



# BULLETIN

**SPECIAL ISSUE ON**

**WOMEN IN MECHANICAL ENGINEERING**



**FEATURE**

Engendering  
Engineering Success

PG. 7

**RESEARCH HIGHLIGHTS**

Energy-efficient  
walking robots

PG. 9

**NEW FACULTY SPOTLIGHT**

Manufacturing in the  
age of smart systems

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## CONTRIBUTE TO THE CSME BULLETIN

We welcome submissions of events, announcements, job postings, and feature articles relevant to mechanical engineering from researchers and engineers in Canada.

*Please send your input to:*  
**bulletin@csme-scg.m.ca**

# Editor's Letter



## WELCOME TO OUR SPRING ISSUE OF THE CSME *BULLETIN*! THIS ISSUE FEATURES

a special topic on women in mechanical engineering. We are honored to have the contributions from Profs. Mavriplis, Croft, Wells and Langelier to share their experience and work on this topic. It is quite amazing to see the large number of diverse initiatives put in place (and more to come, for sure) to increase the participation of girls and women in mechanical engineering and more broadly Science, Technology and Mathematics (STEM). I hope that in a near future, women in engineering will not need to be a special topic, with stereotypes and society norms evolving in the right direction, in particular in a country like Canada founded on cultural diversities. After reading the articles of this current issue and reflecting on my own experience, I feel fortunate of having had parents who supported my choice of studying mechanical engineering, in particular coming from a non-engineering or science family background. But, yes, there are some hard lived stereotypes and “subtle” comments that can slow professional female engineers down towards positions of greater status.

I let you discover the sections of the *Bulletin*. The new faculty spotlight series is focused on Western Canada with Profs. Morton, Jelovica, Ahmadi and Weyand. Unfortunately, this time, I did not manage to twist any arm for the Chair's corner... If you are a Department Chair willing to contribute, please do not hesitate to contact me. In fall, our special topic will be focused on the evolution of the mechanical engineering profession in connection with the 150<sup>th</sup> anniversary of Canada. We are looking for contributions reflecting on the past, present and future of mechanical engineering in Canada.

Enjoy this current issue,

**CÉCILE DEVAUD**, PhD, P.Eng., MCSME

*Editor-in-Chief CSME Bulletin*

*Associate Professor*

*Department of Mechanical & Mechatronics Engineering  
University of Waterloo*

Bienvenue à notre numéro du bulletin SCGM du printemps! Ce numéro comporte un thème spécial sur les femmes en génie mécanique. Nous sommes honorés d'avoir reçu les contributions de Prs. Mavriplis, Croft, Wells et Langelier qui ont partagé leur expérience et travail sur ce sujet. C'est assez impressionnant de voir le grand nombre d'initiatives en place (et plus à venir, c'est sûr) pour augmenter la participation des filles et femmes en génie mécanique et plus généralement en Sciences, Technologie et Mathématiques (STEM). J'espère, dans un futur proche, que le sujet des femmes ingénieurs ne sera plus un sujet spécial avec les stéréotypes et les normes de la société évoluant dans la bonne direction, surtout dans un pays comme le Canada fondé sur les diversités culturelles. Après avoir lu les articles de ce numéro et en réfléchissant à ma propre expérience, j'ai eu beaucoup de chance d'avoir des parents qui m'ont soutenue dans mon choix d'étudier en génie mécanique, surtout venant d'une famille sans ingénieur ou scientifique. Mais, oui, il y a des stéréotypes qui perdurent et des commentaires subtils qui peuvent ralentir les femmes ingénieurs dans leurs carrières vers des postes à plus haute responsabilité.

Je vous laisse découvrir les sections du bulletin. La nouvelle série sur des nouveaux professeurs des provinces de l'ouest du Canada présente Prs. Morton, Jelovica, Ahmadi and Weyand. Malheureusement, cette fois-ci, je n'ai pas réussi à convaincre un directeur de département pour l'article “le coin du directeur”... Si vous êtes directeur de département prêt à participer, n'hésitez pas à me contacter. En automne, nous aurons un numéro spécial sur l'évolution de la profession d'ingénieur mécanique en relation avec le 150<sup>ème</sup> anniversaire du Canada. Nous recherchons des contributions traitant du passé, présent et l'avenir du génie mécanique au Canada. J'espère que vous apprécierez ce nouveau numéro.



## President's Message

Dear CSME Members,

**WE ARE IN 2017 AND IT IS HARD TO BELIEVE THAT I AM ALREADY WRITING FOR THE** Spring issue of the *Bulletin*. Indeed, time flies so fast and as a community we have achieved a lot in the past six months. Our membership base has now grown to over 1,600 through the recruitment of many student members and four new sustaining members (BCIT, Simon Fraser, UPEI and Windsor) have joined, bringing the total number of mechanical departments/schools that belong to the CSME to 34 – a new record! I can feel the new energy and vigor in the society and countless volunteers who are putting huge amount of their time to ensure a stronger and a brighter future for the society. We embarked into several new initiatives, including: Board-approved negotiations to transfer the ownership of the journal *CSME-Transactions* to Canadian Science Publishing (CSP); a society-wide consultation process for a new five-year CSME Strategic Plan that will be presented at the upcoming board meeting; and organizations of CSME International Congresses on annual basis starting in 2018. This is all possible because of your dedication and commitment for the CSME, which I deeply appreciate.

Canada is and always has been a country that champions diversity and inclusivity. As a society, we also strive to pursue such endeavors. Hence, this spring issue is dedicated to women in Mechanical Engineering, showcasing how they are shaping the ME discipline and the overall impact it has for Canada. I encourage all Technical Committee chairs to ensure that we have diversity in their memberships, particularly encouraging women to be part of important leadership roles within CSME. Hopefully, these initiatives will lead to greater gender balance on our board and I earnestly request that you nominate deserving women candidates for our various board positions. I hope to see you all at our upcoming Board Meeting and Annual General Meeting on May 30<sup>th</sup> in the beautiful city of Victoria, BC and learn from you how you would like to shape the next five years of this amazing technical organization.

Best wishes,

**SUSHANTA MITRA**, PhD, P.Eng., FCSME, FEIC, FCAE, FAAAS  
*Professor, Mechanical Engineering*  
*Lassonde School of Engineering*  
*Associate Vice-President, Research*  
*York University*

## Message du président

Chers membres de la SCGM,

Nous sommes en 2017 et il est difficile de croire que j'écris déjà pour le numéro de printemps du *Bulletin*. En effet, le temps passe si vite et, ensemble, nous avons réalisé beaucoup de projets au cours des six derniers mois. Le nombre de membres dépasse maintenant les 1600 grâce au recrutement de nombreux membres étudiants. De plus, quatre universités (BCIT, Simon Fraser, UPEI et Windsor) se sont joints comme nouveaux membres souteneurs, ce qui porte le nombre total de départements / écoles mécaniques appartenant à la SCGM à 34 – un nouveau record ! Je peux ressentir la nouvelle énergie et la vigueur dans la société alors que d'innombrables bénévoles consacrent une grande partie de leur temps libre à assurer un avenir plus fort et plus brillant pour la société. Nous avons lancé plusieurs nouvelles initiatives, y compris : des négociations approuvées par le Conseil pour transférer la revue *CSME-Transactions* à la firme Canadian Science Publishing (CSP) ; un processus de consultation à l'échelle nationale pour un nouveau plan stratégique de cinq ans qui sera présenté lors de la prochaine réunion du conseil d'administration ; et l'organisation de congrès internationaux de la SCGM sur une base annuelle à partir de 2018. Tout ceci est possible en raison de votre engagement et dévouement pour la société, ce que j'apprécie profondément.

Le Canada est, et a toujours été, un pays qui défend les valeurs de la diversité et l'inclusivité. En tant que société, nous nous efforçons également de poursuivre de tels valeurs. Par conséquent, ce numéro du Bulletin est consacré aux femmes en génie mécanique, mettant en valeur à quel point elles façonnent notre discipline et l'impact global que leurs réalisations ont sur le Canada. J'encourage tous les présidents du Comité technique à faire en sorte à ce que la diversité de notre communauté soit reflétée sur leur comité, en particulier en encourageant les femmes à faire partie d'importants rôles de leadership au sein de la SCGM. J'espère que ces initiatives conduiront à un plus grand équilibre entre les deux sexes au sein du conseil d'administration et je vous demande de suggérer des candidats féminins méritants pour les différents postes du Conseil. J'espère vous voir nombreux lors de notre prochaine réunion du conseil d'administration et de l'assemblée générale annuelle, le 30 mai dans la belle ville de Victoria, Colombie-Britannique. Je compte apprendre de vous sur ce que vous souhaitez voir comme réalisations au cours des cinq prochaines années de cette incroyable organisation technique.

Salutations,



# Highlights of the Ontario NSERC Chair for Women in Science & Engineering 2011-2016

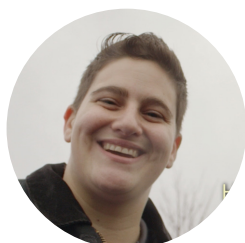
## THE NSERC / PRATT & WHITNEY CANADA

Chair for Women in Science and Engineering for the region of Ontario recently wrapped up its five-year term with a celebration of its accomplishments and giving thanks to the many participants and contributors. It was also an occasion to thank the sponsors, NSERC, Pratt & Whitney Canada and University of Ottawa, for this far-reaching project: more than 6,000 people were directly engaged in workshops, research or outreach activities in the 2013-2016 period alone. The bilingual Chair program has developed a strong following through a comprehensive communications campaign, meaningful professional development programming, engaging interdisciplinary research projects and strategic partnerships in the Science and Engineering (S&E) community.

The Chair program aims to address issues for the entire spectrum of girls to women, from early interest in schools, through university studies and professional lives, in particular at the mid-career level and on to leadership. The program is comprehensive in its approach to advancing women in S&E professions addressing:

- a. Recruitment to the professions
- b. Retention and advancement of professionals already employed in S&E sectors and
- c. The status of women and the S&E environment through interdisciplinary research.

These goals were pursued through: outreach and professional development programming, such as the new Go Code Girl program for girls adopted by 8 Ontario universities through ONWiE (Ontario Network of Women in Engineering); partnering with like-minded organizations and grassroots groups in campaigns such as the #WISELegacy project, that aims



women in S&E in collections such as our online #30in30 tableau of 30 women engineers in 30 days of National Engineering Month; researching factors influencing women's participation through interdisciplinary approaches, such as those examined in a Sociology PhD thesis looking at the lived experiences of mid-career women mechanical engineers in industry; and providing thought leadership in the national and international discussion.

Readers interested in recruiting students to Engineering programs might benefit from materials on the Chair website, such as the Techsploration videos of women in a number of different science, engineering and trades careers (some in French and most in English). Related to Mechanical Engineering are the stories of **Catherine Tsoulvaltsidis** (photo above, left) at Thoth Technology and **Rachel Vanasse** (photo below, left) at Brookfield Energy. Pratt & Whitney's video promoting their new PurePower® PW800 Engine featuring Development Engineer **Amanda Ennis** (photo above, right) is another visual way to recognize women's participation in and enthusiasm for Mechanical Engineering.

to create historical archives chronicling the accomplishments of Canadian women in S&E; a vigorous online communications campaign; featuring and archiving accomplishments of current professional



Professional development workshops were held for women (and men) in a number of areas. Master's of Communications student, Jerie Shaw developed and deliv-

ered Negotiation Skills in Male-Dominated Professions workshops for over 500 people in 9 cities in academia and industry, including Pratt & Whitney Canada. Pratt also benefited from Cultural Diversity workshops for men and women that were very well received. Professional development for professors through the "FORWARD to Professorship" workshop for pre-tenure candidates and the "Take the Final Step" workshop associate professors seeking promotion to full professor was also developed during the term of the Chair. These workshops are now held across the country with sponsorship through the National Network of NSERC Chairs for Women in Science and Engineering. The next workshop will be held in Hamilton, Ontario at McMaster University in June, while the most recent "Step-Up" workshop was held in St. John, New Brunswick in March.

On-campus, the Chair partnered with several other faculties and investigators to leverage our efforts and create new activities for students. A new Women's Startup Network in collaboration with NSERC Chair in Entrepreneurial Engineering Design Hanan Anis and Telfer School of Management Prof. Catherine Elliott (co-author of *Feminine Capital*) provides a mentoring and instruction program for women to build a technology venture as well as their entrepreneurial and professional skills. A collaboration with Faculty of Education Prof. Donatille Mujawamariya has led to a successful SSHRC Insight grant for an investigation of people's attitudes towards Engineering in the Service of Women. Graduate and undergraduate students are currently being recruited for these and other interdisciplinary activities.

The Ontario Chair works closely with the four other regional Chairs in Canada and with the international community. Currently, NSERC is busily preparing the program for the November 2017 international Gender Summit in Montreal with input from the five Chairs. Canada is proud to be showcasing its culture of diversity at this international event and has chosen the overarching theme of "Embracing pluralism and thriving through diversity – shaping science and innovation". Visitors will also have the unique opportunity of participating in Canada's 150th and the city of Montréal's 375th anniversary celebrations.

For similar programs and activities in the rest of Canada, speak to your regional NSERC Chair for Women in Science and Engineering or contact us at [cwsecfsg@gmail.com](mailto:cwsecfsg@gmail.com).

**CATHERINE MAVRIPLIS**, PhD, is an Associate Professor of Mechanical Engineering at the University of Ottawa. She is a graduate of McGill University and received her PhD in Aeronautics from the Massachusetts Institute of Technology. She spent 25 years in the United States, primarily as a faculty member at the George Washington University in Washington, DC. She holds the NSERC Chair for Women in Science and Engineering for the Ontario region and conducts research in Computational Fluid Dynamics.



ENGINEERING ANALYST RACHEL VANASSE AT BROOKFIELD ENERGY

# Early Engagement is Essential for Increasing Girls' Interest in Engineering

**TODAY IT IS STILL CONSIDERED AN** unusual decision for a woman to choose to study and work in the Canadian engineering profession. As the mother of three children, two of whom are teenage girls, I clearly remember thinking when my daughters were born that women would achieve parity across all professions by the time my daughters were ready to decide what career to pursue. Sadly this is still not the case, especially in my own field – engineering.

The call for more women in engineering resonates within government organizations, professional engineering bodies, and academic circles. There is an established consensus on the innumerable benefits that gender equity and increased diversity will bring to engineering fields. One of the main challenges regarding recruitment and retention of women in engineering continues to be the lack of female role models and knowledgeable people who have the ability to influence girls' early understanding of how engineers shape and

contribute to our world. From kindergarten to professional engineer, it is essential to ensure all girls and women feel they can belong in technical disciplines and are able to envision themselves having vibrant, fulfilling careers.

Ask a girl in elementary school what an engineer does and there is a good chance she will draw you a man in overalls with a cap, driving a train. Yet ask her what a doctor or teacher does for a living, and she will draw capable women with stethoscopes helping patients or reading to children (<https://www.youtube.com/watch?v=fhE4cChhkkk>). This lack of engineering narrative has been going on for a long time. Our surveys show that most women entering university for an engineering education have done so not because they heard good things about engineering in their daily lives, but rather, they chose engineering because a person they trusted (teacher, guidance counsellor or relative) suggested it. Here is a typical quote that highlights this from a recent female engineering graduate.

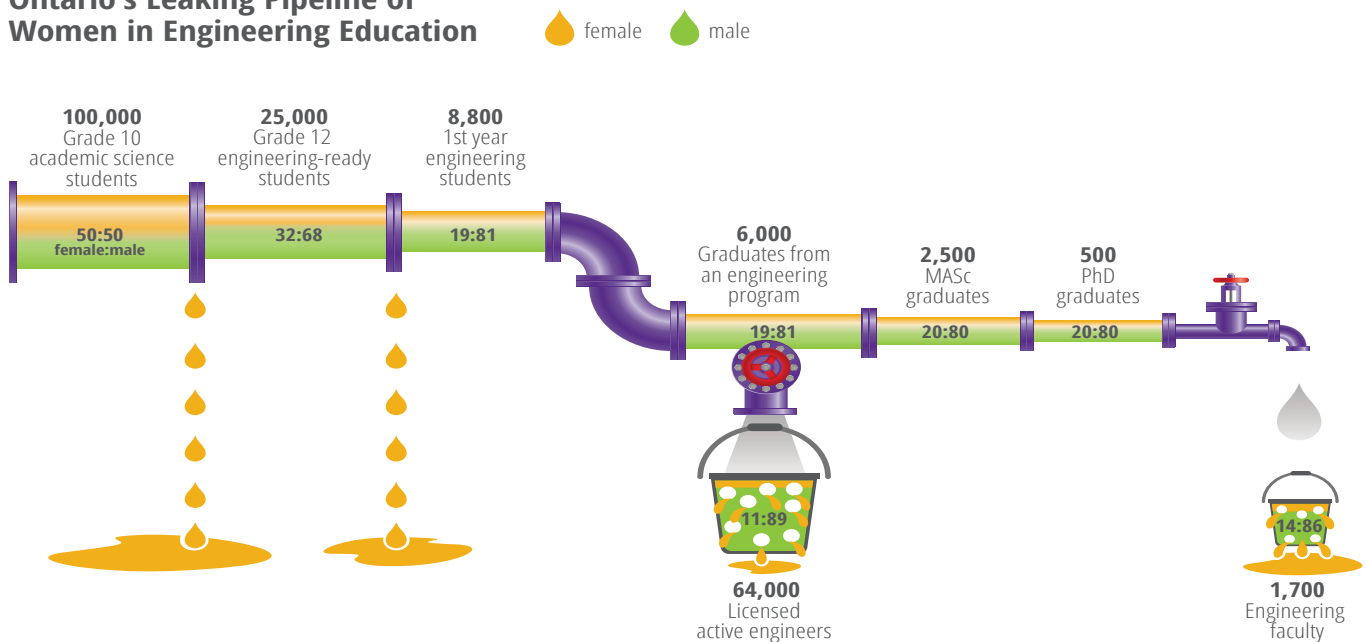
*"I remember discussing with my Dad what I should do after high school. He asked me if I liked science, math, problem-solving, figuring out how things worked, and helping people. I agreed whole heartedly with his list. My Dad then recommended engineering which I had never considered before. I'm so grateful I followed his suggestion as this field has opened so many doors for me,"* said Lyndia Stacey, BEng.

As part of my role as the Associate Dean of Outreach for the Faculty of Engineering at University of Waterloo, I examine where we lose women in our engineering profession. I call this the 'Leaking Pipeline' and have summarized my findings in Figure 1 below.

One of the largest leaks in the pipeline is the high school years where the fraction of female grade 12 students I call "engineering ready" (i.e. they have taken the required courses to apply to an engineering program) is significantly lower than grade 12 male students (33% women and 67% men). Surprisingly, it is not the advanced math courses that cause this divide but rather

... continued page 8

## Ontario's Leaking Pipeline of Women in Engineering Education







THROUGH ADVANCED RESEARCH, UBC MINING ENGINEERS MARIA HOLUSZKO AND AMIT KUMAR HAVE DEVELOPED A NEW PROCESS FOR MINERAL RECOVERY IN E-WASTE.

## Engendering Engineering Success

**WOMEN IN SCIENCES, TECHNOLOGY, ENGINEERING, AND MATHEMATICS (STEM) DISCIPLINES HAVE MADE GREAT STRIDES OVER** the past century. Presently, women make up 37% of Canada's undergraduate STEM enrolment, similar to most developed countries. Yet the participation of women in technology focused disciplines like engineering and computer science has stalled nationwide at 20%. Moreover, the further one looks up the ranks, the smaller the number of women. Meanwhile, the demand for STEM professionals is outstripping supply and the need for women to participate in developing the technology that will profoundly affect our society has never been greater.

Universities and colleges across Canada, supported by the efforts of the Natural Science and Engineering Research Council of Canada Chairs for Women in Science and Engineering, the Deans of Engineering and Science, industry and community groups, and many others are working hard to move the needle on the participation of girls, women and other diverse groups in STEM education. Companies like General Electric [1] are stepping forward and committing to hire many more women and minorities into STEM positions. With both pull and push in place there is much to celebrate, yet still much more to do to move a place where 'the face of our professions reflects the face of our society'.

As this diverse cohort graduates and moves into the workforce, the next challenge arises; namely, the significantly higher departure rate, particularly for women [2], from STEM careers due to outdated stereotypes and negative workplace cultures. Working with colleagues in social psychology and business our Social Sciences and Humanities Research Council supported Engendering Engineering Success Partnership Development grant looked at human resources policies and practices, including work-life balance, child and elder care supports, and flexible work hours, in Canadian organizations that employ engineers and how these policies and actual use and practice of the policies correlate with tenure and advancement of female engineers.

To understand company practices, we surveyed a Human Resources professional in each of 39 companies that employ engineers. The organizations represent six engineering sectors (Consulting Services, Utilities, Communications, Transportation, Government, Primary and Resource Industries, Construction and Manufacturing and High Technology). Our study found that the majority of companies reported offering training, career planning and mentorship to both men and women. A minority of companies had HR programs focused on recruitment, retention and advancement of female engineers. Very few companies reported having a policy of promoting women to senior positions, all else equal. We found that the tenure of men with their company was, on average, longer than for women and this difference was statistically significant. The tenure of female engineers was also positively related to the company's 'gender diversity performance' culture. A company with a high gender diversity performance culture is one that conducts ongoing measurement of diversity indicators and has a strategic goal to improve gender diversity.

We also surveyed 269 professional engineers (148 female; 121 male) and HR personnel at their employers. On average, men and women report more commitment to their organization when that company has gender inclusive policies and practices in place, where employees have positive attitudes toward those policies, and when they personally benefit from them. This pattern of results was also present for feeling valued and for intentions to leave.

Some clear messages arise from this work, and that of many others who are championing changes.

... continued page 8

To achieve diversity, organizations must understand and value diversity. If STEM employers and employees cannot articulate why it matters, then nothing will change. There are sufficient studies to support the case, many summarized in the briefing book by Parker et al. [3] and available as white papers ([www.sfu.ca/wwest/resources/white-papers/White-Papers.html](http://www.sfu.ca/wwest/resources/white-papers/White-Papers.html)).

Everyone can contribute and all can benefit from increased diversity. Male and female Leaders at all levels need to be aware of their own biases and work to eliminate workplace cultures, procedures or requirements that systemically disadvantage or deter women and other diverse groups from pursuing and staying in STEM careers long term. The evidence of gender bias in selection panels [4], resume review [5] and in assessing competence in person is overwhelming. Taking the Harvard implicit bias test at [www.implicit.harvard.edu](http://www.implicit.harvard.edu) can help open eyes.

The adage “what’s measured gets managed” applies. Goal-setting, continual improvement and best practices, accountability, and ongoing self-checks are required. Consider the sustained effort to create a safety culture in industry; an inclusive culture will require the same level of ongoing, focused determination to improve our profession. A perfect challenge for engineers.

To learn more about a new Canada-wide consortium for research aimed at tackling these issues, visit Engendering Success in STEM at [SuccessinSTEM.ca](http://SuccessinSTEM.ca).

1. L. Shen, “GE to Reach Gender Parity by 2020 with 5,000 Women STEM Hires | Fortune.com,” *Fortune.com*, 2017. [Online]. Available: <http://fortune.com/2017/02/08/general-electric-gender-parity-workforce-by-2020/>. [Accessed: 09-Apr-2017].
2. N. A. Fouad and R. Singh, “STEMMING the Tide: Why Women Leave Engineering,” Milwaukee, Wisconsin, USA, 2011.
3. R. Parker, J. Pelletier, and E. A. Croft, *WVEST's Gender Diversity in STEM: A briefing on women in science and engineering*. San Francisco, CA: Blurb, 2015.
4. C. Goldin and C. Rouse, “Orchestrating Impartiality: The Impact of ‘Blind’ Auditions of Female Musicians,” *Am. Econ. Rev.*, vol. 90, no. 4, pp. 715–741, 2000.
5. C. a. Moss-Racusin, J. F. Dovidio, V. L. Brescoll, M. J. Graham, and J. Handelsman, “Science faculty’s subtle gender biases favor male students,” *Proc. Natl. Acad. Sci.*, Sep. 2012.

**ELIZABETH CROFT**, PhD, P.Eng. FCAE is a Professor of Mechanical Engineering and Associate Dean, Education and Professional Development for the Faculty of Applied Science at UBC and a former NSERC Chair for Women in Science and Engineering (BC/Yukon).

**WILLIAM HALL**, PhD is a Postdoctoral researcher at the University of British Columbia.

**TONI SCHMADER**, PhD is Professor of Psychology and the Canada Research Chair in Social Psychology at the University of British Columbia.

**MICHELLE INNESS**, PhD is an Associate Professor of Strategic Management and Organization at the Alberta School of Business.

**NICOLE WILSON**, MSc, is a Doctoral Student in Human Resources Management and Industrial Relations at the University of Alberta School of Business.

**VALERIE DAVIDSON**, PhD, P.Eng., is Professor Emerita at the University of Guelph and a former NSERC Chair for Women in Science and Engineering (Ontario).

Grade 11 and 12 physics! In fact some schools and faculties of engineering in Canada are now actively discussing dropping the Grade 12 physics requirement as a way to open up the pipeline and create better gender diversity in the “engineering ready” pool. As educators, we must clearly communicate to young women the course requirements for applying to engineering programs across Canada, especially the need to take physics!

To combat these stereotypes and help girls envision themselves as future engineers, the Ontario Network of Women in Engineering (ONWiE) was launched in 2005. All schools and faculties of engineering in Ontario are members of ONWiE; hence it is well positioned to create tangible impacts on gender diversity in Canadian engineering education. Working collaboratively, the overarching purpose of ONWiE is to provide girls and women across the province of Ontario opportunities to explore and excel in engineering professions and to encourage the next generation of women to pursue careers in engineering. In 2005, ONWiE launched its flagship outreach program Go ENG Girl as a province-wide, bilingual (French and English) event for girls in Grades 7 to 10 and their parents to engage in engineering activities. Go ENG Girl has continued as an annual program across Ontario and has been so

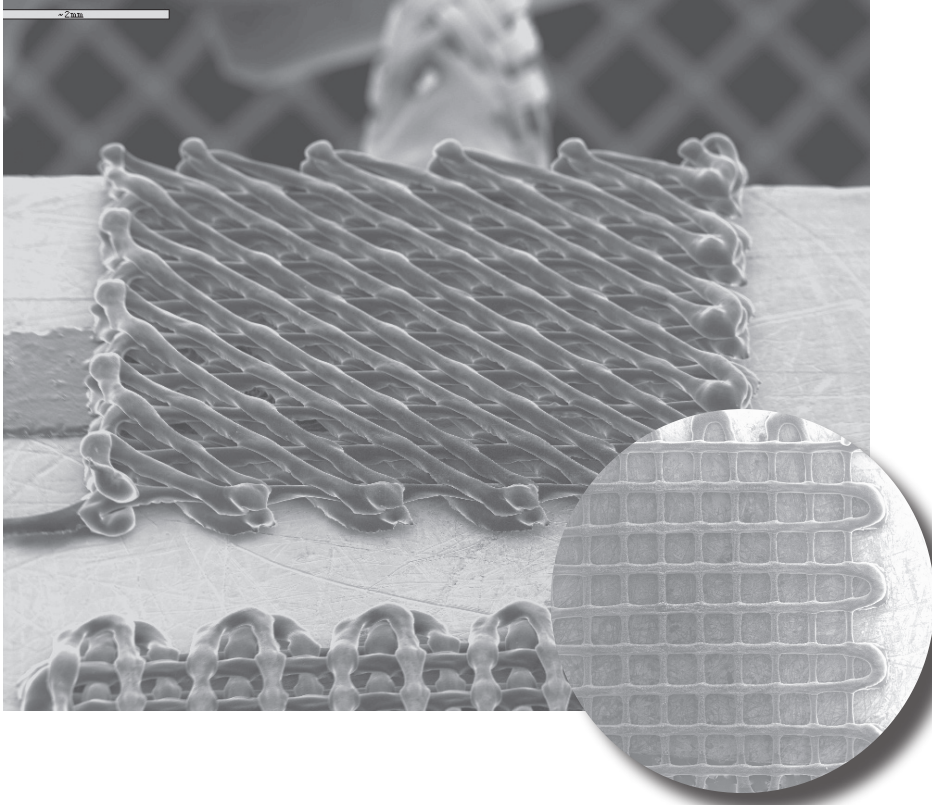
successful that it has expanded across Canada and is now offered at close to half the schools and faculties of engineering in Canada. ONWiE members also offer Girl Guide (grades 4-6) badge day programs in science and engineering as well as a more specialized Go CODE Girl event for girls in grades 7-10 to learn about computer and software engineering. As the current Chair of ONWiE, I can proudly say that we are making a difference in the Canadian engineering landscape. Since ONWiE was established, female enrolment in engineering programs across Ontario has more than doubled and we have collectively improved the engineering narrative.

In order to get more girls interested in engineering, we need to continue to tell our stories of who engineers are and how they help to make our world a better place to live. No longer is an engineer just the technical specialist who only does complex calculations; today, engineers are (and will be) the technical ambassadors that bridge the divide between technology and society. Our work has purpose and engineering is a meaningful career that continues to shape society’s future. I challenge all engineers to tell stories of why their profession matters and of the good work they do to improve people’s lives – especially to children. These stories are part of what will encourage our daughters, sisters, nieces and grand-daughters to envision their own future as engineers, bringing diversity and progress to our world.

**MARY A. WELLS**, PhD, PEng, is a Professor in the Department of Mechanical and Mechatronics Engineering as well as the inaugural Associate Dean Outreach for Waterloo’s faculty of engineering. In 2013, Dr Wells was appointed the chair of the Ontario Network for Women in Engineering (ONWiE). Dr. Wells is an accomplished researcher in the area of mathematical modelling of manufacturing operations including casting, extrusion, forging and forming and she examines the interdependency between processing, microstructure and properties for advanced metallic alloys. To improve the gender diversity of the engineering profession, Dr Wells has led a series of initiatives to uncover the root causes of the continued lack of participation of women in engineering as well as programs to address these barriers.



# HIGHLIGHTS



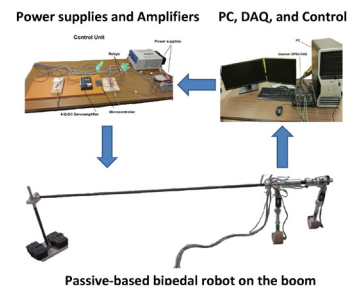
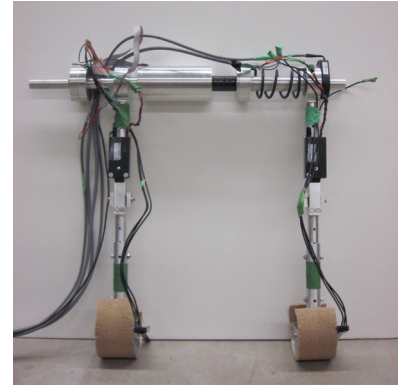
## 3D Printed Conductive Nanocomposites for Detection of Toxic Liquids

Could something that looks as simple as a cloth be the solution for oil pipeline leak detection? A research team consisting of **Kambiz Chizari**, **Mohamed Daoud**, **Anil Ravindran**, and Professor **Daniel Therriault** at École Polytechnique Montréal have developed a 3D printing based technique to produce a conductive nanocomposite for the detection of toxic liquids. The process combines a thermoplastic, a solvent, and carbon nanotubes to make a thick conductive ink. This ink is then applied using a printing process and hardens forming a mesh with filaments slightly larger than the thickness of a human hair. When the resulting conductive nanocomposite mesh is exposed to liquids, the mesh swells, changing the overall resistivity, allowing for detection of liquid contaminants. To date, the research team has been able to use the approach to identify acetone, isopropanol, and a few other liquids. The method can be applied in a range of applications, from detecting leaks in oil pipelines, to determining methane concentrations in fuel cell applications. The research team is currently studying electromagnetic shielding applications and also pursuing other innovative projects on the additive manufacturing of composites for aerospace applications. Interested Master or PhD students may contact Prof. Therriault. — *Technical Editor, Professor Amy Bilton*

ABOVE: CHIZARI, K., DAOUD, M.A., RAVINDRAN, A.R., & THERRIAULT, D. (2016). LIQUID MATERIALS: 3D PRINTING OF HIGHLY CONDUCTIVE NANOCOMPOSITES FOR THE FUNCTIONAL OPTIMIZATION OF LIQUID SENSORS (*SMALL* 44/2016). *SMALL*, 12(44), 6176-6176.

RIGHT: M. ALGHOONEH, C. Q. WU, AND M. ESFANDIARI, "A PASSIVE-BASED PHYSICAL BIPEDAL ROBOT WITH A DYNAMIC AND ENERGY-EFFICIENT GAIT ON THE FLAT GROUND," *IEEE/ASME TRANSACTIONS OF MECHATRONICS*, VOL. 21, NO. 4, AUGUST 2016.

## ENERGY-EFFICIENT WALKING ROBOTS



Walking robots have been growing in prevalence in the past decade, but they have tended to be inefficient. A research team at the University of Manitoba, consisting of Professor **Christine Wu**, Dr. **Mansoor Alghooneh**, and Dr. **Masoumeh Esfandiari** have developed an energy efficient method for bipedal robot locomotion. The concept extends the ability of passive walking robots to move on surfaces with a slight declined slope. The robot has three degrees of freedom, an active hip joint, and two passive knee joints connected via pylons to rounded feet. It has a compliant hip actuation system enables the robot to exploit its natural gait to complete more than 60% of its walking gait with no external actuation or control. As a result, the robot can walk on flat ground with comparable energy efficiency seen in humans. Future work will utilize all the insights acquired through the development and experimentation, to develop a lower-body exoskeleton for efficient gait rehabilitation and mobility assistance.

— *Technical Editor, Professor Amy Bilton*



## BREAKING THE GLASS CEILING

### Cristina Amon

Dr. Amon started her journey as an undergraduate student in Mechanical Engineering at Simón Bolívar University in Venezuela and now appointed as the Dean of the Faculty of Applied Science & Engineering and Alumni Chair Professor of Bioengineering in Mechanical & Industrial Engineering at the University of Toronto since 2016 – an exemplary leader for which the entire mechanical engineering community feels proud.

Professor Amon has created programs that foster collaborative scholarship, deepen and strengthen the student experience, encourage active learning, enhance diversity, accelerate research impact and spark innovation. With more than 5,400 undergraduates, 2,400 graduate students, 260 faculty members and 300 research and administrative staff, and an annual operating and research budget of over \$210 million, U of T Engineering is a dynamic community known for excellence in experiential learning and multidisciplinary research. It is consistently ranked among the world's leading engineering schools.

In terms of her research leadership, she is a pioneer in the development of Computational Fluid Dynamics for formulating and solving thermal design problems subject to multidisciplinary competing constraints. Her research at U of T in nanoscale thermal transport in semiconductors, energy systems and biomedical devices has generated 16 book chapters, more than 350 refereed articles and numerous keynote lectures worldwide.

Prior to joining U of T, Professor Amon was the Raymond J. Lane Distinguished Professor and Director of the Institute for Complex Engineered Systems (ICES) at Carnegie Mellon University in Pittsburgh. As Director of ICES, she conceived and led multidisciplinary research initiatives, launched university-wide team-based product design courses, fostered a culture of innovation, seeded high-impact projects with financial support raised from the state government, and promoted strong interactions with the regional industry and local community.

She is active on several executive boards and in professional societies. Professor Amon is chair of the research committee of NCDEAS (National Council of Deans of Engineering and

Applied Science in Canada), founding chair of the Global Engineering Deans Council, and has served on advisory boards for several institutions, including Stanford University, University of California Los Angeles, University of Illinois Urbana-Champaign and the University of Waterloo, and Foundations for Science, Engineering and Technology in Brazil, Chile, Germany, Hong Kong, Ireland, Qatar and Portugal.

Her academic and professional achievements have been recognized at the highest international levels. Professor Amon has received the American Society of Mechanical Engineers (ASME) Gustus Larson Memorial Award, American Society for Engineering Education Westinghouse Medal and the ASME Heat Transfer Memorial Award. In 2011, she was conferred the Society of Women Engineers' (SWE) highest honour, the SWE Achievement Award, for her outstanding contributions to engineering over more than 20 years. In the same year, she was also the recipient of the prestigious YWCA Toronto Woman of Distinction award, celebrating her achievements in improving the lives of girls and women in science and engineering. . . . continued page 18





### NEW FACULTY SPOTLIGHT SERIES:

# FOCUS ON WESTERN CANADA

This recurring series highlights some new Canadian ME faculty members by region. In this issue, we focus on British Columbia and Alberta with research highlights from:

Dr. Keivan Ahmadi, University of Victoria

Dr. Jasmin Jelovica, University of British Columbia

Dr. Chris Morton, University of Calgary and

Dr. Sabine Weyand, University of British Columbia, Okanagan

# University of Victoria

## Dr. Keivan Ahmadi

### *Manufacturing in the age of smart systems*



Dr. **KEIVAN AHMADI**, PhD

*Dr. Ahmadi started researching the mechanics and dynamics of machining processes in 2004 as part of his Master's research project. He earned a PhD in mechanical engineering from the University of Waterloo, ON, where he developed physics-based simulations of 5-axis milling processes. In 2011 he joined the Manufacturing Automation Laboratory (MAL) of the University of British Columbia as a postdoctoral fellow, and became part of the team that researches the development and implementation of Virtual Machining Systems. He then joined the Manufacturing Technology Development team in Pratt and Whitney Canada in Longueuil, QC, where he had a chance to study the performance of Virtual machining systems in the development of intelligent manufacturing processes of critical gas turbine parts. Dr. Ahmadi has been the director of University of Victoria's Advanced Manufacturing lab since 2015.*

Manufacturing systems are always evolving. Historically, the most critical turning points for their evolution are the eras of mechanization, mass production, and automation. Goods that were once manufactured exclusively by hand, such as textiles, were manufactured more efficiently by machines in the age of mechanization, and so on. Parts became identical and standardized—which enabled mass production—and more recently, in the age of automation, computer-aided manufacturing (CAM) became integral to the process of production.

Now, smart systems and the Internet of Things are poised to bring the next manufacturing revolution: the so-called smart factory. Similar to how the influx of smart objects are changing our lives in areas such as how we shop, how we learn, and how we socialize (and just about everything else), smart factories will change how we produce and assemble parts. Inside a smart factory, cyber-physical systems will communicate through the Internet of Things to create a network that joins the virtual world with the physical and human (hence the name). In order to realize the smart factory, certain challenges need to be worked out, such as communication between cyber-physical systems, decentralization of the processes through the application of cloud computing, virtualization of the manufacturing processes, and the application of autonomous robotic systems to perform tasks in the manufacturing process.

Dr. Ahmadi has created the UVICAM lab at the University of Victoria, or the UVic Advanced Manufacturing Lab. His research addresses the challenges of smart factories by developing virtual manufacturing systems (VMS), robot-assisted manufacturing, and real-time monitoring of manufacturing processes. VMS are physics-based simulations of a process that represent the physical operations (e.g. the machining operations) in digital manufacturing systems. The ultimate goal of developing VMS is to use them in the development of smart cyber-physical manufacturing systems, but they also are used independently to simulate and optimize the process for higher throughput without having to perform costly trials in the physical world. In the last decade for instance, the development of VMS has significantly improved the productivity of the Canadian aerospace industry. Extending the application of VMS to other applications re-

quires studying the mechanics and dynamics of the manufacturing (e.g. machining) processes of advanced materials, as well as multi-scale manufacturing processes. Studying the physics underlying manufacturing processes is also necessary for preparing autonomous robots to undertake major manufacturing operations. At UVICAM, the lab also studies the kinematics and dynamics of robots to optimize their performance in various machining operations, like milling and drilling. The modeling of the mechanics and dynamics of manufacturing operations also creates the context for interpreting the “big data” generated by digital manufacturing systems. This interpretation is essential for the online monitoring and control of the process, and for the optimization of the process based on sensor data.



# University of British Columbia

## Dr. Jasmin Jelovica

### *Towards increased efficiency of ship structures*

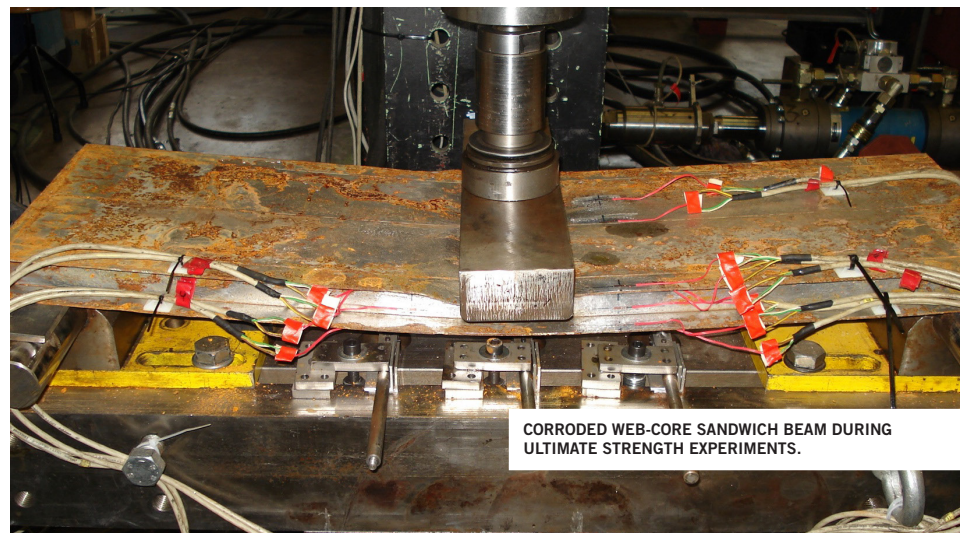


Dr. **JASMIN JELOVICA**, MSc, DSc

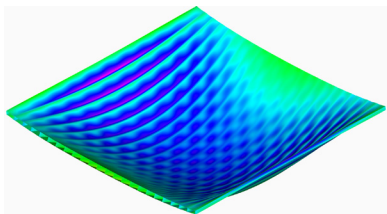
Dr. Jelovica obtained his MSc degree in Naval Architecture at the University of Rijeka, Croatia and DSc in the same field from Aalto University, Finland in 2014. He was afterwards lecturer of ship design at Aalto, before joining UBC in January 2017. His interest in ships began in the childhood, living in a busy port town with few shipyards. The research is focusing on improving the sustainability of ships through advanced structures of high quality. Another sphere of interest is on computational models for strength prediction and optimization using evolutionary methods.

Maritime transportation is the backbone of world trade and globalization, as about 90% of all goods are shipped by sea. It is the most environmentally sound mode of mass transport, both in terms of energy efficiency and the prevention of pollution. Predictions are that the extent of shipping will triple or quadruple in the coming decades, resulting in 10-15% of world's CO<sub>2</sub> emissions. To combat pollution, authorities are considering various approaches to improve the efficiency of ships. However, environmental studies predict that only about half of the technical solutions to achieve needed pollution reductions are available. One of the possibilities for additional improvement lies in reducing structural weight and reducing fuel consumption. This is achieved by introducing new lightweight structural components. These have to be reliable and tailored for marine environment.

Dr. Jelovica's research program aims to improve the efficiency and safety of ship structures. He works on computational models for design of novel structural components in large ships. In particular, steel sandwich panels have the capacity to significantly reduce the weight of the structure, while giving a designer possibility to tailor structural properties, e.g. natural frequencies, impact resistance, fatigue life, modularity and manufacturing. Yet these panels have low shear stiffness and are thus more sophisticated than traditional ship panels which causes several challenges. One of them is the need for robust and effective strength prediction methods as the ship design process remains short and requires fast analysis tools. Dr. Jelovica approaches this by using homogenization and continuum plate theories. Panel is not considered as a discrete structure, but as continuum, drastically reducing numerical modeling and analysis time to estimate structural behavior. Failure modes under in-plane loading and production imperfections at different scales are modeled using nonlinear stiffness in the constitutive relations. This aims to determine load-carrying capacity of lightweight structures beyond the first failure, in timely manner. Corrosion and fatigue are also under investigation, as they limit the life span of thin-walled structures in marine environment. Finally, heuristics of structural design are implemented to evolutionary optimization framework to overcome their computational expense.



CORRODED WEB-CORE SANDWICH BEAM DURING ULTIMATE STRENGTH EXPERIMENTS.



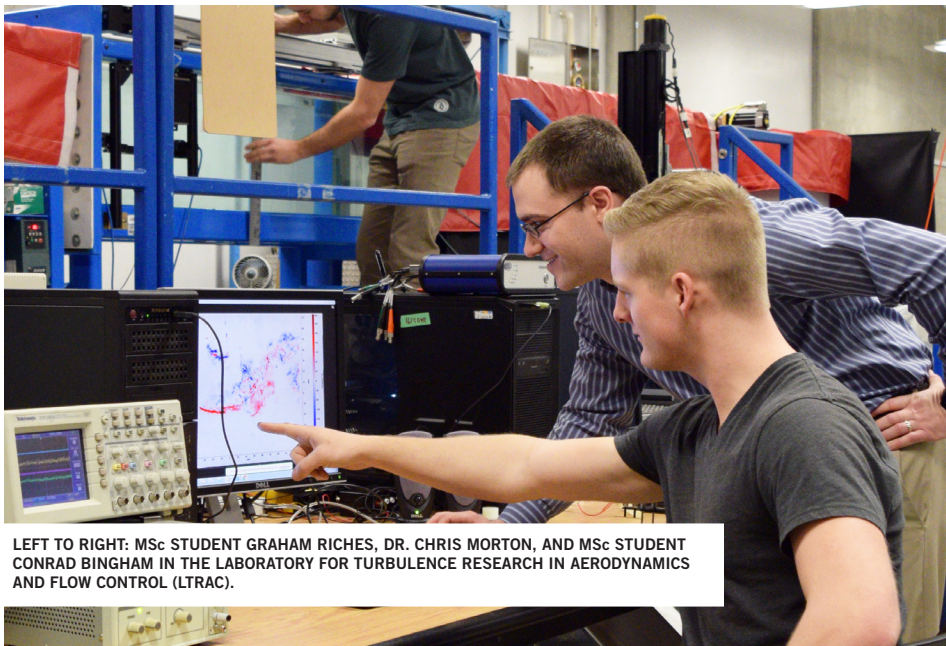
WEB-CORE SANDWICH PANEL IN POST-BUCKLING, SHOWING GLOBAL AND LOCAL DEFORMATION.



# University of Calgary

## Dr. Chris Morton

### *Coherent structures in bluff body aerodynamics*



LEFT TO RIGHT: MSc STUDENT GRAHAM RICHES, DR. CHRIS MORTON, AND MSc STUDENT CONRAD BINGHAM IN THE LABORATORY FOR TURBULENCE RESEARCH IN AERODYNAMICS AND FLOW CONTROL (LTRAC).

#### Dr. CHRIS MORTON, PhD

Dr. Morton is an Assistant Professor in the Department of Mechanical and Manufacturing Engineering at the University of Calgary. He received his PhD in 2015 from University of Waterloo and was a visiting scholar at TU Delft in The Netherlands gaining experience and expertise with Tomographic Particle Image Velocimetry (Tomo-PIV). His current research is on bluff body aerodynamics, flow induced vibrations and flow control.

What is common to wind turbines, heat exchangers, power transmission lines, and offshore pipelines? They are all bluff bodies and are often subjected to wind or water flows in natural environments which are highly unsteady. The nature of such turbulent flows is one of the significant challenges in mechanical engineering design, imposing demands on efficient use of raw materials while maintaining safety and reliability. Hence, it is of critical importance to understand the nature of the three-dimensional flow field and the resulting unsteady interactions with engineering structures.

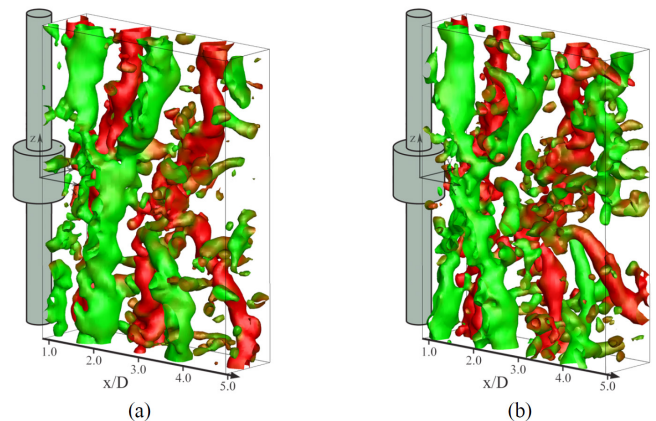
Dr. Morton's research program, in collaboration with the Laboratory for Turbulence Research in Aerodynamics and flow Control (LTRAC) at the University of Calgary, is devel-

oping diagnostic techniques to better understand the complex nature of turbulent flows, as well as active and passive methods of flow control. Within LTRAC, Morton has constructed a state of the art time-resolved Tomographic Particle Image Velocimetry (Tomo-PIV) system enabling three-dimensional velocity field measurements to be carried out in the water and wind tunnel facilities. First, small micron-sized particles are introduced to the flow and used as tracers. Tomo-PIV requires a minimum of three high speed cameras synchronized with a high repetition rate laser illuminating a volume of the fluid flow containing the tracer particles. The particle images are processed using a cross-correlation technique in order to extract three-dimensional velocity vectors. Visualizations of the three-dimensional topology can then be rendered, as seen for example in Figure 1.

The state-of-the-art PIV system can be synchronized with external sensors or devices,

which includes multi-axis force transducers, surface pressure sensors, in-flow velocity sensors and encoders. This enables the imaged flow behavior to be correlated to structural forces and/or structural response, which is of paramount importance in understanding any fluid-structure interaction problem. This technique has already been applied by Morton's research team to study both fundamental and practical problems in bluff body aerodynamics including: force predictions on bodies undergoing arbitrary motion, vortex-induced vibrations of pipelines, flow-induced vibration energy harvesting devices, and pitching/plunging airfoil energy harvesters. Moreover, when the Tomo-PIV measurements are synchronized with surface pressure or in-flow sensor readings, a model may be constructed based on the correlation between the sensor and flow field measurements. Morton's long term goal is to have a single sensor or an array of sensors become trained to predict the state of the three-dimensional flow field. This sensor-based estimation of three-dimensional flow behavior could be used for flow monitoring, and serves as a starting point in the design and implementation of closed-loop feedback control for unsteady turbulent flows.

FIG. 1 – IMAGE OF TOMOGRAPHIC PIV: VISUALIZATIONS OF TURBULENT VORTEX SHEDDING IN THE WAKE OF A DUAL STEP CYLINDER USING ISO-SURFACES OF VORTICITY, FOR A REYNOLDS NUMBER BASED ON THE LARGER CYLINDER DIAMETER OF  $Re_D = 2100$ .



# University of British Columbia, Okanagan

## Dr. Sabine Weyand

*Fostering design, innovation, and entrepreneurship inside and outside the classroom*



**Dr. SABINE WEYAND, MAsc, PhD**

*Dr. Weyand received her MAsc degree from the University of Ottawa in 2011 where she developed and tested a Neonatal Intensive Care Unit Physician-Parent Decision Support Tool (PPADS). In 2015, she received her PhD in Biomedical Engineering from the University of Toronto. Her research focused on developing a Neurofeedback-Based Near-Infrared Spectroscopy Brain-Computer Interface. From 2015 to 2016, she worked as a Course Instructor and Design Studio Coordinator at the University of Toronto. In 2016, Dr. Weyand joined the educational leadership stream of the Mechanical Engineering department at the University of British Columbia Okanagan.*

Dr. Sabine Weyand is the newest addition to the School of Engineering Educational Leadership Stream faculty. Dr. Weyand's passion for teaching first emerged in high school when she was tutoring her peers and uncovered her love for imparting knowledge and helping others learn new skills. Her teaching philosophy is rooted in the belief that learning is 90% attitude and the key to fostering a positive attitude is creating an engaged classroom through her enthusiasm, problem based learning approach, real-world links, and structure. She is currently teaching fourth year capstone design, a technical communications course, and a second-year design course.

Beyond the classroom, Dr. Weyand is engaged in several initiatives, including: coordinating a multidisciplinary Design Showcase, developing the UBCO Design Thinking Hub, engaging engineering students in entrepreneurship, running a longitudinal research study on Applied Science graduates, and running outreach events to encourage more women to enter the field of engineering. Along with fellow Educational Leadership Stream faculty members Dr. Carolyn Labun and Dr. Jannik Eikenaar, Dr. Weyand is organizing a campus wide Design Showcase to be held this May. The event aims to showcase

how instructors from various disciplines teach and evaluate design in the undergraduate classroom and allow for cross-discipline knowledge exchange and collaboration. Additionally, Dr. Weyand is working alongside Dr. Ray Taheri and Dr. Susan Crichton to develop a new blended learning module that will provide students from a variety of disciplines with the opportunity to obtain certificates (badges) in design-thinking, design prototyping and manufacturing, and entrepreneurship, with an anticipated launch date of May 2018. Dr. Weyand is also actively encouraging engineering students to have a more entrepreneurial mindset. This year, as a judge at the annual Entrepreneurship Bootcamp hosted by the Faculty of Management, she was thrilled to see a significant increase in participation by engineering students and their success at the event.

Dr. Weyand is currently conducting a longitudinal research study to track Bachelor of Applied Science graduates post-graduation. She is hoping that the study will result in both academic and administrative outcomes, and be of potential benefit to individual students both locally and across Canada. Academically, the data could be used to inform curriculum design and pedagogical approaches. She believes that by better understanding the activities students are engaged in post-graduation, we will be able to make more effective changes to the curriculum to better meet student needs. Additionally, determining indicators of success post-graduation would allow us to stress the importance of these areas to our current students and put more effort into these initiatives. Finally, Dr. Weyand is actively engaged in recruiting more women into engineering. She has been involved with several initiatives, including GoEng Girl, Women in Science and Engineering, and the Science Fair. She hopes to continue and grow her involvement in these initiatives in the future and serve as a role model for as many young women as possible.



# Q&A

**DR. EVE LANGELIER** has a bachelor's degree and a master degree in mechanical engineering. She also did a doctoral degree in biomedical engineering. She obtained a faculty position at Université de Sherbrooke in 2004 where she teaches mechanical engineering and bioengineering and conducts research in biomechanics and mechanobiology. Since May 2015, she holds an NSERC Chair for Women in Science and Engineering in the Quebec region.



**You are one of NSERC Chairs for Women in Science and Engineering and at the same time, an accomplished researcher in bioengineering. What motivated you into taking an active role towards increasing women enrollment and participation in Science and Engineering?**

I find that science and engineering (SE) are great fields to discover, learn about, work in, and I always loved to share this passion with youths. Moreover, I realized that not all girls and women are as lucky as I am. I had the chance for example to be exposed early to SE, to have supporting parents and to work in a welcoming environment. Many girls and women could be happy and successful in SE but experience gender related barriers during their life. These barriers are often unconscious, but still have a negative impact on women enrollment and participation in SE. But I have to say that the trigger for my active engagement was an initiative of the former NSERC Chairs for Women in Science and Engineering held by Claire Deschênes to create junior chairs. The goal of these junior chairs was to disseminate (to spread) the message and the impact of the chair... and it worked out well for me!

**Throughout your studies and career, have you ever felt any gender discrimination?**

Yes, I did, but not a lot. When I was doing my bachelor's degree, a professor wanted to help me

make a professional traineeship with a company he was collaborating with. Unfortunately, the company did not want to hire "a girl". In another traineeship, some man workers whistle at me while I was walking to the plant site. Later on, while looking for a job, someone asked me why he should hire me since I would certainly want babies. I have to say that I also had incredible experiences that probably had positive impacts about my perception of women's place within SG. While I was pregnant, a supervisor brought me a pillow and a mattress and found me a quiet place to take a nap if required.

**Have you had any role model that helped you achieve your goals?**

Yes, I had many role models. The first ones were certainly in my family. My mother and my grandfather worked in health care. My father studied in physiology and flew planes for a hobby. That influenced me to study in mechanical and bioengineering. Moreover, having a job I would love was very important to my mother. I also had, and still have, role models in my career: professors, colleagues and chair of my department. Men and women who cared about me, my happiness, and my success, people whom I could relate to and be inspired from. In the context of the chair, Claire Deschênes is a great inspiration for me. She was my former fluid professor, she held the Alcan/NSERC chair for women in sciences and engineering, she launched AFFES-

TIM (Association de la francophonie à propos des femmes en sciences, technologies, ingénierie et mathématiques) and she won a Synergy award from NSERC.

**In Canada (and many other countries), the number of women in science and engineering has remained low. In your opinion, what are the main factors explaining this trend?**

There are many factors explaining low representation of women in SE:

- There are gendered roles in the society as well as stereotypes and unconscious bias.
- Some elementary school teachers do anxiety when teaching science and technology. Indeed, they are generalists and must teach and thus master many different subjects.
- There are not enough female role models in SE for girls and young women.
- Careers in SE, as well as their impact on society health and environment, are not well known.
- Women take fewer opportunities than men for mentorship and sponsorship.
- Women in SE would lack professional development.

Efforts have been made for years, but I think we now need to combine strategic efforts from many instances at every step in a woman's life.



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Efforts have been made for years, but I think we now need to combine strategic efforts from many instances at every step in a woman's life.

Moreover, we need to be patient because such changes take time. But still, when we compare today's situation with the one related in the movie *Hidden Figures* back in the '60s, we made progress.

**Could you describe some of the activities you initiated as NSERC Chair and outcomes?**

Here are some examples of activities we initiated:

- A classroom education kit in science and technology about the problem solving process in engineering and simple machines.
- Training for teacher in science and technology about the design process and simple machines.
- Role model videos.
- A page on the Academos web platform for mentoring and career guidance.
- In collaboration with WinSETT Center, workshops for women in SE about leadership.
- Awareness of hiring committees and human resources to advantages of diversity, unconscious bias and auto-exclusion.
- A study about the impact of traineeship on engagement and perseverance of students in SE.

**Until now, what have you found the most rewarding experience in your NSERC Chair activities? Why?**

I think the most rewarding experience would be meeting girls, women, collaborators, colleagues



and discuss with them. I love when a spark happens in a girl's eyes, to help colleagues or parents understand women's situation in SE, to elaborate ideas, projects and plans to increase women's participation in SE, to talk with passionate people...

**As part of your NSERC Chair mandate, what do you want to accomplish in the 5-year time frame?**

1. Demystify SE;
2. Inform about the social importance of careers in SE;
3. Present female role models in SE to counter stereotypes;
4. Equip women who chose to have a career in SE and raise awareness of their environment;

5. Support teachers in science and technology;
6. Understand and report the situation of women in Quebec;
7. Identify and diffuse strategies for female students and professors in SE in Quebec.

**Do you have any advice for female students who want to pursue science or engineering studies?**

My advice for female students in SE:

- Learn about yourself, find your intrinsic motivation,... be yourself;
- Have a growth mindset, believe that you can learn and improve, see difficulties as challenges not obstacles;
- Build a relationship with a mentor you trust.

## CSME 2017 Annual General Meeting

CSME's **Board of Directors** will be meeting on 30 May 2017 in Room 430 of the EOW Building at the University of Victoria, in conjunction with CANCAM 2017 Conference, being held 29 May-1 June in Victoria, BC. The **Annual General Meeting** will be held between the Outgoing and Incoming Board meetings, i.e. from approx. 1 PM – 2 PM. CSME members are invited to attend the AGM either in person or by teleconference (1-888-884-4534 / Access ID: 2534515#).

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...continued from page 10

In 2012, Professor Amon was recognized as one of Canada's Most Influential Women by Women of Influence magazine, and in 2014 received the Canadian Society for Mechanical Engineering Robert W. Angus Medal for outstanding contributions to the management and practice of mechanical engineering. Most recently, she was awarded the Sir John Kennedy Medal from the Engineering Institute of Canada. She has also been made an ASME Honorary Member and was awarded the 2015 PEO Gold Medal, which is Ontario's most prestigious honour for engineering public service, technical excellence and professional leadership.

Professor Amon has been inducted into the Canadian Academy of Engineering, the Hispanic Engineer Hall of Fame, the Spanish Royal Academy, the Royal Society of Canada and the U.S. National Academy of Engineering. She has been elected fellow or honorary member of all major professional societies in her field.

During her term as Dean, she has made specific efforts in advancing gender diversity in engineering. The Faculty of Applied Science & Engineering has launched numerous strategic outreach and recruitment initiatives and introduced a highly selective broad-based admissions pilot project, all of which have been effective in enhancing diversity within their programs, and promoting inclusivity across all STEM disciplines. For the past three years, they have welcomed more than 30 per cent women in their incoming first-year engineering class, and this year that number grew to 40.1 per cent, the largest proportion in their Faculty's history. Additionally this academic year, nine of the 14 faculty members joining U of T Engineering are women. With these advances, U of T Engineering is a key partner in Engineers Canada '30 by 30' objective, which seeks to achieve 30 per cent female representation among newly licensed engineers by 2030. Excellent progress, though more to be done, but one can be confident that under Dr. Amon's leadership female engineers would definite shape the future of Canada and beyond. – *Sushanta Mitra, FCME with input from Catherine Riddell, University of Toronto*

## Women in Mechanical Engineering: Fight Against Stereotypes

**AS A MECHANICAL ENGINEER WORKING IN MANUFACTURING INDUSTRY, I SEE THAT** there are a lot of motivated and young women in mechanical engineering. Women are taking diverse roles and responsibilities very similar to men in mechanical engineering related industry. These days we can hardly differentiate between men and women in terms of roles and responsibilities in our industry but mechanical engineering is still a male-dominated field. Recent surveys show that there is a negative stereotype on careers of women in science and technology and mechanical engineering is no exception. I personally think that the mechanical engineering field is suffering even more from gender stereotypes compared to other fields of engineering. Maybe, these stereotypes can be tracked back to a time when we buy the toy truck and dirt digger truck for our sons.

One of the most effective ways to combat on negative stereotypes is to raise awareness in our fields about how stereotypes can affect our decision-making unconsciously. There is a responsibility on any individual in our industry to combat these stereotypes. Women have a key role in transforming our society. Mechanical engineering industry cannot match-up with the demand of modern times without women's contributions. Finally, CSME Student Chapter promotes activities such as conferences, lecture series and workshops which are aimed to raise awareness on issues which women engineers are facing in workplace and university.

CSME Student Affairs would love to know the women students' views on this topic. Please share your story with us. This will be a great help for us to tailor our activities towards your needs and move the field steps closer towards gender equality. – *Reza Pedrami, MCSME*

### STUDENT CHAPTER REPORT: McGill Association of Mechanical Engineers

The McGill Association of Mechanical Engineers (MAME) organized a 36-hour design competition, CAD Madness, on January 28<sup>th</sup>, 2017 in the McConnell Engineering Building at McGill University. The designers, participants competed in teams, creating optimal CAD designs for a ticket dispenser. This year's event was a major success with over 40 students competing for a grand prize of \$500, a second-place prize of \$200 and a third-place prize of \$100. The winning design will also be manufactured for official use within the faculty for McGill Engineering events. CSME Student chapter is glad to have sponsored this exciting event. – *McGill Association of Mechanical Engineers*



McGILL ASSOCIATION OF MECHANICAL ENGINEERS:  
AFNAN BIN HELAL AND FARHAN TANVEER HASAN



# CSME Honours & Fellowships 2017



## Robert W. Angus Medal

Professor **Ebrahim Esmailzadeh** is recognized internationally for his significant contributions to the mechanical engineering profession through his expertise and leadership as a dedicated educator, researcher and engineer. He is a distinguished scholar and has a long record of exemplary service as a leader in engineering education and as a mentor and role model for many generations of engineering students and young professors. He has published over 300 journal and conference papers and has played significant roles within professional societies as well as facilitated many international collaborations between industry and academia throughout his distinguished career.

Esmailzadeh's excellence in teaching and research has been recognized through several prestigious national and international awards and honors. He is a Fellow of the Canadian Academy of Engineering, the Engineering Institute of Canada, the American Society of Mechanical Engineers, the British Institution of Mechanical Engineers and the CSME.



## Jules Stachiewicz Medal

Professor **Ned Djilali** received BSc and MSc degrees in Aeronautical Engineering from University of Hertfordshire and Imperial College. After completing a PhD in ME at the University of British Columbia, he joined the Advanced Aerodynamics Department of Bombardier Inc. In 1991, he joined the ME Department at University of Victoria where he developed research programs in thermofluids engineering and energy systems, and trained over 150 graduate students, undergraduate research students and postdoctoral fellows.

Professor Djilali holds the Canada Research Chair in Advanced Energy Systems and has served as Director of the Institute for Integrated Energy Systems and the Pacific Institute for Climate Solutions. His contributions include pioneering work in computational modelling of transport phenomena in fuel cells, turbulent flows, heat and mass transfer in crystal growth of semiconductors and in porous media. He has published over 170 journal papers and holds 12 patents. Djilali is the recipient of numerous teaching and research awards. He is a Thompson-Reuters Highly Cited Researcher, Fellow of the CSME, the Canadian Academy of Engineering, and the Royal Society of Canada.



## Fellow

Professor **Sanjeev Chandra** is an internationally recognized researcher in the field of heat transfer. He received his PhD degree from Cornell University and spent the subsequent 27 years in the Department of Mechanical & Industrial Engineering at the University of Toronto. He has published 250 archival papers in refereed journals and international conferences. He is the author of one book and he has contributed to two additional books. He is also the holder of a patent for an innovative droplet generator that produces metal droplets on demand.

Dr. Chandra's principal area of research involves the physics and applications of liquid droplets impacting on solid surfaces. He pioneered the study of molten metal and ceramic droplets striking solid surfaces and solidifying. His photographs in this area have received wide acclaim, and they have been published in a number of leading scientific books and journals.



## Fellow

Professor **Daniel (Xiongbiao) Chen** is an internationally leading scholar in biofabrication and mechatronic engineering. His most notable achievement is creating and leading a new interdisciplinary research program in tissue engineering at the University of Saskatchewan, with the aim of developing advanced technologies for the production of artificial tissue/organ substitutes or scaffolds to repair the damaged ones. He has developed novel methods and technologies, leading to significant progresses and breakthroughs in design and fabrication of scaffolds for various tissue engineering applications as well as in design, modeling, and control of complex mechatronic systems/processes.

Dr. Chen's research has to date resulted in 131 peer-refereed journal articles with many published in the most prestigious journals of mechanical engineering. He has been supervising 46 graduate students in their research, and has been providing leadership in research and development as well as in solving company-specific problems in industry.



## Fellow

Dr. **Aleksander Czekanski** is an Associate Professor in the Department of Mechanical Engineering and the NSERC/Quanser Chair in Design Engineering at York University. Previously, he held the position of Engineering Manager at Magna International, a tier-one automotive global part supplier. He has over 15 years of industry engineering experience, giving him a keen understanding of the automotive business and manufacturing fields. Dr. Czekanski is the recipient of numerous distinguished honours and awards including the prestigious NSERC Chair in Design Engineering and NSERC Gold Medal.

Dr. Czekanski conducts fundamental research in applied and experimental mechanics as well as advanced manufacturing. He is also a prominent contributor to Canadian professional societies. He sits on the CSME Board of Directors, is the founding Chair of the CSME National Student Design Competition as well as the Conference Chair of 2018 CSME International Congress.





### Fellow

Professor **Marilyn Lightstone** is the current Chair of Mechanical Eng. at McMaster University. After receiving her Ph.D. degree from the University of Waterloo in 1992, she joined Atomic Energy of Canada Limited. She subsequently joined the University of Toronto in 1995 and McMaster University in 1999. Dr. Lightstone became the first female Department Chair in the history of the Faculty of Engineering at McMaster in 2013. Dr. Lightstone is a distinguished Canadian mechanical engineer, educator, researcher and administrator. She has been a mentor to many new faculty members at McMaster. She has been very active in promoting the mechanical engineering profession not only within McMaster, but also within the research community at the national and international levels.

Dr. Lightstone served as the Director and Executive Officer of the Computational Fluid Dynamics Society of Canada and as conference co-chair, was the National Fluids Examiner for the PEO for 2007-2010, and chaired the eSim Conference in 2016. She was a member of the NSERC Grant Selection Committee for 2008-2011 and co-chaired that committee in 2010-11. She was a Project Leader in thermal energy storage for the Solar Net-zero Energy Buildings Research Network.



### Fellow

Professor **Yuri Muzychka** has made significant research and teaching contributions to the fields of heat transfer, thermodynamics and fluid mechanics. He is a Professor and Department Head of Mechanical Engineering at Memorial University.

Dr. Muzychka's contributions to the development of advanced predictive models of heat transfer have been widely adopted and cited in the archival literature. He has authored or co-authored over 130 journal and conference papers in thermal and fluid engineering. His research contributions have enabled thermal engineers to develop more efficient designs for heat exchangers, electronics cooling, and HVAC systems.



### Fellow

Dr. **Aman Usmani** has over 40 years of experience in nuclear power plant design, analysis and management. He worked on stress analysis, seismic design, feeder and piping design, reactor, fuel handling and fuel channel engineering, CANDU plant design development and engineering services to domestic and overseas CANDU clients.

At AECL and AMEC FW Nuclear Canada, Dr. Usmani has held various management positions as design engineer, manager, engineering director and principal consultant. Qualified as a Seismic Capability Engineer, Dr. Usmani performed seismic walk-downs and assessment of Canadian, European and U.S. plants. He is currently Principal Consultant Nuclear Equipment, Seismic Engineering and Structural Mechanics at AMEC Foster Wheeler Nuclear Canada.

Dr. Usmani is chair of the CSA N289 Technical committee on seismic design and chair/member of its technical sub-committees. Dr. Usmani is a long-term Council member of the Canadian Nuclear Society and member of the CSME. For his contributions to Canadian industry, he won AECL President's Discovery and Outstanding Merit awards and the CSME Robert W. Angus medal for outstanding contributions to the management and practice of mechanical engineering.



### Fellow

Dr. **Youmin Zhang** has made significant contributions in developing new techniques and methodologies on condition monitoring, fault detection and diagnosis, and fault-tolerant controls with broad engineering applications to aircraft, satellites, and unmanned aerial, ground, and marine vehicles, wind turbines and smart grids, as well as machining tools. He has also contributed to the development of new techniques for the use of Unmanned Aerial Vehicles (UAVs) in different applications such as forest fires, power lines monitoring and safety inspection by combining with remote sensing techniques. He is widely published with a high number of citations.

Dr. Zhang serves as Editor-in-Chief, Editor-at-Large of international journals and as General Chair and Program Chair of several international conferences. He has been invited numerous times to deliver plenary talks, tutorial workshops, and research seminars worldwide.

## CSME Members honoured with Engineering Institute of Canada Awards

The CSME is pleased to announce that CSME Fellows Dr. **Cristina Amon** (*photo left*) Dr. **Marius Paraschivoiu** (*photo centre*) and Dr. **Jean Zu** (*photo right*) have received senior Engineering Institute of Canada awards at the 2017 EIC Awards Gala held on 1 April. For details, please refer to the press release ([www.eic-ici.ca](http://www.eic-ici.ca)).





# ICTAM 2016

The Canadian Society for Mechanical Engineering was honoured to host the 24th International Congress of Theoretical and Applied Mechanics (ICTAM 2016) in Montreal August 22-26, 2016. **Maciej Floryan** of Western University was chair of the organizing committee as well as the congress president, and **Michael Paidoussis** from McGill University was the honorary president.

ICTAM is the flagship event of the International Union of Theoretical and Applied Mechanics (IUTAM) and it is held once every four years. The first Congress took place in 1924 in Delft, The Netherlands. These Congresses are viewed as the "Olympics" in theoretical and applied mechanics.

The IUTAM is formed by fifty national organizations with interests in mechanics and is managed by the General Assembly, consisting of members appointed by the national organizations. Canada's national organization is The Canadian National Committee, with its membership approved by the CSME Board of Directors. Further details can be found at [www.iutam.net](http://www.iutam.net).

The Congress' scientific program consisted of plenary opening and closing lectures, seventeen sectional lectures, six mini-symposia, and contributed papers organized into sixteen technical sessions on fluid mechanics, sixteen sessions on solid mechanics and ten sessions on fluid-solid interactions. The special lectures as well as the contributed papers covered all aspects of mechanics and provided an excellent overview of the current research directions in the field. The breadth and quality of the papers was an inspiration. The Congress program also featured two prestigious lectures, the Rodney Hill Prize Lecture and G.K. Batchelor Prize Lecture. Further details can be found at [www.ictam2016.org](http://www.ictam2016.org). Seventy travel awards were made to provide young scientists with an opportunity to attend.

All contributed papers were peer reviewed. Recommendations to the International Papers Committee (IPC) were received from Pre-selection Committees of the National Committees of the eight countries: Canada, France, Germany, China, Poland, Russia, UK and USA. Recommendations were also received from the chairs of the mini-symposia and chairs of the Thematic Sessions.

The final program consisted of 1498 contributed papers and 188 invited talks for a total of 1686 making this ICTAM largest and most successful in history (see table below). The authors came from 55 countries from around the world.

Following the tradition since ICTAM 1988 in Grenoble, the IUTAM Bureau selected three outstanding young scientists for Bureau prizes, based upon their papers and presentations at the Congress. The recipients of the prizes at ICTAM 2016 were Dr. Romain Labbé of the Laboratoire d'Hydrodynamique (LadHyX), Ecole Polytechnique, Palaiseau, France; Dr. Stavros Gaitanaros of the John Hopkins University, Baltimore, USA; and Dr. Ashleigh Hutchinson of the University of the Witwatersrand, Johannesburg, South Africa.



**ICTAM 2016 MONTRÉAL**

**24<sup>th</sup> International Congress of Theoretical and Applied Mechanics**

**24<sup>e</sup> Congrès international de mécanique théorique et appliquée**

**Palais des congrès, Montréal, Canada**

**August 21-26 août 2016**

**Mechanics — Foundation of Multidisciplinary Research**

**La mécanique — fondement de la recherche multidisciplinaire**

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National Research Council Canada  
1200 Montréal Road, Building M-19  
Ottawa, ON Canada K1A 0R6  
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Conseil national de recherches Canada  
1200, chemin Montréal, Édifice M-19  
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In order to receive future announcements and other information about the Congress, register your interest at :  
Si vous désirez obtenir des annonces et toutes informations relatives au congrès, veuillez remplir la déclaration d'intérêt à l'adresse suivante :

**[www.ictam2016.org](http://www.ictam2016.org)**

Photos © NASA and Tourisme Montréal

ICTAM 2016 was the culmination of 8 years of concerted effort, which included the NRC, to bring the Congress to Canada and to orchestrate the event. The CANCAM Bell was used for its opening and closing. The opening ceremony featured presentations by *Cirque Éloize*, beautifully illustrating practical aspects of classical mechanics, and congress participants were asked to identify features of these presentations which were of interest from a mechanics point of view. A short video from the opening ceremony is available at the congress web site.

	Number of Papers Presented		Participants	
	All	Host Country	All	Host Country
<b>Grenoble 1988</b>	573	n/a	951	340
<b>Haifa 1992</b>	420	n/a	525	85
<b>Kyoto 1996</b>	703	192	936	332
<b>Chicago 2000</b>	1,126	445	1,430	587
<b>Warsaw 2004</b>	1,273	144	1,515	194
<b>Adelaide 2008</b>	901	109	1,176	139
<b>Beijing 2012</b>	1,271	400	1,561	612
<b>Montreal 2016</b>	1,686	185	2,106	239

**Table 1.** A comparison of the participation figures for the past eight congresses.



**2018 CSME  
INTERNATIONAL  
CONGRESS**



**2018 CSME International Congress**

York University - Keele Campus

Toronto, Ontario, Canada

May 27-30, 2018

[csme2018.lassonde.yorku.ca](http://csme2018.lassonde.yorku.ca)



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mitras@yorku.ca  
floryan@uwo.ca  
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homayoun.najjaran@ubc.ca  
prahimi@ualberta.ca  
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floryan@uwo.ca  
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x6li@uwaterloo.ca  
ali.ahmadi@ubc.ca  
babak.owlani@csagroup.org  
eric.lanteigne@uottawa.ca  
behdinan@mie.utoronto.ca  
hnh@blwtl.uwo.ca  
jeswiet@me.queensu.ca  
park@mie.utoronto.ca  
fsharifi@ryerson.ca  
carlos.escobedo@chee.queensu.ca  
k.siddiqui@eng.uwo.ca  
ebrahim.esmailzadeh@uoit.ca

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cdevaud@uwaterloo.ca  
pouya.rezai@lassonde.yorku.ca  
bulletin@csme-scgm.ca  
bilton@mie.utoronto.ca  
paul@cim.mcgill.ca  
ilian.bonev@etsmtl.ca  
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Ali Dolatabadi, FCSME

ali.dolatabadi@concordia.ca

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Executive Director / Directeur exécutif  
Administrative Officer / Agent administratif

Guy Gosselin, FEIC, FCSCE  
Mohammud Emamally

ggosselin.eic@gmail.com  
admin.officer@csme-scgm.ca

## 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



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