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Math Kangaroo puts the "M" in Canada's STEM

Outer Space Treaty: 50 Years Later



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President's Farewell Message/L'adieu du président

Witold Kinsner
PhD, PEng, FEIC, FEC, FCAE



2016-2017
IEEE Canada President and
Region 7 Director

With this last column, I send warm greetings and best wishes to all IEEE Canada members, volunteers, and activists, both young and seasoned!

It has been an honour and a joy working with all of you as your IEEE Canada President over the last two years. I am grateful to all for your support and encouragement, and I would like to extend my sincere thanks to everyone from our Team Canada for making IEEE Canada stronger, more diverse, brighter and a better place to contribute.

In the previous 2016/17 issues of the *IEEE Canadian Review* (*ICR*), I described our mission, core values, challenges, and priorities, followed by some of the technical and social initiatives to solve the challenges.

I also summarized several of our annual IEEE activities. Focus was given to the efforts to re-engage industry directly and indirectly, and I described some of the recent IEEE and IEEE Canada activities. IEEE has also strengthened ethics in all the new-directions initiatives and, particularly, in the engineering and technological designs.

Looking back over the last two years, we started our 2016 operations

(Continued on page 4)

Je profite de ce dernier message pour transmettre mes meilleurs vœux à tous les membres, bénévoles et militants de l'IEEE Canada!

C'est pour moi un honneur et un bonheur de vous avoir côtoyés ces deux dernières années comme président de l'IEEE Canada. Je suis reconnaissant de votre appui et de votre encouragement, et je souhaite remercier chaleureusement tous les membres de la division canadienne d'avoir contribué à l'essor, à la diversification et au rayonnement de l'IEEE Canada.

Dans les précédents numéros de la *Revue canadienne de l'IEEE*, j'ai présenté notre mission, nos valeurs, nos priorités et nos défis, mais aussi quelques initiatives sociales et techniques pour surmonter les épreuves.

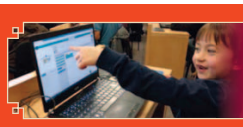
J'ai aussi présenté sommairement quelques-unes de nos activités annuelles. J'ai souligné les efforts déployés pour réintégrer directement et indirectement l'industrie dans nos activités et décrit les plus récentes initiatives d'IEEE et de l'IEEE Canada. Par ailleurs, l'IEEE a renforcé son code d'éthique pour l'ensemble de ses nouvelles orientations, plus particulièrement du côté de la conception technique et technologique.

Faisons le bilan des deux dernières années : nous avons amorcé 2016 avec de nouveaux responsables à la barre, soit M. Scott Melvin comme

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President's Message/Message du Président

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with a new set of officers: Secretary, Scott Melvin; Treasurer, Rasheek Rifaat; and a new Administrator, Ashfaq (Kash) Husain. They have worked hard to complete their obligations well. Much of our initial effort has gone into updating our Bylaws, Operations Manual, rosters, and many operational documents. Later, we developed more effective operations of our committees, expanded their depth by introducing vice chairs, started revitalizing their operations, and instituted two strategic planning forums (SPF) of the Board. The IEEE President-Elect, Maike Luiken, and Past President, Amir Aghdam, were instrumental in many of those critical activities.

Much effort has been given to the operations of the Areas (East with Brian Kidney in 2016 and Christopher Whitt in 2017, Central with Xavier Fernando first and Murray MacDonald later, and West with Bob Gill and Dan Coode) consisting of seven IEEE Sections in each area. Operations and revitalization of various IEEE Canada Committees was due to the effort of their Group Chairs (Member Services with Dave Kemp in 2016 and Elena Uchiteleva in 2017, External Relations with Raed Abdullah and Sreeraman Rajan, and Publications and Communications with Branislav Djokic and Wahab Almuhtadi). The Group Chairs coordinate committee activities in each of their areas.

I would like to thank each of our region-level committee chairs. Special appreciation goes to the Industry Relations Committee Chair, Kexing Liu, for his effort to elevate industry towards the centre of our activities so that practitioners could also become creators of knowledge useful not only to other practitioners, but also to students. The Section/Chapter Vitality Committee has developed new initiatives under its Chairs Raed Abdullah (2016) and Sreeraman Rajan (2017). The Chair of the IEEE Teacher In-Service Program (TISP), Dirk Werle, has coordinated STEM outreach activities across the country very effectively. In Membership Development, Chairs Mazanna Armstrong (2016) and Jameson Hyde (2017) helped us analyze our growth and identify priorities. The Student Activities Committee Chair, Lori Hogan, energized the next generation of IEEE members across the country. To encourage Student Branches to further develop their McNaughton Student Resource Centres, IEEE Canada is in the process of reprinting the three-volume General McNaughton biography. I have also started replicating the McNaughton Centres in other IEEE Regions.

Our *Canadian Journal of Electrical and Computer Engineering* (*CJECE*) is increasing its reputation under the guidance of its Editor in Chief, Shahram Yousefi. The Young Professionals Newsletter (its Latin name *Aurum* for GOLD, and the new proposed name *Iuventus* for young and developing) has been revived under the guidance of Dario Schor. The IEEE Canada Newsletter has been cared for by its Editor, Lena K. Jin. The French language version of the Newsletter has been revived by Translation Committee Chair Clement Ahoua, who also provides support for other regional communications. IEEE Canada's impactful presence on the Web is maintained and increased by our Webmaster, Jeffrey Arcand. Our Publicity and Advertising Chair, Tushar Sharma, helped create profile for several IEEE Canada initiatives.

I would like to thank the Editor-in-Chief, Bruce Van-Lane, for delivering high-quality issues of the *IEEE Canadian Review* over the last two years. In order to increase a dialogue between various IEEE Regions, I distributed each new issue to the 10 Regional Directors, 10 Division Directors, as well as the IEEE President and Vice-Presidents at the three Board of Directors Meeting Series.

The IEEE Canada Conference Advisory Committee (CONAC) has given strong support to further improving our Canadian and international conferences. Wahab Almuhtadi (in 2016) and Raed Abdullah (in 2017) have steered it well, energizing the many organizing

(Message du Président suite de p. 3)

secrétaire, M. Rasheek Rifaat comme trésorier et M. Ashfaq (Kash) Husain comme administrateur. Ils n'ont ménagé aucun effort pour remplir leur mandat. Nous avons d'abord travaillé à la mise à jour de nos règlements administratifs, tableaux de service, guide d'utilisation et autres documents courants. Nous avons ensuite réintégré la vice-présidence à nos comités pour accroître leur portée et leur efficacité, puis mis sur pied deux forums de planification stratégique pour le conseil d'administration. Les présidents, Mme Maike Luiken (désignée) et M. Amir Aghdam (sortant) ont joué un rôle clé dans nombre de ces étapes cruciales.

De plus, nous avons consacré beaucoup d'attention aux activités des zones (Est, sous la responsabilité de M. Brian Kidney en 2016 et de M. Christopher Whitt en 2017; Centrale, dirigée par M. Xavier Fernando, puis par M. Murray MacDonald; et Ouest, avec M. Bob Gill et ensuite M. Dan Coode à sa tête), chacune subdivisée en sept régions. Les présidents de leurs différents groupes (Services aux membres, M. Dave Kemp en 2016 et Mme Elena Uchiteleva en 2017; Relations externes, M. Raed Abdullah et M. Sreeraman Rajan; et Communicaitons et publications, M. Branislav Djokic et M. Wahab Almuhtadi) ont grandement contribué à la revitalisation de plusieurs comités de l'IEEE Canada. Chaque président de groupe coordonne les activités des comités de la région à sa charge.

Je veux également remercier les présidents de comité de notre région, et tout particulièrement M. Kexing Liu, président des Relations industrielles, qui a fait des affaires industrielles un pilier de nos activités et érigé les professionnels en phares du savoir; leurs connaissances rayonneront sur leurs pairs comme sur la relève en devenir. Le comité Sections/Chapitre Vitalité a piloté de nouveaux projets sous la direction de M. Raed Abdullah (2016) et de M. Sreeraman Rajan (2017), tandis que le président du Programme des enseignants en service, M. Dirk Werle, a coordonné avec brio diverses activités de promotion des STIM d'un océan à l'autre. Les présidents du comité Développement du recrutement, Mme Mazanna Armstrong (2016) et M. Jameson Hyde (2017), ont contribué à l'analyse des progrès et à la définition des priorités. Mme Lori Hogan , présidente du comité Activités étudiantes, a quant à elle insufflé l'énergie de l'IEEE à la relève. Pour inciter les branches étudiantes à enrichir leur Centre de ressources éducatives McNaughton, l'IEEE Canada travaille à la réimpression de la biographie en trois volumes du général McNaughton. J'ai aussi entrepris des démarches pour implanter des Centres McNaughton dans d'autres régions de l'IEEE.

Le *Journal canadien de génie électrique et informatique* (*JCGEI*), parrainé par l'IEEE Canada, ne cesse de gagner en crédibilité grâce à son rédacteur en chef, M. Shahram Yousefi, tandis que la revue des jeunes professionnels a fait un retour en force sous la direction de M. Dario Schor, délaissant au passage le nom *Aurum* (« or », en latin) pour *Iuventus* (« jeunesse »). Le bulletin d'information de l'IEEE Canada a été encadré par sa rédactrice en chef, Mme Lena K. Jin, et sa version française a été relancée par le gestionnaire de traduction, M. Clement Ahoua, qui contribue également aux autres communications régionales. C'est à notre webmestre, M. Jeffrey Arcand, que nous devons la forte présence de l'IEEE Canada sur le Web et à notre gestionnaire des publicités et annonces, M. Tushar Sharma, la grande portée de plusieurs initiatives de l'IEEE Canada.

Je veux aussi souligner le travail de M. Bruce Van-Lane, qui signe comme rédacteur en chef les numéros de *La revue canadienne de l'IEEE* depuis les deux dernières années. Pour favoriser les échanges entre les différentes régions de l'IEEE, j'ai remis un exemplaire de chaque numéro aux dix directeurs de région, aux dix directeurs de division, ainsi qu'aux président et vice-présidents de l'IEEE lors des trois réunions du conseil d'administration auxquelles j'ai assisté.

Le comité consultatif en matière de Conférences (CONAC) de l'IEEE Canada a grandement contribué à l'amélioration de nos rencontres nationales et internationales. M. Wahab Almuhtadi (2016) et M. Raed Abdullah (2017) l'ont dirigé d'une main de maître, dynamisant du même coup

committees throughout our region. I wish to express my gratitude to those countless volunteers that make our conferences so successful. Particular recognition is due to the organizing committees of IEEE Canada's three national conferences: CCECE 2016 and 2017, EPEC 2016 and 2017, and IHTC 2017, chaired respectively by: Rodney Vaughan and Rabab Ward; Majid Ahmadi and Esam Abdel-Raheem; Branislav Djokic and Raed Abdullah; Tony C.Y. Chung; and Xavier Fernando.

The efforts of IEEE Canada's Humanitarian Initiatives Committee can be seen through the many activities of its Special Interest Groups on Humanitarian Technology; Alfredo Herrera's personal commitment to helping humanity has given inspiration to everyone involved. IEEE Canada's exceptional volunteers and outstanding technical leaders have been given due appreciation through the efforts of its Awards and Recognition Committee, chaired by Vijay Sood.



IEEE Canada President Witold Kinsner engages the audience in discussing "What is involved in advancing technology for humanity?" at IEEE Sections Congress '17

I would like to recognize the enormous effort by all the IEEE Canada Sections with their Student Branches, Society Chapters, and Affinity Groups such as Women in Engineering (WIE) and Young Professionals, and Life Members. The main activities of our region (Region 7) happen there, and the real value of IEEE to its members is developed there too. IEEE by itself does not create value to its members; it is its members that create the real value to all.

Special thanks go to our Director Emeritus, Ray Findlay for his continuous support as the Parliamentarian to IEEE Canada. Celia Desmond also started as an Associate Parliamentarian last year. Rob Anderson has led judicious oversight of IEEE Canada's operations as Chair of the region's Audit Committee.

In January 2018, we will welcome Dr. Maike Luiken as the next IEEE Canada President for 2018-2019, and Dr. Jason Gu as IEEE Canada President-Elect for 2018-2019. I am confident that they will continue to help IEEE Canada grow stronger and more meaningful to its members. I will be supporting them in that process as IEEE Canada Past President and as the newly-elected IEEE Vice President for Educational Activities for 2018.

The pioneering computer scientist and US Navy Rear Admiral, Grace Hopper, often mentioned John A. Shedd's observation "A ship is safe in harbour, but that's not what ships are built for." IEEE exists because of explorers. We must continue being explorers to find the values that matter to humanity. ■

Respectfully submitted,

Witold Kinsner,
PhD, PEng, FEIC, FEC, FCAE
2016-2017 IEEE Canada President
2016-2017 IEEE Region 7 Director
2018 IEEE Vice President, Educational Activities

plusieurs comités organisateurs de la région. Je désire exprimer toute ma gratitude aux innombrables bénévoles qui font de chaque conférence une réussite. Je pense notamment aux comités organisateurs des trois conférences nationales de l'IEEE Canada, à savoir la Conférence canadienne de génie électrique et informatique (2016 et 2017), la Conférence sur l'énergie électrique (2016 et 2017) et la Conférence internationale de la technologie humanitaire (2017), respectivement présidée par M. Rodney Vaughan et Mme Rabab Ward; M. Majid Ahmadi et M. Esam Abdel-Raheem; M. Branislav Djokic et M. Raed Abdullah; M. Tony C.Y. Chung; et M. Xavier Fernando.

Par ailleurs, le comité humanitaire de l'IEEE Canada peut se féliciter des nombreuses activités de ses groupes d'intérêt spécial sur la technologie humanitaire (SIGHT);l'attachement que porte M. Alfredo Herrera à la cause humanitaire a été source d'inspiration pour tous. Présidé par M. Vijay Sood, le comité Prix et Distinctions a récompensé les bénévoles et les responsables techniques d'exception de l'IEEE Canada.

Je ne peux passer sous le silence le travail colossal des sections de l'IEEE Canada en faveur de leurs branches étudiantes, chapitres de société et groupes d'affinité, dont Femmes en génie, les jeunes professionnels et les membres à vie. C'est là que se déroulent les principales activités de notre région (région 7) et que l'IEEE prend tout son sens aux yeux de ses membres. Après tout, ce sont eux qui font la valeur ajoutée de l'IEEE, et non l'inverse.

Je remercie spécialement M. Ray Findlay, maintenant directeur émérite, pour son soutien indéfectible comme parlementaire de l'IEEE Canada, poste repris avec adresse par Mme Celia Desmond l'an dernier. De plus, M. Rob Anderson a surveillé avec le plus grand soin les activités de l'IEEE Canada en qualité de président du comité de Vérification.

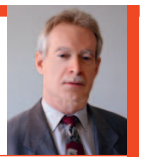
En janvier 2018, Mme Maike Luiken et M. Jason Gu seront faits respectivement présidente de l'IEEE Canada et président désigné de l'IEEE Canada pour 2018-2019. Je suis persuadé qu'ils intensifieront le rayonnement de l'IEEE Canada et accroîtront sa pertinence aux yeux de ses membres. Ils pourront compter sur ma collaboration en qualité de président sortant et de vice-président des activités éducationnelles de l'IEEE pour 2018.

L'informaticienne d'avant-garde et contre-amirale de la US Navy, Grace Hopper, affectionnait particulièrement cette citation de John A. Shedd : « Un bateau dans un port est en sécurité, mais ce n'est pas pour cela qu'il a été construit ». L'IEEE est le fruit d'explorateurs, et il nous faut continuer d'explorer pour trouver les valeurs qui sont chères à l'humanité. ■

Respectueusement soumis,

Witold Kinsner,
Ph.D., ing., FEIC, FEC, FCAE
Président d'IEEE Canada pour 2016-2017
Directeur de la région 7 de l'IEEE pour 2016-2017
Vice-président des activités éducationnelles de l'IEEE pour 2018

A few words from the Editor in Chief / Quelques mots du rédacteur en chef



Bruce Van-Lane, P.Eng.

Two of our stories this issue take us time traveling. Dario Schor's extended "Lift-Off!" column straps us in for a tour of the history and evolution of the 1967 Outer Space Treaty. It wasn't just the standard g-forces space scientists and engineers from that era contended with 50 years ago. The geo-political tensions of the cold war were a catalyst for space exploration, so it's not surprising they are reflected in this seminal document that sought to preserve space as demilitarized, and keep it accessible to all of humankind.

"Letters from Canada" sweeps us back roughly 25 years. But at first glance, you might not know it. Although the industry players are different in some instances, the basic observation made by the German writers is that despite numerous successes across a variety of industries and its research achievements, Canada's image was then one tied in large measure to its traditional resource extraction economy. The relatively low contribution to R&D by Canadian industry is highlighted, acknowledging the struggle to grow a base of Canadian-owned companies large enough to have the resources to invest this way. What's your perspective on this? Could Profs. Heywang and Heimann have written virtually the same piece today? Our thanks to Daryoush Shiri for the translation.

Our third major article is present-day focused, but takes us back to the roots of success in university-level science and technology: proficiency in math. The Canadian Math Kangaroo Contest is led by Rossitza Marinova, a TISP

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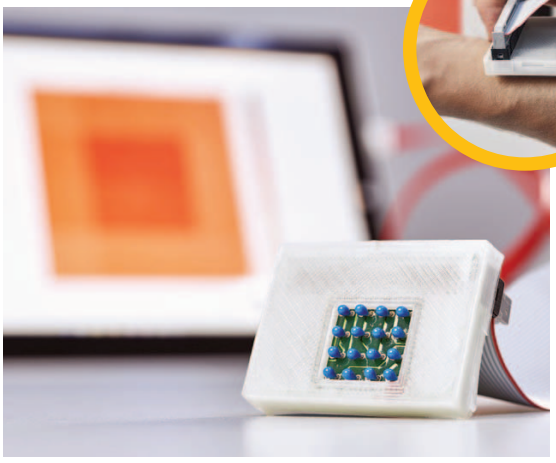
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Biz-tech Report



by Terrance Malkinson

A group of Canadian medical and bioengineering undergraduates from McMaster University surpassed more than 1,000 other ideas from around the world to win this year's James Dyson Award for design engineering, [www.jamesdysonaward.org] worth $US 40,000, with a device called The sKan. [www.jamesdysonaward.org/projects/the-skan] The McMaster group has developed an early prototype of an inexpensive handheld scanner that holds the possibility of helping doctors diagnose skin cancer in their offices. With further work incorporating the team's planned improvements to the design, future models will have the potential to save lives. "It's a very clever device with the potential to save lives around the world," said James Dyson, himself an inventor. The last Canadian team to win the international Award was Waterloo-based Voltera in 2015 who created a custom circuit board printer that has been launched commercially. Additionally, two University of Toronto students won the competitions' national award for their project "Force-Film: A Digital Sense of Touch for Minimally Invasive Surgery" Force-Film is a thin add-on for minimally invasive surgical instruments that provides surgeons with a digital sense of touch which will help improve surgical safety. There are many success stories of Canadian creativity and innovation. In the opinion



of the author (T. Malkinson) Canada has the talent to be world leaders in innovation. What we lack is the management acumen in, and real understanding of, creativity and innovation to take advantage of our outstanding people. Indeed, this is one of the themes of a recent book by the serial entrepreneur Anthony Lacavera and journalist Kate Fillion, *How We Can Win*, (Penguin Random House, Canada. 2017).

"Power Up" is the title of an article in the November, 2017 issue of The Globe and Mail's *Report on Business* [www.theglobeandmail.com/business/rob-magazine]. Ontario's eighteen nuclear reactors provide 60% of its electricity. In 2017, Ontario Power Generation embarked on a 10-year $12.8B refurbishment of its Darlington Nuclear Generating Station. Of importance is that 96% of the work will be done by local companies, and six of these vendors are profiled in the article. The upgrade is forecast to ensure the safe and clean operation of the reactors that provide electricity for over two million people for the next thirty years.

Avro Canada was a Canadian aircraft manufacturing company started in 1945 and within thirteen years became the third-largest company in Canada. Avro Canada was best known for the highly advanced CF-105 Arrow aircraft. This was an advanced, supersonic, twin-engined, all-weather interceptor jet aircraft developed by A.V. Roe of Canada at the site of the present-day Pearson International Airport. Work started in 1949, advancing until the Diefenbaker government's controversial cancellation of the project in 1959. Following the cancellation of the CF-105 Arrow the company ceased operations in 1962. All plans and prototypes were destroyed by order of the government. Many Canadians were upset by the loss of Canada's aircraft industry, what could have been, and the resulting migration of scientists and engineers to other countries. There was a loss of more than 14,000 jobs. Indeed, many of the soon-recruited aerospace engineers helped NASA and its US contractors in their space program. Recently, (summer 2017) a test model used in the program was found on the bottom of Lake Ontario and it is believed that there may be eight others located in the lake. The plan is to very carefully recover this discovery, stabilize it, and display it in one of Canada's national museums.



Financial Post Magazine [www.business.financialpost.com] has named its selection of Canada's Outstanding CEO of the year. In the November 2017 issue, Sun Life Financial's Dean Connor was named the recipient of this honor. Constant improvement is the mantra for his success and as stated in the profile "each new hire, has to raise the collective bar at least a little." Also provided in this issue is a ranking of the top 100 Canadian CEO's based on their company's return to investors. The October issue of this magazine provides a listing of twenty-five of the most influential people believed to be affecting Canadian business and policymaking. An exclusive profile of the Richardson family who for over 160 years have built a $9B Western Canadian agricultural heartlands business in Agriculture and Food Processing, Energy, Financial Services and Real Estate is provided in the November, 2017 issue of the *Globe and Mail's Report on Business*.

Electrical Business [www.ebmag.com] announced in its November-December issue the Canadian electrical award winners. These awards acknowledge noteworthy electrical installations and electrical safety champions. Project winners included Tata Steel Concentrator Mill (self-sufficient iron ore concentrator), Maritime Link Submarine Cable (500MW HVDC cable between Newfoundland and Nova Scotia), Shell Scotford Refiners Turnaround (electrical upgrades for a 20% debottleneck project), and the Brockville Railway Tunnel (525-meter pedestrian walkway tunnel). People winners included Ronald Bergeron (writer and practitioner of electrical safety), and Terry Becker (developer of electrical safety standards). Why they received the award and profiles of each of the winners are provided in the article. ■

About the Author

Terrance Malkinson is a communications specialist, business analyst and futurist. His career path includes technical supervisor and medical researcher at the University of Calgary, business proposal manager for the General Electric Company, and research administrator with the School of Health and Public Safety at SAIT Polytechnic in Calgary. He is currently an international correspondent for IEEE-USA *Today's Engineer*, contributing editor for *IEEE Canadian Review*, and a member of the editorial advisory board of IEEE *The Institute*. He was Vice-Chair of the IEEE-USA Communications Committee (2004-2010), and editor-in-chief of IEEE-USA Today's *Engineer Digest* (2004-2008). He was an elected Governor of the IEEE Engineering Management Society as well as past editor of *IEEE Engineering Management*. He is the author of more than 550 earned publications, and an accomplished triathlete. **malkinst@telus.net**

How and Why I Volunteered for IEEE



After finishing my bachelors in Industrial and System Engineering, in 2012 I came to Canada from Iran and started my doctoral studies in Industrial Engineering at Université Laval's Mechanical Engineering Department. My doctoral thesis project was on healthcare service delivery. As a young engineer, I was looking to extend my network, strengthen my technical skills and form my professional career. Through one of my friends, I became familiar with IEEE, and soon started my activities as a graduate student member. Becoming more familiar with the wide range of IEEE activities, I became interested in greater involvement. I have long been drawn to women's issues, which led me to learn about IEEE WIE activities. Throughout my life, I have looked for any opportunities to inspire girls to follow their dreams and to believe in their abilities. As women were in the minority in my engineering program and even in my faculty, I became interested in how gender affects interest and education in the STEM -related fields, and how we could engage more female students in these fields. IEEE WIE has beautifully guided me along a path to achieve these goals.

Following my interests, in 2014 I founded IEEE WIE Québec affinity group to support other women in these fields, and as Chair launched a variety of initiatives. Through my activities as an IEEE and IEEE WIE member during subsequent years, I have been given the opportunity to meet inspiring leaders, successful engineers and scientists; to learn from them, and enrich my personal and professional skills as a young engineer. Having completed my doctoral program, I am now working in a research capacity that includes giving women more influence and power in determining their health decisions. I believe that women build the foundations that next generations depend on, and their empowerment directly benefits society. IEEE has given me the opportunity to serve my interest in inspiring and empowering women in my community and consequently serve society.

Samira Abbasgholizadeh Rahimi
Université Laval, Eng., Ph.D.
WIE Chair (and founder), IEEE Québec Section
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Working successfully in multi-disciplinary teams
– an Industrial Engineer's perspective

IEEE members will increasingly find themselves working in multi-disciplinary teams. These teams will not only include members from other engineering disciplines, but will also include those with totally unrelated backgrounds, e.g., law, medicine and the social sciences.

The *IEEE Canadian Review* recently interviewed Dr. Rahimi about her research work in shared decision making in the Faculty of Medicine, Université Laval. She and her colleagues in the Department of Family Medicine and Emergency Medicine seek how to best enable patients and clinicians to collaborate to make healthcare decisions based on best evidence and what matters most to patients, which will ultimately have profound impacts on health outcomes.

Dr. Rahimi is part of a team working on a large-scale implementation project on prenatal screening for chromosomal abnormalities such as Down Syndrome. Her specific research has to do with shared decision making in whether or not to have a test performed and if so, which test.

ICR: How are shared understandings of problems arrived at?

SR: If you mean shared understanding between my point of view as an engineer and a clinician's point of view, I could say it was quite challenging to me at the beginning to adapt myself to very different fields' cultures to help reach a shared understanding. But with the passage of time, and by picking up some key points, it became much easier. In bridging differences, I can say empathy, flexibility, transparent communication, and having a sense of belonging are the most important. It requires empathy to understand what other team members' points of view are, e.g., those of clinicians. My philosophy is to place myself into their position and appreciate their views and potential concerns. Flexibility is needed to not only bring to the problem or solution your own expertise, but to adapt to working with the other team members. Transparent and good communication is essential as well—achieving that requires good listening skills. Lastly, it is important to have the sense of belonging to the team that you are working with… you shouldn't see yourself as a separate part even though

...Continued on page 23 »



Photo: La maison Simons

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The 31st Canadian Conference on Electrical and Computer Engineering (CCECE 2018) will be held in Québec City, Canada on May 13-16, 2018 at the Québec City Convention Centre.

CCECE is the flagship conference where researchers, students, and professionals in Electrical and Computer Engineering meet annually in a Canadian city to get up to speed with the latest developments, foray into new fields and emerging topics, network with colleagues to strengthen partnerships, and foster new collaborations.

Papers, in French or English, are solicited in the tracks below:.

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Deadlines

Full Paper Submission (see *ccece2018.org* for details):	**Thursday, January 18, 2018**
Notification of Acceptance:	**Friday, March 2, 2018**
Author Registration & Final Paper Submission:	**Sunday, March 18, 2018**

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by **Dario Schor**

The more one learns about the 1967 Outer Space Treaty (OST), the more one can appreciate why it is often referred to as the Magna Carta of Space Law. This short document combines the different ideologies of the 1960s that included the geopolitical hostility from the Cold War and the visionary technological outlooks from the engineering community. It is inspired to some extent by the utopian views of a generation that ushered in principles of human rights, peace, and environmental protection. Since its signing 50 years ago, this unique piece of legislation has provided the foundation for a responsible use of outer space that stimulated historic international collaborations. In this column we reflect back on key developments in space exploration and how they have provided the impetus for expansion of the scope of the treaty. In the next column we cast our gaze forward to the next 50 years.

Ad adstra,

Dario Schor; schor@ieee.org

ORIGINS OF SPACE LAW

The turn of the 20th century was filled with exciting telecommunication developments and aviation milestones that prompted the establishment of new legal regimes. Marconi's first transatlantic signals paved the way for incorporating radio transceivers in ships for search and rescue operations. The benefits were undisputed, yet they were not formalized until the 1906 International Radiotelegraph Convention defined both the SOS distress signal and the first assignment of frequency bands for different applications [1]. Similarly, advancements in aviation led to the 1944 Convention on International Civil Aviation (aka, the Chicago Convention) governing airspace, establishing requirements for aircraft registration, and defining safety standards [2]. In parallel, rocketry was transitioning from science fiction to reality with contributions from Kostantin Tsiolkovsky in the USSR, later Robert Goddard in the United States, and others. The combination of new legal frameworks and the emerging field of rocketry gave rise to the first discussions about the laws of outer space.

The early mentions on space law extrapolated on issues from aviation and radio communications as they would apply to the new domain. For example, in 1910, the Belgian lawyer, Emile Laude, posed issues of ownership and frequency allocation as it relates to space activities, and in 1926, the USSR official, V. A. Zarzar, questioned whether the domestic airspace legislation was applicable in outer space [3]. However, the first formal publication on space law is often attributed to the Czechoslovakian lawyer, Vladimir Mandl for his 1932 manuscript "Outer space law: A problem of astronautics" [4] where he described the differences between aviation and space law. Ultimately, all these scholars and others of the time agreed that the sovereign extension of airspace above a nation would not be applicable and new laws were required for outer space.

On October 4, 1957, the USSR launched Sputnik-1 instantly transforming the theory into a very real and serious discussion on the laws of outer space. This battery powered, spherical, low orbiting spacecraft used four antennas to transmit limited telemetry over open frequencies and frighten the public about the potential militarization of space. Wisely, other nations did not object to the spacecraft flying over their territories, and set the precedent differentiating airspace from outer space. Within months, the United States launched Explorer-1 and other nations began experimenting with their own rocket technologies. The US State Department noted the rapid development of outer space and proposed the formation of a United Nations (UN) committee focused on the legal implications of spaceflight [2].

In 1959, the UN General Assembly passed resolution 1348 (XIII) to establish the Committee on the Peaceful Uses of Outer Space (COPUOS) that later became a permanent body. To date, the committee meets annually in Vienna and has grown from the initial 24 member states and become one of the largest committees within the UN with 84 member states represented. Many of the activities are discussed by two subcommittees that focus on the technological and legal developments related to outer space.

In 1963, COPUOS adopted the Declaration of Legal Principles Governing the Activities of States in the Exploration and Uses of Outer Space (aka, the Principles Declaration). However, these resolutions were not binding, so in 1966, instructed by US President Lyndon B. Johnson, Arthur Goldberg, the US Ambassador to the UN, began writing a space treaty. Goldberg based the draft on the Principles Declaration and incorporated language on the peaceful uses of shared territories found in the 1959 Antarctic Treaty. This work culminated in the 1967 "Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies" most commonly known as the Outer Space Treaty (OST).

The OST was opened for signatures on January 27, 1967. Parallel signing ceremonies were held in London, Moscow, and in Washington D.C., where Canada was represented by Geoffrey Murray, H. F. Clark, and Albert Ritchie respectively. The treaty entered into force on October 10, 1967 and, as of the writing of this article, the OST has been ratified by 106 nations (including the recent addition of Nicaragua in August 2017) and signed by a further 24 States.

THE OUTER SPACE TREATY

The OST consists of a preamble and 17 articles addressing different areas of space exploration. The remaining part of this section provides an overview of the treaty along with some historical background and examples of how these laws apply in today's space industry.

The preamble to the OST does not set any obligations to the signatories, however, it states the intended vision for interpreting all subsequent statements. The first five statements contain words like 'inspired', 'believing', and 'desiring' to encompass the dreams of peaceful and collaborative uses of

outer space for the benefit of all humankind. Furthermore, it maintains the notion of 'principles' from its earlier document recognizing, as Christopher Johnson, the Space Law Advisor at the Secure World Foundation, describes this "is not a comprehensive nor exhaustive set of exacting rules" [2].

As a binding continuation to the preamble, Article I designates the exploration and use of space as the province of all humankind and states that the use of outer space "shall be carried out for the benefit and in the interests of all countries, irrespective of their degree of economic or scientific development." When read in isolation, the article raised concerns that some countries without the ability to develop their own space assets would be getting a free ride. However, the intent is not to force nations to develop missions that have economic and humanitarian benefits for the entire world. Rather, as explained by Goldberg to the US Senate, this article emphasizes that "space shall be free for exploration and use by all states without discrimination of any kind" [5].

Article II prohibits any type of national appropriation, thus assuring to the Space Race adversaries that second place would not need a foreign visa to land on the Moon. By pre-emptively adding a clause before anyone landed on another celestial body, the UN's COPUOS avoided convoluting the text to acknowledge disputes about territorial claims like those found in the Antarctic Treaty. Hence, it is no wonder why Neil Armstrong's poetic words while descending from the Lunar Module did not focus on an American accomplishment, but rather on "one giant leap for mankind."

In recent years, Article II appeared in the mainstream media for both commercial schemes and legitimate business ventures. A few crafty online entrepreneurs began selling plots of land on the Moon claiming that the OST only applies to states and does inhibit private individuals or corporations from engaging in these activities. It is not worth devoting much time to these scams other than to say they are not supported by the legal community who insists Article II must be read in the context of the full treaty. This includes Article VI, that entrusts all actions performed by individuals or corporations to their respective states. In addition, the national appropriation topic has also been discussed in the context of resource extraction. In many cases, the media extrapolates the plans to focus on capturing and mining resources from asteroids. While this may be feasible in a blockbuster movie, it is not realistic following the physics principles of orbital dynamics. As discussed in the next issue, smaller incremental steps starting from in situ resource utilization (ISRU) are more realistic first steps. Hence the reason for the recently approved US and Luxemburg laws related to space mining explicitly stating that they are not claiming ownership of any celestial body, but rather only using the resources.

The first five statements contain words like 'inspired,' 'believing,' and 'desiring' to encompass the dreams of peaceful and collaborative uses of outer space for the benefit of all humankind.



When one thinks about these contemporary national space laws in the context of the treaty, it is appropriate to remember that "law is not created in a vacuum, not even space law" [6]. This is the essence of Article III that situates the OST within broader international laws; bringing to it broader principles from other treaties, and also defining the scope and overlaps with specialized laws affecting space activities like frequency regulations through the International Telecommunication Union.

On June 20, 1967, the Hon. Paul Hellyer, Minister of National Defence, spoke to Parliament about Canada's intention to ratify the OST. Like many politicians in office at the time, he brushed through most of the treaty and dwelled on the importance of Article IV banning the use of weapons of mass destruction in space [7]. Prime Minister Diefenbaker (then Leader of the Opposition) took this a step further in his remarks referring to the OST as a "treaty for the control of armaments in outer space," thus neglecting all the other articles. However, these comments did not come as a surprise, as earlier in his career he had instituted measures in the event that Canada was attacked by intercontinental ballistic missiles and even built a secret bunker outside of Ottawa (now known as the Diefenbunker Museum) to ensure continuity of government in the event of an attack.

Going back to the treaty, there are two important elements carefully worded in Article IV. First, the text does not demilitarize space, but rather removes the use of certain types of weapons. That was needed because both superpowers wanted to continue using space for reconnaissance and remote sensing to support their military activities. Second, like Johnson says, "this article concerns weapons of 'mass destruction' and it may therefore tacitly permit other types of weapons" [2]. Since it does not define what is allowed, Wong and Fergusson argue that anything can be considered a weapon, as

"paranoia over space projects can be seen largely as a product of its time" [8]. To illustrate this, they remind us of the opening scene in the 1967 James Bond movie *You Only Live Twice* where a large shuttle-like spacecraft captured an enemy spacecraft in its cargo bay. Thus, if this level of geopolitical animosity had continued during the first tests of Canada's robotic manipulator, it is possible that "Soviet nightmares [would have] included the space shuttle pulling up next to a critical Soviet satellite, and menacing it with the Canadarm" [8].

In spite of the geopolitical tensions of the Cold War, the space superpowers agreed through Article V of the OST that astronauts were envoys of humanity and nations should make every effort to help each other's national heroes. Coincidentally, cosmonaut Alexey Leonov was involved with two missions that serve as examples of both the risks and potential mitigation strategies to protect astronauts. After completing the first spacewalk in March 1965, Leonov and his fellow cosmonaut encountered problems detaching the landing module and endured a 46-second delay in their reentry plan. Derailed from the predicted landing site, the cosmonauts ended up in the middle of a forest more than 380 km away. While they were still inside the Soviet Union, the risk of landing and getting captured in enemy territory frightened both nations. Thus, the treaty included a statement ensuring that astronauts would be safely returned to their home nation. Having said that, being lost in a forest for a day is not as bad as potentially being stranded in a capsule in low-Earth-orbit, so further provisions were added to help other nations if their astronauts were in danger. To equip themselves against this unlikely scenario, the US and Soviet Union agreed on a docking interface that would allow their two spacecraft to rescue astronauts marooned in orbit. This system was tested in the Apollo-Soyuz project during Leonov's second flight in 1975, and even though it was never used for an emergency rescue, it was a historic step towards international collaboration. Furthermore, nations were also required to share information with the UN about hazards to humans health in space to ensure that all current and future astronauts were cared for. The protection of national heroes was so important that in 1968, this article was expanded into its own treaty known as the Rescue Agreement.

At the time the OST was being formalized, private space companies were already investing in communication satellites like AT&T's Telstar-1. Consequently, Article VI was added to ensure these corporations were also following the same principles from the treaty. Per Article VI, each nation is responsible for all space ventures from its citizens. This encourages governments to define policies and laws to license, oversee activities, and ensure that they are in compliance with international laws [4]. As a direct continuation, Article VII makes the launching state liable for any physical damages associated with a space asset.

Expanding on the idea that space is the province of all humankind, Article IX declares that nations exploring space should (i) be mindful of activities from other nations, (ii) do so while avoiding the harmful contamination of space and other celestial bodies, and also (iii) avoid "adverse changes in the environment of the Earth resulting from the introduction of extraterrestrial matter."



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In 1978 the failed nuclear-powered Kosmos 954 satellite spread radio-active debris over northern Canada. As part of Operation Morning Light, soldiers recover material from snow. Clean up cost $6M.

Acknowledging the possibility of international cooperation for launches, the OST defines a few different categories of launching state that would be liable jointly and severally: (i) the state that launches, (ii) the state that procures the launch, (iii) the state from whose territory the object is launched, and (iv) the state from whose facility the object is launched. Naturally, the OST did not address all the intricate details, so Article VII was expanded in the 1972 Liability Convention. Although there have been a few instances of physical damages, none of them have reached the International Court of Justice. For example, in 1978, the Soviet reconnaissance satellite, Kosmos 954, reentered the atmosphere after a malfunction and scattered radioactive debris over northern Canada. The cleanup effort was dubbed Operation Morning Light and cost $6M. Ultimately, it was settled by diplomatic means with a $3M payment from the Soviet Union.

Aside from a few catastrophic failures leading to premature reentries, most non-operational spacecraft become space junk and remain in orbit for a long time. Even though they are not in use, Article VIII states that the "State Party to the Treaty on whose registry an object launched into space is carried" shall retain jurisdiction in perpetuity both in orbit and upon reentry. Hence, in the context of the Cold War, this prevented the Soviet Union from capturing a defunct spacecraft from Americans to reverse engineer the design. Practically, it led to the 1975 Registration Convention dictating that ownership requires countries to register and track space assets. Unfortunately, this limits present day initiatives to address problems with space debris, as prior approval would be required from its rightful nation before an object can be removed from orbit.

Expanding on the idea that space is the province of all humankind, Article IX declares that nations exploring space should (i) be mindful of activities from other nations, (ii) do so while avoiding the harmful contamination of space and other celestial bodies, and also (iii) avoid "adverse changes in the environment of the Earth resulting from the introduction of extraterrestrial matter." In essence, the environmental focus aims at "protecting future uses and users of space" through responsible exploration of outer space [2]. That is why, Armstrong, Aldrin, and Collins were in a small quarantine box while greeted by President Nixon following their historic flight. More recently, this is why the Cassini spacecraft plunged into Saturn to prevent contaminating Enceladus and Titan, two of Saturn's moons. The former has intriguing ice coverage, and the latter pre-biotic chemistry.

The remaining articles are divided into two categories. Articles X through XIII encourage nations to share information regarding their space activities and define visitation rights for each other's future bases on other celestial bodies. Finally, the remaining four articles of the treaty deal with the diplomatic processes for signing, ratifying, amending, and even withdrawing from the treaty.

(Continued on page 21) »

IEEE Canadian Foundation

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The IEEE Canadian Foundation wants to hear from you – if we can better engage and support our community, please let us know. (president@ieeecanadianfoundation.org, president@ieeefondationcanadienne.org).

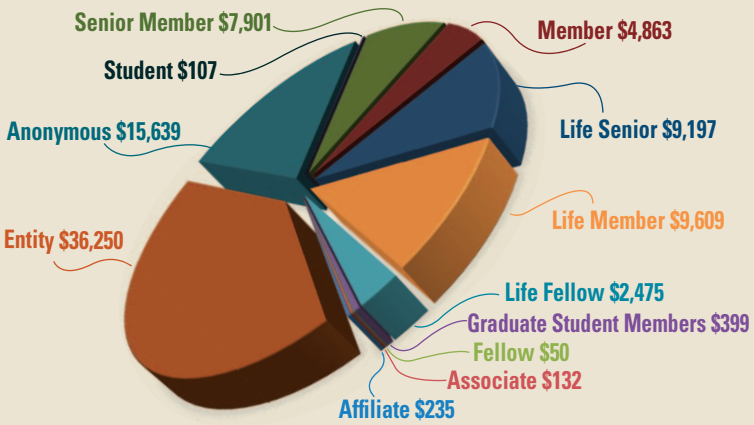
Many IEEE members in Canada contribute to the all-volunteer effort that is the IEEE Canadian Foundation, including the invaluable assistance of Luc Matteau, John Mowbray and many others in the preparation of this 2016 Honour Roll of Donors.

Yours sincerely,



David H. Whyte
President, IEEE Canadian Foundation

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MOT DU PRÉSIDENT—J'aimerais vous remercier encore une fois et souligner votre soutien à la Fondation canadienne de l'IEEE en 2016. Administrés dans le respect le plus strict des attentes des donateurs, les dons aident les ingénieurs d'aujourd'hui et de demain.

Vos dons nous ont permis d'améliorer l'expérience d'étudiants en génie électrique, en génie électronique et en génie informatique grâce aux programmes et bourses de nos Centres McNaughton, et ce, partout au Canada.

Vos dons auront aussi permis de cofinancer des projets spéciaux visant à stimuler l'intérêt pour le génie et à offrir aux étudiants et à d'autres des occasions de perfectionnement. De plus en plus, ces projets mettent la technologie au profit de l'humanité. Les études de cas publiées sur notre site Web, dans l'infolettre mensuelle de l'IEEE Canada et dans cette revue témoignent de la diversité des occasions de perfectionnement technique et professionnel que nous soutenons.

Pierre angulaire de notre autonomie financière et de notre capacité d'action au quotidien, le Fonds général se nourrit de vos dons à usage non déterminé.

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Nous vous remercions de votre soutien et vous invitons à maintenir vos contributions, voire à les augmenter. Vous n'avez pas encore donné? Faites comme vos pairs, posez un geste dès maintenant. Nous pourrons faire tellement plus avec votre appui! Notre site vous permet de choisir le type de don que vous désirez faire et d'en savoir plus sur notre programme de reconnaissance des donateurs.

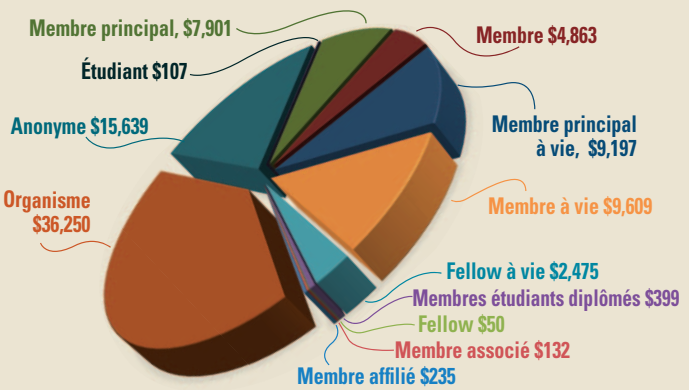
La Fondation canadienne de l'IEEE cherche sans cesse à mieux soutenir son milieu et reçoit donc avec plaisir tous vos commentaires et propositions à cet égard. (president@ieeecanadianfoundation.org, president@ieeefondationcanadienne.org).

De nombreux membres de l'IEEE consacrent généreusement une partie de leur temps à la Fondation canadienne de l'IEEE. Nous sommes notamment reconnaissants à MM. Luc Matteau et John Mowbray et à plusieurs autres pour la préparation de cette liste d'honneur des donateurs 2016 .

Sincères salutations,

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Mathematics Outreach for Motivating Students to Prepare for STEM Careers

Rossitza S. Marinova,
Ph.D., Professor,
Concordia University of Edmonton,
Volunteer for IEEE Canada's Teacher In-Service Program (TISP) and Canadian Math Kangaroo Contest (CMKC)

The STEM fields (encompassing natural sciences, mathematics and statistics; information and communication technologies; and engineering, manufacturing and construction) are especially important for fostering innovation and economic growth. Almost all top ten best jobs of 2017, published by CareerCast.com, are STEM-related jobs. Four of the jobs are explicitly mathematical, and seven involve mathematics and computing. On the other hand, results of the Education at a Glance 2017 study show that STEM is a less attractive field of study in which post-secondary students enrol, even though graduates from STEM disciplines are usually the most employable, and particularly so graduates in information and communication technologies (ICT). The field of ICT attracts less than 5% of new entrants, the smallest share to a field of study, yet yields the highest employment rate on average across OECD countries, signalling a shortage of supply.[1] Workers who successfully combine mathematical and interpersonal skills in the knowledge-based economies of the future will be, and already are, highly prized.



How can IEEE volunteers, including industry professionals and university educators, motivate the new generation to want and prepare for one of these great jobs? What skills should individuals be acquiring to ensure they have value in the modern workplace? To be successful in STEM education, one must be ready for challenging work, and develop the qualities of perseverance and focus. Preparing for careers in STEM must start early – teachers and parents should be a part of the process. Some may be surprised to learn that skills children develop in pre-school such as sharing and negotiating will be crucial and valued highly. "Along with those soft skills, mathematical ability will be enormously beneficial," according to weforum.org.[2]

The Teacher In-Service Program (TISP) connects IEEE volunteers with pre-university educators and students. TISP volunteers share their real-world experiences, and demonstrate engineering, science and mathematics concepts. The Canadian Math Kangaroo Contest (CMKC) is a volunteer-run, not-for-profit organization, with similar goals – to spread the joy of mathematics, science and engineering and instil a passion for these subjects among youth in an inclusive atmosphere.

Competing in math can start from grade 1

Participating in math contest-games can start in grade 1. Math and science competitions are often neglected in Canada as a motivating tool for awakening and developing the curiosity and interest of students. Some of these young children might become future inventors. No one expects that the participants in math competitions will all become mathematicians, just as not all children who take sports or music lessons become athletes or musicians. Parents are seeking challenging math programs for their children in order to develop children' analytical and problem-solving skills. The impression exists that schools nowadays fail to sufficiently develop in children a love and appreciation of mathematics. Certainly, university educators are concerned about the fact that students arrive with certain attitudes toward mathematics, which is an obstacle in getting them excited about all other science and engineering areas. The STEM university teachers and students can help.

The Great Canadian Math Debate

The K-12 mathematics curricula in many provinces of Canada are sources of confusion for teachers, students, and university educators. Children in elementary school are asked to discover and devise their own personal strategies prior to being taught standard arithmetic facts. As a result, many students do not understand and master mathematics; naturally, standardized math scores have been declining. Understanding and skills are essential for doing well in mathematics. Acquiring and retaining math skills requires memorization and practice, effective not only in math but in all natural sciences. How can one progress in engineering, medicine, modern technologies, if every generation has to "discover" every phenomenon already documented? There is hope for improvement after some changes in math curricula took place during the past years. A positive action indeed but a lot more is needed for fixing the broken curricula.

Canadian Math Kangaroo

The purpose of the game contest is to stimulate and motivate the largest possible number of students (as a complement to other activities, competitions, Olympiads and rallies). Consequently, the overarching goal of the CMKC program is to inspire and support students in Canada to choose careers in math, science and technology-related fields, and to help them succeed in their studies. Indirectly, this is achieved by raising awareness and appreciation of math challenges among broader communities, as well as by supporting and educating teachers in providing challenging math opportunities in their classrooms.

It is worth mentioning, as well, that there are unique benefits of Math Kangaroo for mathematically promising students of all ages. Such students are usually under-served in the public education system, which does not provide them with enough challenging and motivating tasks.

The CMKC is part of a broader international project that, as of 2017, involves over six million students and hundreds of mathematicians from more than 65 countries. The contest is organized by the international association "Kangourou Sans Frontières" as an annual game-contest, usually held in March. It consists of a multiple-choice game-test, that is open to all students in grades 1-12, and is an inclusive and broad participation contest-game.

The best part of the competition are the problems – they are provocative, require a great deal of attention and creative thinking, and cover inter-

[1] OECD (2017), Education at a Glance 2017: OECD Indicators, OECD Publishing, Paris. http://dx.doi.org/10.1787/eag-2017-en

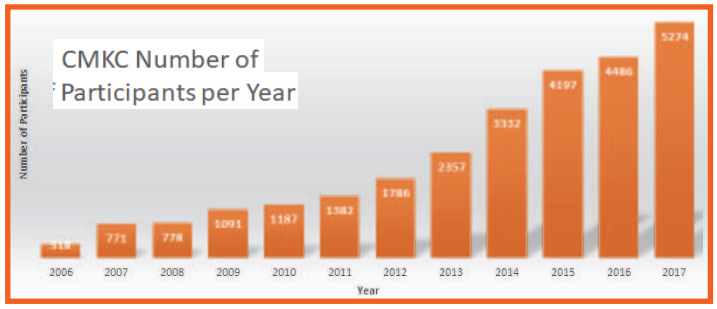
[2] https://www.weforum.org/agenda/2016/09/jobs-of-future-and-skills-you-need/, World Economic Forum



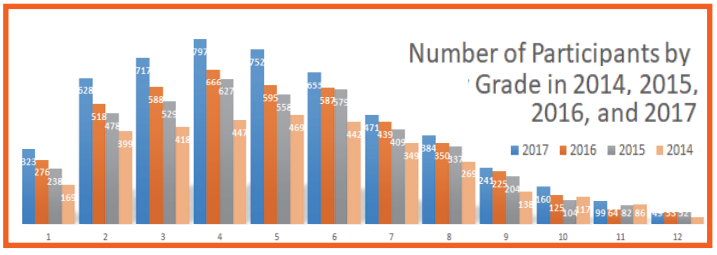
esting mathematical concepts. Students, teachers, and parents love the problems. They are selected from a larger set of problems proposed by the participating countries each year. Representatives from all countries make the selection during the annual meeting of the international association. Finally, countries are authorized, for reasons justified by the characteristics of their school curricula, to make specific changes in the sets.

The following sample problem [2014, grade 5-6 paper] was solved correctly by only 11% of the students in grade 5 and 17% of those in grade 6: "It takes Ben 30 minutes to cut a long log of wood into six pieces. How long does it take him to cut another log of wood into nine pieces? (A) 40 (B) 44 (C) 45 (D) 48 (E) 54."

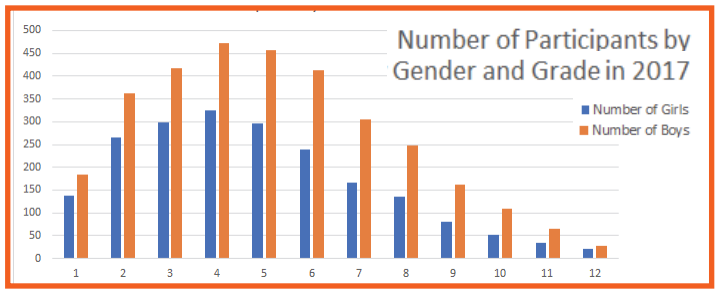
The CMKC contest was offered by 48 institutions in 2017, with a total number of participants 5274. ▼



The number of participants per grade also increased in 2017. ▼



The number of boys outnumbered the number girls. ▼



There is potential for attracting even more participants in many regions. CMKC is constantly seeking ways to expand the contest and its programs, aiming to reach more participants and volunteers across the country. CMKC will work with other organizations to attract more girls to participate in the CMKC programs.

Training activities

- **Math clubs (also known as math circles) and training sessions:** Math clubs aim to challenge and stimulate students with advanced and entertaining mathematical topics, and to prepare students for national and international competitions such as the Canadian Math Kangaroo Contest. A core purpose of the clubs is to meet the educational needs of students who require math challenges beyond the regular school curriculum. Students who learn advanced math have better grades in school, and become better prepared for more rigorous math in high schools and universities. The clubs provide fun, friendly and welcoming places for students to interact with peers who are also interested in math. This is often difficult to achieve in a conventional classroom as there are different interests and abilities. The math clubs offer students ample opportunities to learn from each other and support each other in their math journey.

- **International competitions and training**: Students have participated in international mathematics competitions in Asia and Europe. The training classes prepared students for these contests, and the improved scores boosted their interest and motivated them to work harder. Representing Alberta and Canada in international contests is also an experience that students treasure for a lifetime.

Workshops and math and science fairs

- **TISP workshops to K-12 teachers and students:** Promotion of math and science-related activities for the public are facilitated by the IEEE and CMKC through special sessions bringing together interactive, hands-on science and engineering experiences. An example would be the IEEE TISP activities held with the purpose of showing how mathematics, science, and engineering are related.

- **Coding workshops bringing computer science to local school or district:** IEEE TISP and Math Kangaroo Edmonton hosted two Hour of Code workshops for students, teachers, and parents in November 2016. The workshops were attended by approximately 160 people. Hour of Code https://code.org/ and EU Code Week http://codeweek.eu/ websites contain great resources.

- **Math and science fairs:** The Math Fairs are non-competitive events where students can solve a variety of math and logic puzzles at their own pace. Hosting a Math Fair during math club sessions helps students do problem solving with a goal in mind. IEEE Northern Canada Section also supports Edmonton Regional Science Fair providing opportunities for students to build a life-long love of scientific discovery and learning.

Besides an improvement in grades and contest scores, students who receive training also develop mathematical and critical thinking, which in turn fosters problem-solving skills, creativity, confidence, attention to details and leadership skills. Team training in the program promotes teamwork and collaboration which are invaluable in the workplace. These skills will help students become more productive citizens and employees, thus contributing to our country's future and economy.

What is most rewarding in this work?

Seeing the sparks in children' eyes during challenging outreach experience. It is great to share love and passion with others who can change the future in positive ways. People are usually interested in helping because they love to teach, they are passionate about math, it is for a worthy cause, and they are satisfied to see improvement.

Here are some testimonials on what motivated individuals to volunteer for Math Kangaroo contest and clubs:

> **"I really like what these clubs are doing for students [who are] curious about math outside of what they see in school"**
> — a PhD pure mathematics student.

> **"It might change the life of some of the kids"**
> — one enthusiastic volunteer.

For more information, please have a look at: **www.mathkangaroocanada.com**. Those interested in administering the Canadian Math Kangaroo contest in a school or university can find an application form from the Contact page of the website. ■

About the Author



Rossitza Marinova (SMIEEE) has been a Professor in Mathematics and Computing Science at Concordia University of Edmonton since 2004. She has a Ph.D. in Computational and Applied Mathematics (Bulgarian Academy of Sciences), M.Sc. in Mathematical Modeling, and B.Sc. in Mathematics (Sofia University, Bulgaria). She also worked as a research scientist in the software development industry in Canada and in the National Aerospace Laboratory of Japan. Dr. Marinova is a member of the IEEE TISP Canada committee, contributing through her long-standing service as co-secretary, co-organizing numerous Edmonton-area events and playing a role in several national TISP Canada workshops. She is 2018 Chair of IEEE Canada's Educational Activities Committee. Dr. Marinova is a Life Member of Canadian Mathematical Society and a member of Canadian Applied and Industrial Mathematics Society.

Book Review/Revue de livre

By **Jon Rokne**

"Is technology good for education?" (author: Neil Selwyn)

Selwyn's book is a timely contribution to the debate surrounding uses of technology in education. It is well-organized and easy to read. Selwyn's thoughtful use of questions encourages readers' engagement as he examines benefits and disadvantages of technology as it is used in education in the broader sense.



Author: Neil Selwyn
Publisher: Polity
ISBN-13: 978-0-7456-9646-1
Date: 2015
No. of pages: 175

Selwyn categorizes the use of technology in education into three broad areas: improving, transforming, and revolutionizing education. He organizes the discussion into six chapters - five of which are framed as questions:

Digital Education and Educational Change, Making Education More Democratic?, Making Education More Personalized?, Making Education More Calculable?, Making Education More Commercial?, 'Good' Education and the Digital – So What Needs to Change?

Selwyn notes that the current debate on technology in education tends to be one-sided in favour of technology where some of the arguments are that the current educational model is broken and that digital technology can fix it. Such declarations stifle debate and hinder deeper examinations on how technology may serve learners' endeavours. Selwyn rightly encourages debate when he says: "The ideas of digital improvement/transformation/disruption of education clearly require problematizing: that is, taking a step back from them and not taking them at face value" (page 23).

Selwyn notes that proponents of technological solutions for education may have vested interests. Are they careerists employed to sell technology solutions? Or perhaps academics eager to publish "learned analyses?" Selwyn points out that student learning is not top-of-mind if those are the motivations.

In his first chapter **"Digital Technology and Educational Change"** Selwyn casts his discussion wider than mere classroom practice, noting that this is but a small part of the overall impact of technology in education. Do the politics of education warrant discussion? He asks what changes are realized by the introduction of technology: do the changes actually improve the educational process, are these changes in the learners' best interest?

In the following chapter, "Making Education More Democratic" Selwyn challenges claims that technology improves both access to and success within institutions of higher learning. Where and what is the supporting evidence?

Selwyn considers experiments in massively open online courses (MOOC) — those which are available at no or low cost to anyone with an internet connection. How many students succeed and which demographic do they represent?

In **"Making Education More Personalized"** Selwyn focuses on the claim that the ability to provide customization is one of the important features of on-line education. He provides a balanced view of the claim, citing the perceived advantage of such concepts as e-portfolios while noting that the material learned in an on-line environment will essentially be the same for every student.

Selwyn then focuses his discussion on **"Making Education More Calculable"** where the concept of "datafication" of education is gaining some prominence. He defines "datafication" as the ability to collect data on performance of all actors involved in the educational process. He brings to question how those data might be used and by whom.

In **"Making Education More Commercial"** Selwyn wonders what happens to the learners' rights when they are in conflict with a corporate requirement to achieve profit.

"'Good' Education and the Digital – So What Needs to Change?" provides a concluding discussion of the advantages and disadvantages of technology in education.

In spite of its small size—six succinct chapters in 175 pages—the conversation generated by Selwyn's questions gives the book heft. ■

About the Author

Jon Rokne (LSMIEEE) is a Professor in the Department of Computer Science at the University of Calgary where he served as department Chair from 1989 to 1996. An IEEE member since 1970, Dr. Rokne has volunteered in a number of capacities. In the Computer Society, he completed two terms as Vice-President, Publications and three terms on the Board of Governors. He served as Vice-President, IEEE Publication Services and Products Board and as a member of the Board of Directors of IEEE for two terms. Dr. Rokne is an Associate Editor of the *IEEE Canadian Review*, and has contributed numerous book reviews and articles. He was also a contributor to the Special Focus on Engineering and Technology Education published in the Summer 2013 issue of the magazine; Dr. Rokne wrote on the topic: "The trend towards abstraction in engineering education."



Photo: La maison Simons

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La 31e conférence canadienne de génie électrique et informatique 2018 (CCGÉI 2018) aura lieu à Québec, Canada du 13 au 16 mai 2018 au Centre des congrès de Québec. La CCGÉI est une excellente occasion pour les chercheurs, étudiants et professionnels en génie électrique et informatique, de prendre connaissances des tout derniers développements, d'explorer les sujets émergents et d'échanger avec des collègues afin de renforcer les partenariats existants ou d'amorcer de nouvelles collaborations.

Les communications sont sollicitées dans les domaines suivants :

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Dates limites

Soumissions - Communications (détails à *ccece2018.org*):	**Jeudi 18 janvier 2018**
Avis d'acceptation - Communications:	**Vendredi 2 mars 2018**
Inscription des auteurs / Version finale des communications:	**Dimanche 18 mars 2018**

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Letters from Canada



In 1991, two German scientists posted to Canada shared their impressions with colleagues ...

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Below is an English translation of "W. Heywang, und R. B. Heimann, Als Physiker und Materialwissenschaftler in Kanada, Physikalische Blätter, *Volume 47, Issue 10, October 1991, Pages 943-944", DOI: 10.1002/phbl.19910471017. The first paragraph is the article's abstract.*

This article reports observations of two German scientists, a physicist and a material scientist, who visited Canada as of their different formal positions. Since 1989, Walter Heywang, professor of Technical University of Munich (TUM) and former director of Siemens R&D, is visiting technical adviser in the University of Alberta, where he visits three times a year for four weeks. His main job is technology consulting and transfer and he helps different companies across the Atlantic. Robert Heimann is head of material science division in Alberta Research Council as well as professor at University of Alberta. He is responsible for technology transfer in raw material and manufacturing industries in the Canadian province of Alberta in the area of traditional materials and high power materials especially high power ceramics. He lives in Canada since 1979 (in provinces of Ontario, Manitoba and Alberta) and worked in McMaster University, University of Toronto and in industry (3M Canada) as well as Federal (Atomic Energy of Canada Ltd.) and provincial research laboratories (Alberta Research Council) where he was and still is active in the area of material research.

When a natural scientist steps in a country like Canada, he/she has reasons to study still interesting topics like ice formation, northern light or other similar northern climate changes which characterize this land. However this is not all; as many important contributions in physical research also happen in Canada. Examples for such are: TRIUMF facilities for medium-energy nuclear and particle research in British Columbia with planned "Kaon factory" for medical research, under construction SNO (Sudbury Neutrino Observatory) in Ontario, Herzberg Institute for Astrophysics as well as high energy physics group at Carleton University in Ottawa and OPAL project (Omni-Purpose Apparatus for Linear Electron-Positron Acceleration) which collaborates with CERN. Also many space research projects should be mentioned as well e.g. Mobile Servicing System for Space Station, VIKING project satellite and interesting Space Shuttle experiments.

Finally the works of Erner Israel, University of Alberta, with Stephen Hawking in Cambridge, UK, about black holes must be named which are very topical today. Despite all of these, Canadian contributions are under appreciated in the view of Europeans, who compare things with United States. This holds even more in terms of technical-industrial applications, in which the neighboring United States with ten-fold development puts Canada in the shadow.

This puzzles us more when we see for example how Bell Northern has established itself beyond a Canada-wide telephone company. Why? The enormous area of the country has a determining role in creating the demand for telecommunications. Likewise there are problems like transportation in the vast country under harsh climatic conditions which must be resolved, and Bombardier, which was founded based on local solutions, found a worldwide reputation. The energy issue adds another dimension. So Hydro-Québec, a pioneer in 735KV-distribution, conquered longer distances. Nuclear energy has another leading role based on heavy water moderated CANDU reactor system and the low energy SLOPOKE system, to heat the isolated settlements in Northwest Territories. The raw material industry can proceed by developing extraction procedures for heavy oil, zinc and nickel and biotechnology with the first application of cloning in beef industry.

The medicine has of course a major role as such a young country shows an extraordinary long tradition in that. In 1923, two Canadians F. Banting and R. Macleod won the Nobel Prize for discovery of insulin and its working mechanism. Their colleague, C. Best, made a breakthrough for insulin mass production as a medicine. The remarkable status in medical technology with important contributions like imaging systems, prosthesic devices and new drugs benefit a lot from their exemplary social healthcare system. And as another example: in Alberta there is a fund to generously sponsor the medical research and developments.

However we should not still use these to compensate the prevalence of physics and technology in United States when comparing with that of Canada. This is because Canada is much younger as an independent country and so far it was only a raw material producer and in many aspects it is still at the beginning of industrialization. Large dependence on the reservoirs of raw material and a less diversified economy of Canada, for example oil and natural gas and coal of Alberta, forest industry of British Columbia and Quebec, potassium and uranium mining of Saskatchewan as well as nickel, zinc

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and copper mining in Manitoba and Ontario, makes the country very susceptible to the cyclic ups and downs of the world market.

As the aforementioned situation in Canada was very much recognized, wide spectrum industrialization felt necessary which will shift the economy toward more high performance products, materials and technology. This is only possible through participating in a steadily increasing globalized commercial competition. The importance of this was mentioned in the so called Halifax-Declaration 1989, a report presented by the National Forum of Science and Technology Council to the Canadian Federal Government. Ultimately that was this necessity which brought the authors together. The realization of these goals from the status of a raw material country with yet weakly developed technological resources was and is not at all easy. A very fruitful step was founding internationally known universities and research institutes, which is of course one of the many prerequisites for commercially usable high technology innovations. For an effective technology transfer the expertise in production and marketing are also necessary. These could not be achieved by merely shifting the existing R&D activities in these directions, although it was recently practiced to some extent - not only in Canada.

Also the required growth of total R&D expenditure in Canada, which is still 1.4% (compared with 2.9% in Federal Republic of Germany) of the gross national product, is not only hampered by the budget crisis due to austerity measures of the fiscal policy, but only provides a partial solution to the problem as the industries are mostly formed from small companies as well as production companies with foreign consortiums that sparsely contribute to local development.

Based on what we have said before, the way to quickly resolve the aforesaid problems is a focused international cooperation through which the missing Know-how's in technology and industrializing as well as management experiences can be incorporated. This is one of the essential tasks that the authors devoted themselves to, a task which is appealing as well because Canada is not empty handed. There is – as it was said before – exceptional experiences from the raw material sector, from agriculture to wood industry as well as its geographical vastness.

Canadian people not only consider themselves as "multicultural", but also they practice it in reality. Thus for a German person it feels more to be "at home" compared to the neighboring United States- and with the same generous and vast nature

In telecommunications sector, first of all the mobile and satellite communications must be mentioned. In addition there are particular achievements from newly founded universities and research centers with remarkable but yet less applied synergy potential. This is partly due to the geographical vastness of the country and partly because of the less developed industrial infrastructure. Although there are many positive aforementioned examples here which could be used, we would like to emphasize on our two year projects with Alberta in focus:

In the material sector, so far two cooperation contracts with European companies as well as research institutes were closed and four more are under progress. In this sector the Alberta experience regarding raw material extraction and processing was an essential factor, possibly by looking back at our economical trade with Soviet Union whose northern territories have geological and climatic similarity with that of Canada.

With regard to agriculture one of these operations in biotechnology must be emphasized. Beside these activities which are mandated by economical conditions, some specific areas must not be forgotten for example laser sector in which two cooperation contracts were signed with German companies or the field of speech recognition and parallel data processing as well as heavy automotive industry with altogether four cooperation contracts in progress.

All of the abovementioned cases fall into the category of the authors' expertise and therefore serve as examples only. But they would like to show that Canada is appealing as a technical-scientific collaborator, a fact that Europeans despite their common cultural roots with Canada took less advantage of as opposed to the Japanese.

In this summary we would like to mention that Canadian people not only consider themselves as "multicultural", but also they practice it in reality. Thus for a German person it feels more to be "at home" compared to the neighboring United States- and with the same generous and vast nature.

This should be a reason for a physicist who is interested in having a technical-scientific cooperation with this country. On the other hand Canada welcomes such cooperation in order to achieve a balanced development not only in the preferential raw material sector but also in industrial business as well. Only if this is achieved very fast, then Canada can protect its economic and technological independence despite having a close border and free trade with USA and it can play its sought role as a bridge between developing economy blocks. ■

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Next issue: ***The future of Space Law***

About the Author



Dario Schor is currently a Software Engineer at Magellan Aerospace while pursuing a Space Studies Ph.D. at the University of North Dakota. He obtained his B.Sc. and M.Sc. in Computer Engineering from the University of Manitoba in 2008 and 2013 respectively before attending the 2013 Space Studies Program from the International Space University in Strasbourg, France. Dario has served in various roles within IEEE Canada and the Winnipeg Section. He can be reached by email at schor@ieee.org.



What's New in the Literature?



by Terrance Malkinson

The close of the year sees a plethora of articles on national and global successes and challenges. *Scientific American* [December, 2017. www.scientificamerican.com] in collaboration with the World Economic Forum profiles "Ten Emerging Technologies of 2017" that are considered to be ideas that are poised to transform society. FORTUNE [November, 2017. www.fortune.com] profiles "The Future 50", innovative companies that are thought to be primed for explosive growth. Both *Popular Mechanics* [December, 2017. www.popularmechanics.com] and *Popular Science* [December, 2017. www.popsci.com] profile their choices for the top technologies of 2017. *Harvard Business Review* [November-December 2017. www.hbr.org] profiles "The Best Performing CEO's in the World – 2017". FORTUNE [October, 2017. www.fortune.com] profiles the "50 Most Powerful Women" and leading the ranking for her third straight year is Mary Barra, Chairman and CEO of General Motors. Finally, *Entrepreneur* [November, 2017. www.entrepreneur.com] has published its first annual list of the "50 Most Daring Entrepreneurs". Inspirational stories of individuals who successfully took a leap in 2017 and enjoyed the rewards of being bold entrepreneurial inventors, leaders, and designers. Valuable insights for those seeking to be proactive and successfully manage their life journey.

Moving along to the future a special issue of *Bloomberg Businessweek* [www.bloomberg.com/businessweek] focuses on "The Year Ahead - 2018" Numerous authoritative articles discuss what the authors think will, and will not, occur in 2018. The introduction to the special issue provides an overview of the world economy which is followed by an in-depth analysis of economics, technology, retail, energy and politics. The issue concludes with profiles of 50 publicly traded companies that Bloomberg intelligence analysts believe are worthy of special attention because they plan to release significant products and services in the coming year or because they face unusual challenges. A special issue of *The Economist* [www.economist.com] "The World in 2018" also provides numerous authoritative articles providing readers with excellent information on what we might expect in the coming year. The savvy worker, investor, job-seeker, and student evaluating their future will take time to review these and other authoritative reports to help ensure their personal and career success.

Jeffrey Immelt has stepped down after 16 years as CEO of General Electric. In his *Harvard Business Review* [September-October, 2017. www.hbr.org] article "How I Remade GE and What I Learned Along the Way" Mr. Immelt shares with the reader what he has learned about leading a giant organization through massive changes. A scientific approach to turning prospects into successful leaders is provided in "Turning Potential into Success: The Missing Link in Leadership Development" *Harvard Business Review.* [November-December, 2017]. The process begins with identifying which of seven key leadership competencies are critical to your organizations' top roles, assessing a candidates' potential by examining five predictors of competency, and providing the correct coaching and development opportunities.

There are a number of space probes on journeys throughout the galaxy in the quest to seek out knowledge that will help characterize the solar system and the processes involved in its formation. The New Horizons probe was launched on January 19, 2006 from Cape Canaveral and was destined for a distant rendezvous with the planet Pluto in ten years. *Discover* [December, 2017. www.discovermagazine.com] provides an overview of the learnings from this satellite as it past the planet Pluto in 2015 and results from another space probe "Dawn" that explored the asteroid Vesta and later began orbiting the dwarf planet Ceres. In late-breaking news (December 2) NASA scientists have successfully reoriented the 40-year-old Voyager 1; the space agency's farthest spacecraft so that its antenna would continue to point toward Earth at a distance of 13 billion miles away. Amazingly they accomplished this trajectory correction maneuver using thrusters, located on the back side of Voyager 1 that had not been used in 37 years. The Voyager 1 and 2 missions discovered the first active volcanoes beyond Earth on Jupiter, and indications of a subsurface ocean on Jupiter's moon Europa. They analyzed Saturn's largest moon, Titan, where data showed a thick Earth-like atmosphere; found the icy moon Miranda at Uranus; and spotted icy-cold geysers on Neptune's moon Triton. It is expected that in the year 40,272, Voyager 1 will come within 1.7 light years of an obscure star in the constellation Ursa Minor. What outstanding examples of sustainable engineering!! The NASA website [www.nasa.gov] provides detailed information on all space probes.

Voyager 1 and 2 found active volcanoes on Jupiter, and indications of a subsurface ocean on Jupiter's moon Europa. They analyzed Saturn's largest moon, Titan, where data showed an Earth-like atmosphere; found the icy moon Miranda at Uranus; and spotted icy-cold geysers on Neptune's moon Triton

Canada also has been successful in space engineering. Canada's first Earth-orbiting satellite, Alouette I launched fifty-five years ago (Sept. 29, 1962) is still orbiting at a distance of 1,000 km above the earth and there's no sign of it coming down. Additionally, Canada launched Alouette II in 1965 and it is also still orbiting the Earth. Now decommissioned, these Canadian satellites incorporated cutting-edge technologies and were a great source of Canadian national pride. The satellites featured innovative Canadian designed antennas (storable tubular extendable members) that were widely adopted and used in future space missions including the Gemini and Apollo moon missions. Canada was the third nation after the U.S. and Russia to design and build its own satellites.

Alouette I and II featured innovative Canadian-designed antennas that were later used in the future Gemini and Apollo space missions.

The first issue of *McKinsey Quarterly* [www.mckinsey.com/quarterly] was published in 1964 and the magazine continues to contribute to the advance of management. A selection of interesting features recently published includes: 1). "Wellness at Work: The Promise and Pitfalls" [October, 2017] examines the totality of workplace wellness that must extend well beyond the typical discounted fitness club membership. 2). "Where is Technology Taking the Economy?" [October, 2017] examines our creation of an intelligence that is external to humans and located in the virtual economy where different rules apply. 3). "What the Future of Work Will Mean for Jobs, Skills, and Wages" [November, 2017] discusses new research yielding information assessing jobs lost and jobs gained under different scenarios through 2030. 4). "Double-clicking on the Chinese Consumer" [November, 2017] discusses new trends in the Chinese consumer landscape, a timely topic with Prime Minister Justin Trudeau's recent visit to China in December to meet President Xi Jinping.

The focus of the November-December issue of *MIT Technology Review* [www.technologyreview.com] is Artificial Intelligence. AI is a widely promoted but sometimes misunderstood technology. The critical question is "What is the best way to design the technology in such a way that people and machines can work together and produce results that neither could achieve on their own?" This is the context for information presented in the ten authoritative articles featured in the issue. ■

For **Terrance Malkinson**'s biography please see page 7.

SAMIRA RAHIMI INTERVIEW cont'd from pg 8 »

your field and background are totally different than other team members. The main goal is shared amongst all, which is success of the team and the project.

ICR: In reaching a consensus, how do multidisciplinary teams avoid creating the perception of invalidation when a member's opinion is not reflected in the final decision?

SR: Based on my experience, I think creating a friendly environment in which all have opportunity to talk and express their thoughts, knowing that they won't be judged could play an important role. First, this could help them to express themselves, bring innovative ideas to the discussions, and if their opinion is not reflected in the final decision at least they had an opportunity to speak up. Second, creating a friendly environment could help team members accept that rejection of an idea by the group isn't a rejection of the person(s) that put forward the idea.

ICR: To what extent do different professions have different approaches to problem solving?

SR: Comparing engineers and clinicians' approaches, I can say they have very different approaches. For example, while engineers are more focused on technical and methodological sides, clinicians' first priority is human aspects. However, I can say that they all have the same goal — which is solving the problem in the best possible way. They reach that with different perspectives, and that's why flexibility is important in multidisciplinary teams.

ICR: How much understanding of different disciplines does the team leader need?

SR: I think that leaders need to engage in an ongoing process and improve their understanding of different disciplines: in addition to seeing the big-picture, they need to also be able to grasp details and understand them. In general, having a big-picture knowledge is required, and in some aspects, detailed understanding is important and influential in guiding the team well. So balanced knowledge and understanding of different disciplines is important for leaders in multidisciplinary teams.

ICR: How can a leader guard against bias in favour of her/his own background/discipline?

SR: I think having an open mind and being eager to learn could help; learning different disciplines could give leaders multiple perspectives and ways of looking at the same problem. Also, having multi-disciplinary team meetings periodically, and at key decision points, would be a way to give equal voice to all disciplines, and guard against biased thinking and decision making. ■

A FEW WORDS FROM THE EiC, cont'd from pg 6 »

Canada volunteer with an IEEE Northern Canada Section record of service going back many years. Over the next few issues, we'll be profiling STEM activities led by IEEE Region 7 volunteers. One of the top three recommedations flowing out of last August's IEEE Sections Congress relates to enabling greater local STEM outreach at the Section level.

Still on the topic of education, Contributing Editor Jon Rokne brings us a book review that looks critically at the efficacy of increased use of technology in education.

In Terry Malkinson's columns, I always find several items that particularly pique my interest. In this issue, "Biztech" takes a brief look at Canada's Avro Arrow fighter jet, an example of this country's aerospace prowess that Profs. Heywang and Heimann might well have cited, had the project not been aborted in 1959. In "Engineering Management: What's New in the Literature?" Terry salutes the 55th anniversary of the launch of the Alouette I satellite, a Canadian space technology success story honoured as an IEEE Milestone in 1993; later satellites in that program enjoyed similar success. Terry also reviews coverage of several NASA probes that have been sending back images and data after their long-planned far-flung rendezvous.

All the best to you and yours in 2018. ■

IEEE Canadian Review

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To inform Canadian members of IEEE on issues related to the impacts of technology, and its role in supporting economic development and societal benefits within Canada. To foster growth in the size and quality of Canada's pool of technology professionals to serve our increasingly knowledge-based economy.

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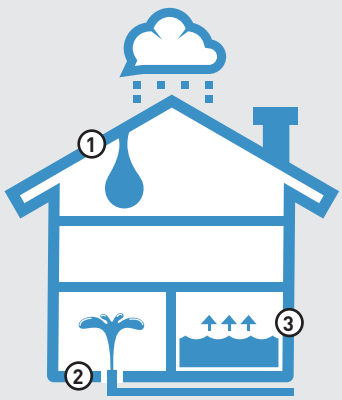
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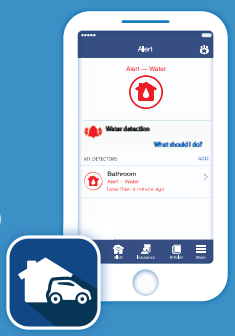
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