness, design for structural safety, and occupant safety. His research group has developed a number of occupant and structural protection devices including a child restraint seat installation aid, a child restraint seat positioning device insert for premature infants, foam filled braided tubes and lightweight aluminum energy absorbing devices both which employ novel modes of deformation for energy dissipation. Altenhof is a registered professional engineer in the province of Ontario and he is also the acting Editor-in-Chief for the International Journal of Crashworthiness. He has received the PEO/OSPE Young Engineer Medal and the Society of Automotive Engineer's Teetor Award for excellence in Engineering Education.*

PHOTOS: UNIVERSITY OF WINDSOR

The implications of automobile accidents and injuries within Canada result in significant economic burdens costing Canadian Taxpayers well into the billions of dollars.[1,2] Importantly, such situations also result in the significant hardships and tragedies of personal injuries and death which are life-changing events. Any contribution which the engineering community can provide to structural safety systems, however small, has the potential to result in significant relief to the costs associated with injuries and accidents.

Researchers at the University of Windsor, directed by **William Altenhof**, PhD, P.Eng., have focused their efforts on attempting to develop novel and lightweight structural safety devices for a wide range of applications, including but not limited to, the fields of automotive safety, blast protection, and personal safety equipment. Through the support of the Natural Science and Engineering Research Council of Canada (NSERC) Discovery Grant (DG) Program, Altenhof and his students have developed novel energy dissipation systems, namely, a metallic foam filled braided tube assembly and aluminum extrusions subjected to a cutting mode of deformation. These energy dissipation systems are unique in the sense that they can be 'tuned' for a specific application and result in a desired force/displacement response and the corresponding deformation energy when each system is activated. Additionally, these systems may be applied in tensile, compressive, torsional, and transverse loading conditions and have proven effective and deform in a stable and repeatable fashion in quasi-static, impact, and blast loading conditions. These innovations have resulted in a North American patent[3] being awarded for the cutting technology applied to aluminum extrusions.

The recent renewal of Altenhof's NSERC-DG was very fortunate to be accompanied with an NSERC Discovery Accelerator Supplement (DAS) Grant. Altenhof wishes to focus his research group's efforts on the development of both passive and active adaptive energy dissipation devices. In the case of the active devices, these proposed energy absorbers will monitor critical aspects of a structure's state, including, but not limited to, aspects of kinematics, payload, and other conditions which may require a limit to the forces and accelerations which the protected entity(ies) should experience if a crash, impact or blast condition occurs. Given this input, the energy dissipation system will actively adapt or transform into a configuration which will attempt to achieve the desired force/displacement response if an incident occurs. Such active adaptive safety systems are currently non-existent and represent a possible significant contribution to the fields of structural safety, blast mitigation, and crashworthiness. Furthermore, given the massive personal and economic burden which injuries and vehicular crashes generate, the potential for significant practical benefits to society are high.

Research efforts within the field of structural deformation for energy dissipation require novel and typically large structural testing apparatus which are often costly. Funding from the NSERC-DAS has been and will continue to be used to develop these novel testing machines which are used for high rate loading of structures. Graduate students are currently designing a droptower impact carriage, which is a critical component in the large energy (80kJ) impact testing machine at the University of Windsor.

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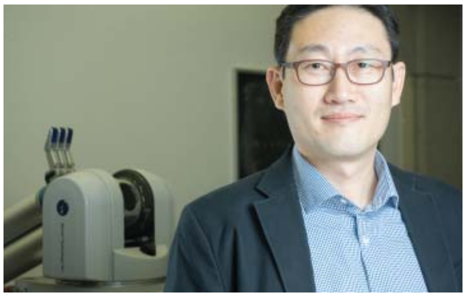
Learning from human motor skills

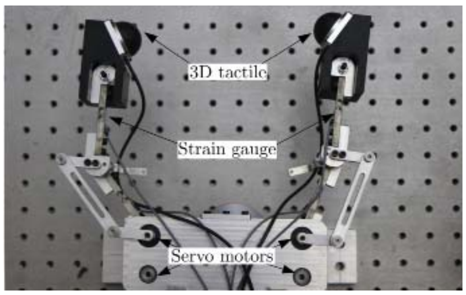


Despite the growing prevalence of automated applications for manufacturing and other activities, current robotic solutions pale by comparison with their human counterparts for complex and unpredictable tasks. Traditionally, motion control has pursued high-speed and high-accuracy trajectory tracking rather than natural, adaptable and dexterous movements. They enjoyed major success in factory environments (e.g. welding robot in automotive factories) but fail to adequately apply to unstructured and dynamic environments that require interaction with random ‘every-day’ objects or with humans. Even in simple tasks, such as reaching out for a cup, the most advanced robotic arm cannot approach the performance of a child in terms of adaptability, efficiency and dexterity.

Of course, the hardware of musculoskeletal systems is fundamentally different from that of artificial ones so the direct comparison may not be fair. Yet there are several features, from the side of sensing and control, that can explain why biological systems possess such a high level of dexterity and agility. Firstly, they are rich in sensing (visual, proprioceptive, force, position, tactility, etc.) and very efficient in integrating them for specific tasks. Secondly, humans improve their motor skills by practice, store them in some form of motor vocabularies, and reuse them for similar tasks.

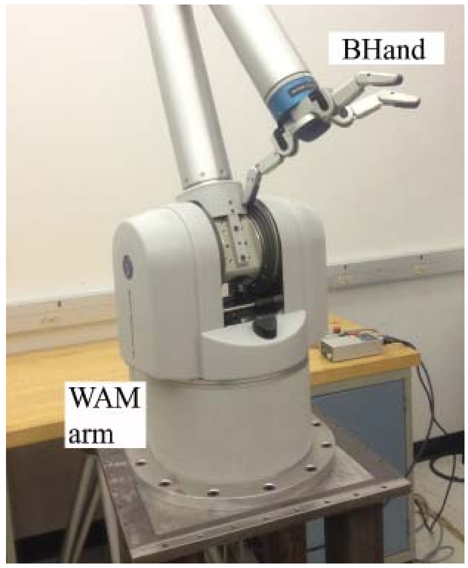
Dr. **Soo Jeon** at University of Waterloo is trying to leverage control engineering and sensory data processing techniques to bridge the gap between motor skills of artificial manipulators and those of humans. The first step toward this goal is to realize that we need a different paradigm in motion control. For example, designing control laws based on time-parameterized trajectories and inverse transformations, as is often done in conventional approach, does not fit well to the new task missions. One idea currently being pursued is to use the energy shaping control combined with the artificial gyroscopic force for direct path following in task space, which can be made free from any inverse transformations for reaching motion. Goal-directed arm motions typically comprise several movement stages; reaching, grasping and manipulating an object. How to arrange controllers for more smooth transition across these movement stages is another intuition we can draw on to realize more human-like dexterity.

In fact, understanding computational mechanisms behind human motor skills has long been a major subject of neuroscience. Robotics technology holds some potential to contribute to neuroscience and neuro-rehabilitation studies through sensory simulation, force-feedback, data logging capabilities, and so on. Recent funding from NSERC under the DAS (Discovery Accelerator Supplement) and the RTI (Research Tool and Instruments) programs enabled Dr. Jeon and other mechatronics engineers to team-up with neuroscientists at University of Waterloo to apply robotics technologies to neuroscience research as well as rehabilitation therapies for patients with neurological disorders.



SENSORY-RICH ROBOTIC FINGER

Automation and mechatronics technologies have been slowly penetrating our daily lives. Robotics, in particular, is considered one of a few modern technologies that has the potential to make an impact that is as transformative as the Internet (according to 2013 US Roadmap for US Robotics). In truth, there still remain many technical challenges, but it seems fair to say that robotics technology will make a broad impact on our society. At the least, it is a driving force behind new technological and scientific advances, and is fostering unique collaborations among experts from a wide range of disciplines
— *Professor Soo Jeon*



LIGHT-WEIGHT ROBOTIC ARM & HAND

DR. **SOO JEON** *is an Associate Professor in the Department of Mechanical & Mechatronics Engineering at University of Waterloo. He received his PhD from University of California at Berkeley in 2007 where he worked on sensor fusion for industrial robots. He is a recipient of Rudonph Kalman Best Paper Award from ASME in 2010 and currently serving as associate editor for ASME Journal of Dynamic Systems, Measurement and Control, and IEEE Transactions on Automation Science and Engineering. His current research is focused on applied instrumentation and robotics.*

PHOTOS: UNIVERSITY OF WATERLOO I ILLUSTRATION (LOWER RIGHT): SHUTTERSTOCK

Data inversion for better aerosol measurements

DR. JASON OLFERT PHOTO BY RICHARD CAIRNEY / GRAPHIC: CAMBUSTION LTD.

Jason Olfert, Associate Professor of Mechanical Engineering at the University of Alberta was recently awarded NSERC's Accelerator Grant, an additional $120,000 awarded based on the merit of an applicant's NSERC Discovery Grant.

Olfert studies aerosol science. "Aerosols are what we call particles when they're suspended in air," he explains. "I've developed a device that can accurately measure the various sizes of particles suspended in a sample of air and determine the range and distribution of particle sizes. It does this without electrically charging the particles, which causes problems in other instruments."

"The grant is to develop mathematical techniques, which doesn't sound very exciting" says Olfert, laughing. "But the technique will make my device much more useful to aerosol science and increase its applications."

Olfert developed his "aerodynamic aerosol classifier" in collaboration with a UK company, Cambustion. The classifier determines the range and distribution of particle sizes suspended in a sample of air by measuring their aerodynamic properties which, Olfert explains, are related to their size.

On his sabbatical from the University of Alberta in 2014-2015, Olfert worked with Cambustion in Cambridge to design and test a commercial version of the classifier. "Cambustion has been really great," says Olfert. "They've licensed the device and we've got patents in Canada, the U.S. and Japan."

With his Accelerator Grant, Olfert will develop a mathematical technique called data inversion, which will translate the raw data of the classifier into a readable and useful output. "CT scanners are a good example of how an inversion algorithm works," explains Olfert. "The radiation in the scanner sends signals to the detectors on the outside of the machine, which then need to be turned into a 2D picture. An inversion algorithm does that translation."

The inversion algorithm that Olfert develops with his Accelerator Grant will translate the classifier's data into readable measurements of aerosol properties, with various applications. "There are pharmaceutical applications, for example," says Olfert. "You can use the classifier to determine the size of pharmaceutical aerosols, which will tell you where the particles will deposit in the lung."

Olfert's NSERC Accelerator Grant will contribute to new knowledge and new applications in Canadian aerosol science.

Visit the Cambustion website (www.cambustion.com) for more information, including an animation of the classifier. *— by Robyn Braun*

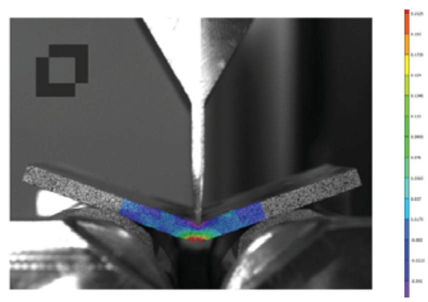
DR. **JASON OLFERT** *is an Associate Professor in Mechanical Engineering at the University of Alberta. His research is focused on developing novel aerosol instruments, characterizing particulate emissions from combustion sources, and understanding how aerosols affect global climate. Dr. Olfert's past and current research is focused on particulate emissions from internal combustion engines, gas turbine engines, flares, and burners. He has worked on the development of the centrifugal particle mass analyzer and aerodynamic aerosol classifier which are sold or licensed by Cambustion Ltd. Dr. Olfert has been awarded the Sheldon K Friedlander Award, Masao Horiba Award, and Fissan-Pui-TSI Award for his contributions to aerosol science.*

Impact...continued from page 7

Additionally, a dynamic tensile loading machine, to explore and quantify the mechanical performance of metallic foam filled braided tubes under impact velocities on the order of 50 m/s, is also being designed and engineered.

These novel machines and all the necessary transducers and data acquisition hardware and software will become important research tools for the development of novel and lightweight energy dissipation systems as a result of the financial support from NSERC.

Furthermore, funding from the NSERC-DG and -DAS programs will be used to support the development of highly qualified personnel and strengthen world-class collaboration with other experts and institutions. For example, the very rare and unique equipment for blast testing of the structures which Altenhof's research group is engineering, are tested with the collaboration between the Blast, Impact and Survivability Research Unit (BISRU) at the University of Cape Town in South Africa. Additionally, research activities at the University of Windsor, associated with the recently announced collaboration agreement between the University of Windsor, the University of Waterloo, and the German Aerospace Research Centre entitled "Novel Lightweight Technologies for Improved Crash Safety", will be supported through the use of the financial contributions of NSERC. These training environments will generate world-class and highly sought after engineers with unique capabilities for structural testing and human safety. *— Professor William Altenhof*



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[3] ALTENHOF, W.J., JIN S.Y., AND MAJUMDER A. KINETIC ENERGY DISSIPATION SYSTEM FOR DISSIPATING KINETIC SHOCK ENERGY. UNITED STATES. US 8,347,775 B2. 2010-05-01., DATE ISSUED: 2013-01-08.

Exploring fundamentals of smart materials for applications in transduction technologies

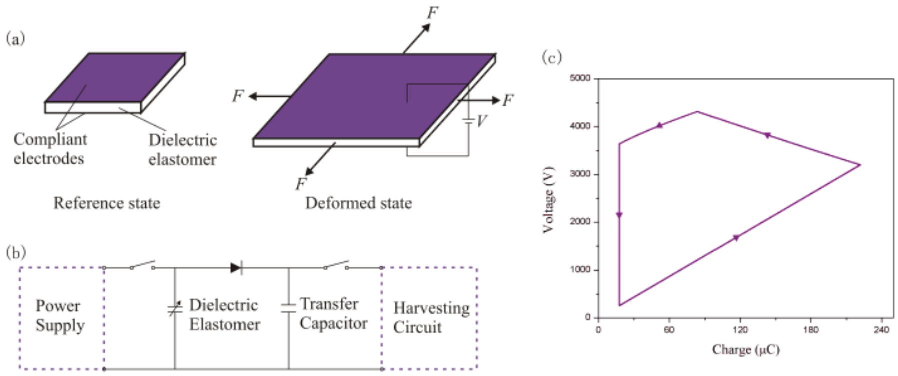
Electroactive polymers (EAPs) are smart materials that exhibit unique mechanical response to an external electric field, which enables engineering designs to have more innovative features and functions. As one family of EAPs, dielectric elastomers (DEs) have received growing interest in soft material-based transduction technologies recently due to their large deformation capability, high energy density, softness and flexibility. These outstanding features make DEs particularly attractive for large-actuation and high-power applications, such as artificial muscles, soft robotics, biomimetics and energy harvesters.

In recent years, DE structures have received much attention for the dynamics applications as resonators, oscillators, generators and waveguides. Since DEs respond to electrical stimuli, these DE-based devices with particular feedback electric circuits could be actively controllable and highly adaptive to the external environment. For example, the application of an electric voltage allows the resonator to have a wider range of resonant frequencies and compensate for the fabrication and environmental imperfection. For a DE waveguide application, it is capable of actively filtering waves in the prescribed ranges of frequencies since its band gaps can be adjusted by changing the applied voltage. It is obvious that DE-based devices could be uniquely designed with tunable capability for vibration and noise control, energy harvesting and guide of wave propagation.

In contrast to the large body of research on quasi-static deformation of DEs, dynamic analysis on finitely deformed DEs is very limited, particularly when involving material's intrinsic viscoelasticity. The lack of understanding the fundamentals underlying the electromechanical dynamics is certainly a major barrier for the full potential applications of DEs. In order to overcome this obstacle, Dr. **Liying Jiang's** research program aims to establish a rigorous modeling and simulation framework for characterizing the electromechanical dynamics of DE-based structures by a thorough understanding of the complex interplay among electromechanical coupling, material viscoelasticity, instability, geometric nonlinearity, and both mechanical and electrical integrity of DEs. Ultimately, we seek to provide insights for the development of multi-functional DE-based devices and DE-based metastructures with desirable properties that could be actively and intentionally controlled by electrical stimuli. This long-term goal will be realized through fundamental studies in two themes: performance analysis and prototype development of DE-based oscillators/resonators and generators; and investigation on wave propagation in DEs for tunable waveguide applications. Specifically, simulation results from our modeling will help to quantitatively understand the effects of material properties upon the dynamic electromechanical responses of DEs and how such responses could be tuned through the applied electrical stimuli.

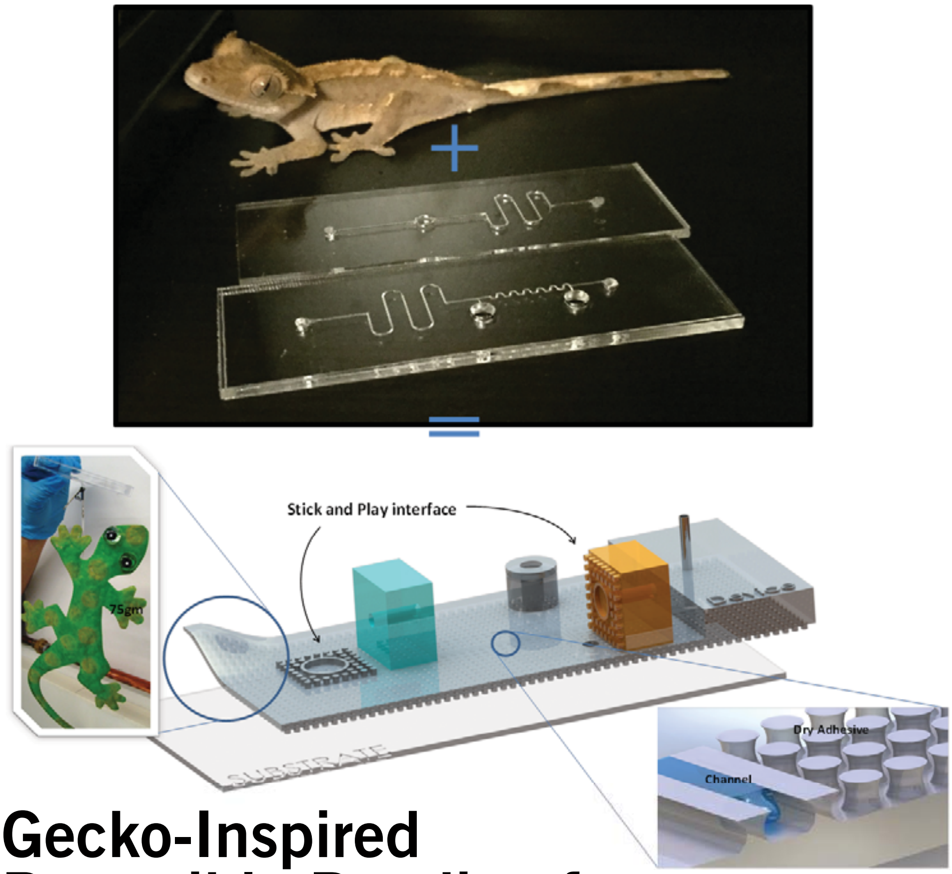
The originality and novelty of this fundamental study are twofold. One aspect is to close a knowledge gap for the research subject coupling nonlinear viscoelasticity and electromechanical dynamics which is still in its infancy, leading to a thorough understanding on the delicate multi-physics coupling mechanisms of DEs. The second aspect is the application features of the program for guiding the design of tunable DE-based devices as electromechanical transducers and waveguides. Fundamental modeling is indispensable in this research and will allow us to make novel and significant contributions to the science and technology of advanced smart materials by addressing the challenges of performance improvement for DE-based devices from the theoretical perspective. The proposed theoretical and numerical approaches are expected to provide a rigorous platform for accurately characterizing the electromechanical dynamics of viscoelastic DEs with finite deformation, thus leading to a better and controlled design for these smart materials in practical applications. *— Professor Liying Jiang*

FIGURE: SCHEMATICS OF A DE GENERATOR: (A) MECHANICAL RESPONSE OF A DE CAPACITOR TO AN ELECTRIC FIELD; (B) ENERGY HARVESTING CIRCUIT DIAGRAM; (B) A TYPICAL EXAMPLE OF SIMULATED VOLTAGE VS CHARGE CURVE FOR THE DE CAPACITOR DURING AN ENERGY HARVESTING CYCLE (DESIGN AND OPTIMIZATION OF THE ENERGY HARVESTING CYCLE COULD CHANGE THIS CURVE AND THUS IMPROVE THE PERFORMANCE OF DE-BASED ENERGY HARVESTER).



DR. **LIYING JIANG**, PhD, P.Eng., *is an Associate Professor in the Mechanical & Materials Engineering Department at Western University. She received her PhD from University of Alberta in 2005. Before she joined Western University in September 2006, she worked as a NSERC PDF at University of Illinois at Urbana-Champaign. Dr. Jiang's research focuses on theoretical modeling and numerical simulation to develop mechanics and physics models for challenging problems related to materials behavior, ranging from traditional composites, to smart materials, and to nanostructured materials. She is currently collaborating with Ford Motor Company USA on computational mechanics modeling of the mechanical properties of chopped fiber reinforced composites, aiming at establishing a comprehensive computation platform for automotive industry.*

HIGHLIGHTS



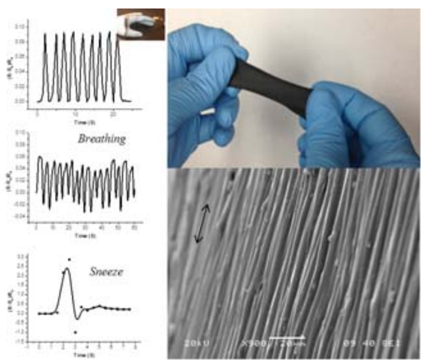
Gecko-Inspired Reversible Bonding for Microfluidics

Abdul Wasay and **Dan Sameoto** from the University of Alberta have recently developed a new concept for reversible adhesion for microfluidics applications. The approach is inspired from how geckos adhere to and climb walls. The adhesion is driven by van der Waals forces on surfaces that have been micro-textured to provide large adhesion areas. The method has been applied to climbing robots and pick and place tools in the past, but this was the first application for reversible adhesion in microfluidics. In the study, the team developed microfluidic channels which were sealed using the gecko-inspired adhesive fibers. To demonstrate the approach, the adhesive was fabricated using multiple grades of SEBS. The manufacturing used a compression molding process and was able to manufacture the bondable device in less than two minutes. The device burst pressures were evaluated for different substrates and was shown to withstand applied pressures of up to 100 PSI and exhibit the desired reversible adhesion properties. The method has advantages in terms of bond strength and ease of manufacture over standards PDMS reversible bonding. This approach could enable flexible stick and play interconnections for future microfluidics applications and a path for low cost manufacturing. — *Technical Editor, Professor Amy Bilton*

A. WASAY, AND D. SAMEOTO, "GECKO GASKETS FOR SELF-SEALING AND HIGH-STRENGTH REVERSIBLE BONDING OF MICROFLUIDICS," *LAB ON A CHIP*, VOL. 15, PP. 2749 2753, 2015.

SOMETHING TO CHEW ON: A STRAIN SENSOR BASED ON CARBON NANOTUBE/ CHEWING GUM MEMBRANE

Malcolm Xing and his team at the University of Manitoba have recently developed a novel approach to fabricate an elastic carbon nanotube (CNT)-based strain gauge to monitor bodily motions. The method aligns CNTs without using external excitations. The alignment is completed by simply depositing the CNTs on the gum, then completing multiple cycles of stretching and folding the gum in the same direction. The resulting sensor was linear in the range of up to 200% strain, could measure up to 530% strain, and was able to withstand 1000 stretch-release cycles. These properties outperform existing strain measurement methods. Bodily motions of finger movement and throat movement during breathing were used to evaluate the sensor. It was found that the sensor was very sensitive and was able to trace patterns of slow breathing. Currently, Xing is working with a clinical team to implant the device in the heart to detect the occurrence of myocardial infarction. — *Technical Editor, Professor Amy Bilton*



DARABI, A. KHOSROZADEH, Q. WANG, AND M. XING, "GUM SENSOR: A STRETCHABLE, WEARABLE, AND FOLDABLE SENSOR BASED ON CARBON NANOTUBE/ CHEWING GUM MEMBRANE," *ACS APPLIED MATERIALS & INTERFACES*, VOL. 7, PP. 26195-26205, 2015.

HOW CAN WE MAKE AIRPLANE SEATS MORE COMFORTABLE?

Passenger comfort is a critical issue for airplane travel. Since we are seated in aircraft seats during flights, they provide the main contact point between us and the airplane and are responsible for much of our comfort. One of the main factors impacting our comfort is the vibration we experience, and the amount of vibration that the seats transmit to our bodies is thus an important issue.

Atef Mohany and **Hossam Kishawy** from the University of Ontario Institute of Technology led a study to investigate the vibration and dynamic seat comfort of aircraft seats. They assessed the economy class seats by mounting them in a multi-axis shaker table, fastening a dummy to the seat, and using a seat pad accelerometer to measure the vibration response. They programmed pre-recorded vibration signals into the shaker table to simulate the conditions experienced during takeoff, landing, and cruising through turbulence. They found that the most discomfort is experienced during landing. Overall, the economy class seat was found to be fairly uncomfortable, but replacing the seat cushion with a business class seat cushion significantly reduced the vibration and increased the dynamic seat comfort of the economy class seat. They also found that adding a second dummy alongside the first, had little impact in reducing the seat comfort in relation to the vibration transmission. Airlines can use the results of this study to enhance passenger comfort and design more comfortable seats. —*Technical Editor, Professor Brendan MacDonald*

H. CILOGLU, M. ALZIADEH, A. MOHANY, AND H. KISHAWY. "ASSESSMENT OF THE WHOLE BODY VIBRATION EXPOSURE AND THE DYNAMIC SEAT COMFORT IN PASSENGER AIRCRAFT". *INTERNATIONAL JOURNAL OF INDUSTRIAL ERGONOMICS*, 45, 116-123, 2015.

SWIMMING THROUGH SAND

Many animals propel themselves by altering their body shape in a smooth wavelike motion, called undulatory locomotion. Examples include the swimming of lampreys in water, slithering of snakes on land, and the sandfish lizard (*pictured above*) – which burrows into the sand and swims through it. **Gwynn Elfring** and **Zhiwei Peng** from the University of British Columbia along with On Shun Pak from Santa Clara University have recently developed a mathematical model to characterize undulatory locomotion in granular media, like sand, and determine the optimal waveform to maximize efficiency. They demonstrated a method to control the orientation of a swimmer by adjusting features of the waveform, such as the amplitude and phase, which enables swimmers to follow complex trajectories and swim to targeted final destinations. They also showed that lizards in nature move with a profile that appears closely tuned for optimality. Ultimately their research helps to understand how we can design biomimetic robots capable of efficient and precisely controlled motion through challenging environments, such as sand. —*Technical Editor, Professor Brendan MacDonald*

PENG, O.S. PAK, AND G.J. ELFRING, "CHARACTERISTICS OF UNDULATORY LOCOMOTION IN GRANULAR MEDIA". *PHYSICS OF FLUIDS*, 28, 031901, 2016.

CSME'S 2016 MEMBERSHIP RENEWALS

In January, the CSME utilized MailChimp to e-mail renewal notices to its members. Switching to e-distribution helps lower administrative costs so more resources can be allocated to meaningful programs and benefits. Reminders have also been sent out recently. If you have not yet renewed your membership for 2016, please do so immediately using CSME's protected online payment facility (www.csme-scgm.ca/membership_renewal) or mail your payment to CSME, P.O. Box 40140, Ottawa, (ON) K1V 0W8.

Members for whom we have no e-mail address were mailed membership renewal notices via Canada Post. Going forward, everyone is encouraged to provide a valid e-mail address to facilitate communications. However, should you prefer to receive notifications through regular (snail) mail, simply advise us.

Thank you,

Mohammud Emamally
Administrative Officer
admin.officer@csme-scgm.ca
+1 613-400-1786

PHOTO TOP RIGHT: WILFRIED BERNS

NEW FACULTY SPOTLIGHT SERIES:

FOCUS ON QUEBEC

This recurring series highlights some new Canadian ME faculty members, by region. In this issue, we focus on *la belle province* – Quebec – with research highlights from Prof. Alain Batailly of École Polytechnique de Montréal; Prof. André Bégin-Drolet, Université Laval; and Prof. Mathieu Picard, Université de Sherbrooke.

École Polytechnique de Montréal, **Alain Batailly**

Blade/casing contacts in aircraft engines: analysis and numerical simulations
Contacts aubes/carter dans les moteurs d'avion: analyse et simulations numérique

New environmental regulations along with a very competitive economical context for airlines call for the development of ever more efficient plane engines. The reduction of blade/tip clearances in both compressor and turbine stages is one of the key strategies that manufacturers focus on in order to increase engines efficiency. However, as a counterpart of reducing clearances, more frequent structural contacts may occur between rotating components (such as the blades) and the surrounding casings (see figure 1). The challenge of accounting for such contact events-that were previously considered only in the context of accidental configurations-is twofold: firstly, dedicated numerical tools must be developed for the simulation of such highly non-linear interactions in order to, secondly, suggest relevant design criteria for the manufacturing of components robust with respect to structural contacts.

L'évolution des normes environnementales et un contexte économique particulièrement concurrentiel pour les compagnies aériennes imposent le développement de moteurs d'avion toujours plus performants. Pour ce faire, une des stratégies privilégiées par les constructeurs de moteurs d'avion est la réduction des jeux aubes/carter aux différents étages des compresseurs et turbines. Cependant, en contre-partie d'un gain de performance significatif, la réduction des jeux favorise l'apparition de contacts entre les composants tournants (tels que les aubes) et les carters environnants (voir figure 1).

Schematic representation of a plane engine with typical blade/casing contact areas (in red)

Depending on the engine angular speed, repeated blade/casing contact events may lead to undesirable vibratory phenomena detrimental to the running engine. In fact, interaction phenomena on a single blade or a single bladed disk have been witnessed experimentally. The development of a numerical strategy for the prediction of such interactions is the focus of Dr. Batailly and his students in the Laboratory for Acoustics and Vibration Analysis (LAVA) at the École Polytechnique de Montréal. In particular, the in-house code that has been developed for an industrial partner allowed for the numerical prediction of several types of blade/casing interactions initiated by structural contacts. The integration of this code within an industrial environment opened avenues for the definition of criteria stemming from non-linear dynamical simulations for the conception of plane engines bladed components (see Figure 2).

Vue de coupe d'un moteur d'avion et lieux privilégiés des contacts aubes/carter (en rouge)

La prise en compte de ces contacts - jusqu'à présent uniquement envisagés dans des configurations accidentelles - représente un défi à la fois numérique et théorique: il s'agit, dans un premier temps, de développer des outils numériques dédiés pour la simulation de ces interactions fortement non-linéaires pour pouvoir, ensuite, proposer des critères de conception pertinents pour rendre les structures robustes aux contacts.

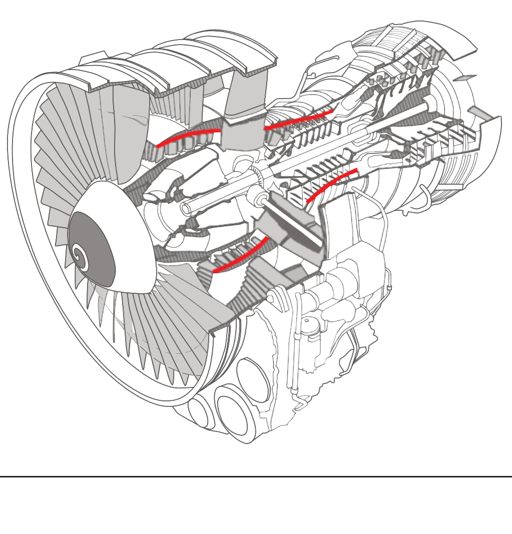


FIG. 1

FIG. 2

Des contacts aubes/carter répétés peuvent, dépendamment de la vitesse de rotation des aubes, être la cause de phénomènes vibratoires préjudiciables au bon fonctionnement du moteur. En particulier, des phénomènes d'interaction localisés sur une aube ou sur un étage du moteur ont été observés expérimentalement. Le développement d'outils numériques permettant la prédiction de telles interactions est au coeur des travaux de recherche du professeur Alain Batailly et de ses étudiants au Laboratoire d'Analyse Vibratoire et Acoustique (LAVA) de l'École Polytechnique de Montréal. Un code développé pour un partenaire industriel a notamment permis de prédire avec précision différents types d'interactions aubes/carter. L'intégration de cet outil dans un environnement industriel a ouvert la voie à la prise en compte de critères issus de simulations dynamiques non-linéaires (voir figure 2) pour la conception des aubes de moteurs d'avion.

Predicted displacement field on a fan stage following blade/casing contact events

Currently, the focus is made on developing a multi-physics numerical strategy. Several types of physical phenomena must be accounted for (such as thermal, structural and aerodynamic effects along with components wear). Concurrently, an in-depth analysis of blade/casing interactions must account for manufacturing imperfections (be it in terms of material properties

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Université Laval Professor, **André Bégin-Drolet**

Designing a better future through mechanical engineering – improving wind energy production in cold climate

Sustainable development is on everyone's lips these days. The concept stems from the Bruntland commission report Our Common Future published in 1987 and is broadly defined as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs". Energy is one of those basic needs and its production must be addressed for it to become more sustainable.

Fortunately, the last decades have seen renewable energy sources, such as wind energy, gain market shares all across the world. However, harvesting wind energy in Canada presents some challenges particularly due to the harsh climatic conditions.

Dr. Bégin-Drolet's research focuses on designing mechatronic systems used as sustainable development tools and a large portion of his work is oriented toward improving wind power production in cold climate where atmospheric icing is prevalent. Atmospheric icing is very difficult to monitor and to quantify due to the nature of the different incarnations it can take (freezing rain, hoar frost, rime ice, glaze ice, …).

Together with his colleagues Jean Ruel and Jean Lemay, he has developed what is now known as the Meteorological Conditions Monitoring System (MCMS), an integrated system that combines an array of sensors including wind speed, wind direction, air temperature, atmospheric pressure, relative humidity as well as two proprietary probes and their algorithms, used to detect atmospheric icing, including an estimation of the liquid water content, the severity of icing and the quantity of ice accreted on a given surface.

The MCMS is a smart sensor that can be used to manage the operation of wind turbines in cold climate and many purposes are foreseen for this sensor. It can be used to trigger and regulate anti-icing and deicing mechanisms when such systems are installed on the turbines.

The MCMS can also be used to derate or stop turbines that are not equipped with deicing mechanisms. It can be used as a tool to monitor the turbines and avoid excessive wear due to improper operation under icing conditions and the MCMS could also be used as a safety feature to mitigate the risk of ice projection.

Moreover, the MCMS can also be used during wind resource assessment to determine the type and the occurrence of icing on a future site, therefore reducing the financial uncertainties of a project.

Industrial partnerships have led to the installation of more than 20 MCMS on multi-megawatt wind turbines to explore the different avenues in which this smart sensor could be used. So far those partnerships have shown promising results and it is expected that the MCMS will play a major role into improving wind energy production in cold climate in the coming years.

DR. **ANDRÉ BÉGIN-DROLET** *is a Professor of mechanical design at Université Laval since January 2014. He received his PhD from Université Laval in 2012 during which he completed an internship at the Wind Energy Institute of Canada (WEICan) where he tested several sensors he had developed. Other than his research in the wind energy industry, Dr. Bégin-Drolet collaborates with McGill University researchers on the development of a bio-artificial pancreas to cure type 1 diabetes. For that project, he has developed a new 3D printer used to manufacture temporary sugar glass structures that mimic vascular networks. The final vasculature is obtained through rapid casting and once manufactured, these networks are used as perfusion channels to deliver oxygen and nutrients essential for cells survival.*

Université de Sherbrooke, **Mathieu Picard**

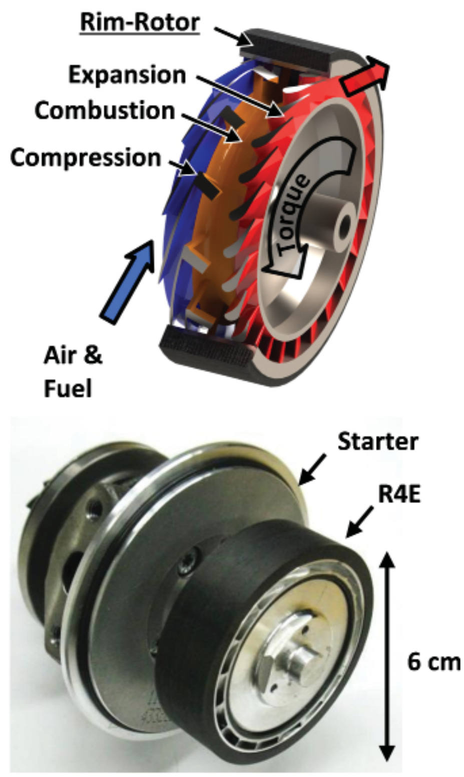
Alternative engines for efficient and sustainable transportation

The challenge we face in transportation is great and conflicting; we need to drastically cut greenhouse gas emissions while we crave for ever more powerful and capable vehicles, such as vertical take-off electric aircrafts, exhilarating hybrid cars, hypersonic jets, personal jetpacks, etc. Clean engines will play a key role in the transition toward a sustainable, yet more efficient, transportation systems. In the short to medium term, improving engine performance is one of the most economical strategy to reduce the impact of transportation on the environment. In the long run, alternative fuel-capable engines will be needed for high power density and long range applications. However, while materials and manufacturing capabilities have evolved rapidly in the last decade, engine technology progress has only been incremental.

Dr. Picard research program aims at developing alternative engines to improve both their efficiency and power density, while reducing their emissions. The approach is to leverage the progress in additive manufacturing and refractory materials to design gas turbines, reciprocating engines, and rotary engines adapted to high temperatures. This not only improves efficiency and power density, but also leads to the capability of burning low-calorific value biofuels.

The Rim-Rotor Rotary Ramjet Engine (R4E), developed in collaboration with Dr. Plante, Dr. Brouillette, and David Rancourt, is one of Dr. Picard's activities that best embodies the spirit of his research. The R4E performs the complete Brayton cycle in a single part rotating at supersonic tip speeds. An air-fuel mixture is first compressed by shockwaves in the inlet blades. The mixture then combusts quickly propagated by buoyancy under a centrifugal field of more than 1,000,000 g's. The products are expanded at high speeds through the nozzle blades generating thrust, that is then converted in shaft power. By his simple configuration, the R4E has the potential to be 10 times lighter than conventional small scale gas turbines, while achieving comparable efficiencies and burning any fuel. The feasibility of the concept has been demonstrated experimentally with a proof-of-concept prototype and Dr. Picard and his team are now pursuing research on derived technologies for highly-efficient and power-dense small-scale gas turbines.

AN EXAMPLE OF ALTERNATIVE ENGINE, THE RIM-ROTOR ROTARY RAMJET ENGINE (R4E)



DR. **MATHIEU PICARD** *started working on alternative engines during his master's degree at Université de Sherbrooke. He then continued his work during his PhD in Mechanical Engineering in the Sloan Automotive Laboratory at the Massachusetts Institute of Technology. After graduating and a short postdoctoral internship at MIT, Dr. Picard joined the Université de Sherbrooke Mechanical Engineering Department as an assistant professor where he leads the sustainable engine development efforts.*

Q&A:
Eldon Pierce

You graduated from University of Alberta in 2004, then joined University of Toronto in 2006 for your MASc studies. Tell us about your experience in this gap and why you decided to pursue a research path?

For the majority of this time I was living in Germany. I wanted to do something completely different after alternating between school and summer jobs for the better part of my life. It was an excellent experience; I discovered an aptitude for teaching and something of an inaptitude for conversational German!

After returning to Canada, I wanted to pursue a career in the field of biomedical engineering, which had piqued my interest during my undergrad. Up to that point, my professional experience consisted of a string of University-affiliated research positions, so an MASc felt like the next logical step. In retrospect, my graduate studies were not a prerequisite for my current work in the private sector, but I don't regret them. They were filled with many useful experiences, including the kinds of challenges that hooked me on engineering research in the first place.

What has been your responsibilities as a research assistant at Applied Research and Instrumentation in Alberta, Glenrose Rehabilitation Hospital in Edmonton, and Toronto Rehabilitation Institute? How has it helped you in your professional life?

In all three research groups, I worked on a short-term basis (e.g. as a co-op student), so I would carve out a small part of an existing program and push it forward to some interim goal. This goal was often a moving target and required persistence and a wide range of technical skills, so I learned a great deal. There were also strong communications components, such as presentations and papers, which were very useful to develop.

You have experience as an independent product development consultant. Tell us about the differences between a research-focused role and a consultation job.

I have worked as an independent consultant with an online retailer to develop a couple of different products for them. My approaches to engineering research and product development were actually quite similar. Previous research usually resulted in a physical prototype and the product development was at early stage, so it felt a lot like research. Even my relationship with the clients was familiar since they embraced a spirit of innovation and curiosity. I'm sure that I was very lucky to have clients that enjoyed the journey as much as the destination.

What are the components of ME education that you currently use in your job as a project engineer at Motion Concepts. Are you involved in R&D?

I work on a small engineering team that oversees a fairly large and dynamic product line, so I'm involved in R&D, but also directly in DFM, production, regulatory affairs, and supply chain management. On a daily basis, I use a range of skills from my ME education: solid mechanics, machining, CAD, FEA, and communications. Looking back, the parts of my education that remain most firmly engrained are those reinforced by extracurricular activities like Formula SAE.

Do you have any advice for students who want to pursue graduate level education in mechanical engineering? How is a Master's or PhD degree in this field going to help students prosper in their profession?

A Master's degree can be almost anything, depending on your supervisor and the study plan you agree upon. So any prospective student should spend a good deal of time thinking about what they want to get out of it. This process should not happen in a bubble! I was surprised to find that engineers in both academia and industry are very open to discussing my professional development, even if it was just a cold call.

I can think of a few ways that a graduate degree could benefit student's careers.

It is an opportunity to specialize, giving a competitive edge in the sector of your choice. This is important when most entry level job postings result in a large stack of generic resumes.

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UNIVERSITY OF ALBERTA

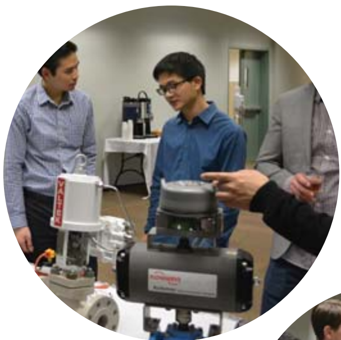
The Mechanical Engineering Club with the support of Mechanical Engineering Graduate Students' Association (MEGSA) hosted the "IPEIA Pipeline Codes Course".

The Codes Course is a one day course for undergraduate and graduate students to learn about pipeline safety codes that is enforced strictly within the Oil & Gas and other industries. The course is taught by **Rick Marsden** *(photo lower right)* the Facility Integrity Engineer at Cenovus Energy. The course focuses, in part, on disseminating knowledge and awareness of pressure equipment safety and reliability.

This event is an annual non-profit event that has been held by the Mechanical Engineering Club for several years. Any net profits that are generated from the event goes directly to support the volunteer, student development, and extracurricular efforts of the MEC E Club.

BRITISH COLUMBIA INSTITUTE OF TECHNOLOGY

BCITSA-CSME hosted a professional networking event for students. This gave students the opportunity to meet with professionals, ask questions and listen to short presentations.



CITSA-CSME PROFESSIONAL NETWORKING NIGHT

MAME INDUSTRY DINNER

McGILL UNIVERSITY

The MAME Industry Dinner was held on the evening of February 3, 2016 at the downtown McGill Faculty Club. It presented a very unique opportunity for leading companies to engage with McGill mechanical engineering students on a personal level as they networked over a fine three-course dinner and cocktail. The attendees this year included, Shell, Schlumberger, IPEX, National Instruments, Aviya Aerospace Technologies, Maya Heat Transfer Technologies, and two faculty members.

The event began with a quick hour of networking cocktail, where gourmet appetizers were passed around as the students networked and engaged with the industry representatives and invited professors. This was followed by the dinner during which each company gave a short presentation about their work and their recruitment procedure/criteria. The night ended with a quick round of speed networking.

ALL PHOTOS COURTESY OF STUDENT CHAPTERS

MEMORIAL UNIVERSITY OF NEWFOUNDLAND

On March 31, the Memorial University CSME Student Chapter held its debut public event, the first annual MUN CSME Design Competition. The event began with a meet and greet, where presenters socialized with attendees over refreshments. Six teams of senior engineering students then presented their design projects to an audience of professors, professionals, and fellow students. With excellent showings from all the competing teams, judges selected "Micro-Hydraulic Arm Design and Development" *(photo below centre)* as the winning project. This project consisted of a 3D-printed robotic arm, designed and fabricated by Nathan Ash, Kyle Doody, Landon Fisher, and Nicholas Martin. This arm was controlled by a joystick and hydraulic mechanisms, with a live demonstration lifting a whiteboard eraser. The winning team was awarded a monetary prize, and commemorated with an entry on the MUN CSME Design Competition plaque, to be mounted in the S. J. Carew building. The MUN CSME Student Chapter is very grateful for the financial support of the Canadian Society of Mechanical Engineers, as well as the financial support and guidance of the Memorial University Faculty of Engineering & Applied Science. We are thrilled by the success of our first event, and look forward to many more.

PHOTO LOWER LEFT: **ROBOTIC GRIPPER FOR AUTOMATIC CRAB MANIPULATION**

PHOTO LOWER RIGHT: **RENEWABLE ENERGY INTEGRATION STRATEGY FOR NAIN, NEWFOUNDLAND AND LABRADOR**

UNIVERSITY OF BRITISH COLUMBIA OKANAGAN

The CSME UBCO student chapters' drone build and racing event was a huge success! Throughout the day 25 students collaborated in five teams to create their quadcopter. Thanks to the mechatronics club, we had tools and workspace for building each drone. We gave each team the same materials, however it was interesting to see the structures students made from materials sourced elsewhere. One example is a group that used a coffee cup as their frame for a lighter machine. Once everyone was finished building they competed in different trials to see who had the best design. The winning team was awarded prizes provided by local sponsors. The students who participated in the event provided positive feedback for the competition and we are excited to build on what they said for next year's competition

WESTERN UNIVERSITY

The Resume Workshop was aimed at providing Mechanical Engineering students at Western University with tips and feedback on their resumes. Resume workshops are available through Western Engineering Career Services, however a distinguishing aspect of this event was the presence of both Kelly Sexsmith, the faculty's Career Services Officer, and Dr. Dave House, a professor at the Richard Ivey School of Business. This provided students with expert input from both an engineering and business perspective, something not readily available through regular Career Services workshops. Starting off with what each speaker expects in a successful resume, and then moving on into a question-and-answer session, the event was a success, leaving students more aware of what makes a resume effective based on industry feedback.

Chair, Mechanical Engineering, Lassonde School of Engineering

The Lassonde School of Engineering, York University is seeking an experienced academic leader at the Full or Associate Professor rank to lead the Department of Mechanical Engineering as its Chair for an initial five year term with the possibility of renewal. This role is a unique opportunity to continue to shape the future of a new Department by implementing visionary educational and research initiatives. The Department has recently launched new undergraduate and graduate programs. It currently comprises about 10 faculty members at all ranks, working in diverse fields of mechanical engineering, and plans to double its size within the next five years. We seek a colleague who will have an established national or international research reputation, relevant administrative experience, and a demonstrated commitment to excellence in teaching and innovative curriculum development and/or implementation. As the successful candidate, you will be an enthusiastic advocate for the Department, showing collegial leadership, furthering the quality of the academic programs, and building national and international partnerships with institutions in academia and industry. You will also implement the strategic vision for the Department, continue the acquisition of state-of-the-art infrastructure, and continue faculty recruitment. Candidates from all areas of Mechanical Engineering are encouraged to apply.

The successful candidate must have a first degree (BASc, BEng or equivalent) in Mechanical Engineering, and a PhD in Mechanical Engineering or related field. S/he should also be a licensed Professional Engineer in Ontario, or be eligible for immediate registration.

The following documents are required as part of the application package: (i) a cover letter concisely highlighting the qualifications of the candidate and other pertinent information; (ii) a detailed curriculum vitae highlighting career achievements in the areas of administrative service and academic leadership, teaching, research, and other information such as work related to program accreditation, scholarly work on pedagogy, awards/honors, interactions with industry, history of funded projects, and supervising student projects; (iii) three samples of the most significant and relevant scholarly work conducted; (iv) names and contact details (full mailing address, phone number, e-mail address) of at least three referees (we would contact the references after obtaining an approval from the candidate).

Applicants should complete the online application process at http://lassonde.fluidreview.com. The start date of the appointment will be no later than Jan 1, 2017 (or earlier by mutual agreement). An executive search company, Perrett Laver, will support the University in helping to identify the widest possible field of qualified candidates and assisting in the assessment of candidates against the requirements for the role. Consideration of candidates will begin immediately and continue until the position is filled.

All York University positions are subject to budgetary approval. York University is an Affirmative Action employer and strongly values diversity, including gender and sexual diversity, within its community. The Affirmative Action Program, which applies to women, Aboriginal people, visible minorities and people with disabilities can be found at http://acadjobs.info.yorku.ca/affirmative-action/ or by calling the AA office at 416.736.5713. All qualified candidates are encouraged to apply; however, Canadian Citizens and Permanent Residents will be given priority.

About the Lassonde School of Engineering

The Lassonde School of Engineering is one of the most ambitious projects in Canadian academia. This $250 million initiative includes hiring 100 new faculty and staff, expanding the student body by 1500, and fostering an inclusive and diverse culture committed to advancing gender parity. We have created a culture where tomorrow's professionals are becoming Renaissance Engineers™ – multidisciplinary problem solvers, critical thinkers, leaders and entrepreneurs who understand creativity, communications, social responsibility, and cultural diversity. Further information is available at http://lassonde.yorku.ca/

or in terms of geometry). These imperfections may lead to a mistuned system---for which the theoretical symmetry cannot be assumed-with a strong impact on its vibratory response, possibly featuring localised modes for instance. Accounting for components mistuning within a highly non-linear framework is key in order to assess the robustness of experimentally witnessed and numerically predicted interactions. This research work focuses on achieving a better understanding of the physical phenomena at play in blade/casing interactions. In the end, this work aims at the definition of relevant design criteria for rotating machine components undergoing structural contacts.

ALAIN BATAILLY *is an Assistant Professor in the mechanical engineering department of the École Polytechnique de Montréal. He is a member of the Laboratory for Acoustics and Vibration Analysis (LAVA)1. He obtained his PhD from the École Centrale de Nantes, in France, in 2008. His research focuses on rotor/stator interactions within turbomachines.*

Champ de déplacements prédit sur des aubes d'une soufflante à la suite de contacts aubes/carter

La mise en place d'une stratégie numérique multi-physique est présentement un axe de développement majeur: il s'agit de pouvoir prendre en compte numériquement plusieurs phénomènes physiques complexes de natures différentes (thermique, structurelle, aérodynamique, ou encore l'usure des composants). Dans le même temps, l'étude de telles interactions ne peut pas se faire en ignorant les imperfections de fabrication inhérentes aux composants des moteurs d'avion. Ces imperfections (aussi bien en termes de propriétés matériaux qu'en termes d'usinage) peuvent être à l'origine d'un désaccordage des roues aubagées-c'est-à-dire d'une rupture de symétrie-pouvant impacter très significativement la réponse vibratoire des composants. La prise en compte du désaccordage dans un contexte hautement non-linéaire est fondamentale pour estimer la robustesse des phénomènes d'interaction observés expérimentalement et prédits numériquement. L'objectif de ces travaux de recherche et d'acquérir une meilleure compréhension des phénomènes physiques en jeu dans les interactions aubes/carter. À terme, ces travaux ambitionnent de mener à la définition de règles de conception pour les composants soumis à des contacts structurels dans des machines tournantes.

Alain Batailly est professeur adjoint au département de génie mécanique de l'École Polytechnique de Montréal, il fait partie du laboratoire d'analyse vibratoire et acoustique (LAVA)1. Il a obtenu son doctorat à l'École Centrale de Nantes, en France, en 2008. Ses travaux de recherche se focalisent sur les interactions rotor/stator pouvant survenir dans les turbomachines aéronautiques.

PHOTO: BRIAN TRAN

University of Toronto ME student **Peter Wen** is the co-founder of TeleHex. His self-adjusting bike maintenance tool is smaller and lighter than other commercial hex keys.

It is also a great opportunity to network within that sector. Of course, it could also be a stepping stone to an academic research career. The academic path can feel like the default option in grad school, so as I said, it is very important to define it for yourself.

As a ME graduate who has experienced a few different career paths, is there any aspect of current Canadian ME programs & curricula that needs improvement or change? What might be possible changes/improvements in your opinion?

It is difficult to identify problems with my ME undergraduate program because I most recall a great deal of flexibility. The final year of my program had a large self-guided project component, and I was even able to incorporate an anatomy course into my schedule. Flexibility is absolutely the most important part of any program.

Industry involvement is one aspect that I think can't be encouraged enough. It can be hard for a young engineer to understand their place in the working world when they have little exposure to it. There are also some topics that only come to life outside of the classroom. For instance, I always took a keen interest in design for manufacturing, but I didn't gain any confidence in it until I started working with actual suppliers.

Some of the more recently established ME programs have moved towards a more interdisciplinary/multidisciplinary curricula, for example, incorporating courses across programs such as law and business or focusing on students' soft skills and leadership. What is your opinion about this approach to ME education and what might be the benefits and drawbacks?

I don't see any drawbacks at all. The fact that is most engineering positions require very robust soft skills, and these only become more important as you advance in the profession. Entrepreneurship is also very prominent among engineers, and I expect that we will see it become more prominent in a generation that was raised on crowdsourced startups and employment uncertainty. For engineering education to remain relevant, it needs to address these new attitudes toward work and innovation.

You have experience in designing instruments and devices for rehabilitation and medical purposes. What is your favorite development/device/product so far and why? Again, what aspects of your ME education do you use more?

My favourite project was a surgical tool that I developed for an arthroscopic surgeon during my undergrad. Accompanying the surgeon during procedures, I gained some very unique experiences and a few good stories. It was also my first time working on a multidisciplinary project, so my soft skills got a good work out.

In Memoriam

Dr. Hugh McQueen (1933-2015)

Only last fall, at the age of 82, as a Distinguished Professor Emeritus, **Hugh McQueen** was still engaged in metallurgical activities, giving presentations on historical aspects of metallurgical engineering, mentoring graduate students and participating in his Department. In fact, although he "officially" retired back in 1997, as far as his Department was concerned, his unofficial retirement was in mid-December 2015, when he passed quietly into the night.

He started his work with metals very early, actually in his summer holidays whilst at High School, helping on the repair of old ships at the place his father worked. After his degrees in metallurgy (McGill University and Notre Dame) he devoted himself to metallurgical research and the education of mechanical engineers. After teaching at École Polytechnique and working at CANMET, he joined Sir George Williams University (one of the precursor establishments of the current Concordia University) as an associate professor in 1968, and was soon promoted to professor in June 1972. He was instrumental in launching the first graduate program in engineering at Concordia and was a stalwart presence in the engineering faculty and the Department of Mechanical (and subsequently, Mechanical & Industrial) Engineering. He committed his career to the teaching and research of engineering materials and the general edification of students and faculty members. Hugh was also a benefactor, making generous endowments to the University to benefit students in engineering with scholarships.

One only has to look at some of the courses he developed and taught here at Concordia which include: Mechanical Forming of Metals, Materials Science, Impact of Technology on Society, Resources and Environment, Materials Engineering for Aerospace, Fracture, High Strength Materials, to see how closely his teaching and research were entwined. Many engineers in Canada

and elsewhere will have seen the movie on dislocations that Hugh produced (and was later released on the web). Distinguished researchers can attest to the research contributions that Hugh made to metallurgical research with his hundreds of papers and conference presentations on dynamic recovery, recrystallization and hot working, especially of aluminum alloys. He was a prodigious author and disseminator of research with latest records showing 499 publications as of 2014. The commitment that Hugh had to sharing both his love and knowledge of metallurgical engineering was phenomenal.

He was a dedicated educator and taught many students, some reluctant and some enthusiastic, about metallurgy and crystallography, dislocations and slip, recovery and recrystallization, elastic and plastic deformation. He made sure that mechanical engineers graduating from Concordia knew something about metals and how they behaved under load and why they behaved that way - essential knowledge for those engineers who will use these materials to build ships, planes, bridges and satellites. He truly wanted them to understand the behavior of metals like an expert and he made them better engineers for it.

He also made students aware of the impact of engineering and technology on society, through his teaching of the subject (e.g. energy savings through recycling of aluminum) but also by his actions – he rode a bicycle to work through sun, rain and snow up until his last months, as part of his commitment to sustainable living, using the same bicycle for 50 years.

In the past few years, Hugh dived into the historical aspects of metallurgy, especially the Victoria Bridge in Montreal, and as he became an expert on this subject his presentations were heard by many people in the general community, with most getting their first education on metals, forming, fabrication and metallurgy through his words.

In summary, Hugh McQueen made a great contribution to Canadian metallurgical and mechanical engineering through his education of two generations of engineering students (and other members of the community) and his research into hot deformation of metals. He is missed by those who knew him.

— **MARTIN PUGH**, *Professor and Chair Department of Mechanical & Industrial Engineering, Concordia University*

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Transportation Systems / Systèmes de transport	Ebrahim Esmailzadeh, FCSME	ebrahim.esmailzadeh@uoit.ca

PUBLICATIONS

Editor, **Bulletin** / Rédacteur, Bulletin	Cécile Devaud, MCSME	cdevaud@uwaterloo.ca
Associate Editor	Pouya Rezai, MCSME	pouya.rezai@lassonde.yorku.ca
Art Director / Directrice artistique et de la publication	Nina Haikara	bulletin@csme-scgm.ca
Technical Editors, Bulletin /	Amy Bilton, MCSME	bilton@mie.utoronto.ca
Rédacteur technique, Bulletin	Brendan MacDonald, MCSME	brendan.macdonald@uoit.ca
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Managing Editor / Rédacteur administrateur	Ilian Bonev, FCSME	ilian.bonev@etsmtl.ca
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CSME Address / Adresse de la SCGM

P.O. Box 40140, Ottawa, ON, K1V 0W8

Phone / Téléphone 613.400.1786 Email: admin.officer@csme-scgm.ca www.csme-scgm.ca

Publications Mail Agreement: 42977524 Registration: 7313893
Return undeliverable Canadian addresses to:
CSME
P.O. Box 40140
Ottawa, ON
K1V 0W8

The CSME would like to acknowledge the support from the following ME Departments:
La SCGM tient à remercier les departements de génie mécanique suivants pour leur aide:

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BCIT
Schulich School of Engineering, University of Calgary
Carleton University
Université Concordia University
Dalhousie University
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