

IEEE

Winter/ Hiver 2011
No. 65

Canadian Review

La revue canadienne de l'IEEE

Use Your Eyes!

*Stereo Ego Motion and
Fault Tolerant State
Estimation in Military
Unmanned Systems*



Reactive Power Services

**IEEE Senior Members
Recruitment**

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The *IEEE Canadian Review* is published three times per year. Its principal objective is to project an image of the Canadian electrical, electronics, communications and computer engineering professions and their associated academic and business communities to:

- (i) Canadian members of IEEE;
- (ii) Canadian members of the profession and community who are non-members of IEEE;
- (iii) The associated Canadian academic (i.e., universities, colleges, secondary schools), government and business communities.

To ensure that the *IEEE Canadian Review* has the desired breadth and depth, editors are responsible for screening articles submitted according to the following general themes:

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4 - Education	8 - Electronics

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The circulation of the *IEEE Canadian Review* is the entire membership of IEEE Canada, plus external subscribers.

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Authors are invited to contribute submissions in electronic form to the *IEEE Canadian Review*. Please contact one of the editors. Responsibility for the content rests upon the authors and not the IEEE, or its members.

Annual Subscription Price

Free of charge to all IEEE members in Canada.

For IEEE members outside Canada: \$20.00/year. Non-members: \$35.00/year. Corporations and libraries: \$37.50/year. Additional copies may be ordered at a cost of \$7.50 each from the Managing Editor.

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The National Library of Canada
ISSN 1481-2002
La Bibliothèque
nationale du Canada

Eric Holdrinet SMIEEE, Rédacteur en chef / Editor-in-Chief: 2005-2010

This is my last editorial for the *Review*, having started assembling this issue last Fall (yes, it does take time.) Dr. Amir Aghdam will now handle the Editor-in-Chief position. I wish him all the success possible and thank him heartily for his help in the last couple of years.



Many thanks to the *Review* team: Dr. Shaahin Filizadeh, who put in place our new peer-review practice; Kexing Liu, who brought our Publicity & Advertisement processes forward; Distinguished Columnists Terry Malkinson (Ed.in-Chief's Award for Most Prolific Article Contributor!) and Alexandre Abecassis; Associate Editors Habib Hamam, Khelifa Hettak, Dave Kemp, Samuel Pierre, Camille-Alain Rabbath, Vijay Sood, Bin Wu and Alain Zarka without whom quality content would be sorely lacking; Bruce Van-Lane and his group at Communications Matters, who take pride in bringing out professional layouts and graphics every issue; the IEEE Canada Board for its support; and all the authors and peer-reviewers who gave freely of their time for the IEEE community.

A thought for Théodore Wildi, who passed away last Fall. Ted was professor emeritus at Université Laval and a member of the Order of Canada, a well-published author and inventor. He was an active volunteer of IEEE Canada and much appreciated by his peers and students, a recipient of the Region's highest award the McNaughton Medal in 1987, and Editor of the *Review* in 1992-1993.

Now for this Issue. "Stereo Ego Motion and Fault Tolerant State Estimation in Military Unmanned Systems", quite a long title for what I would call Dead Reckoning for Robots. GPS is fine, but in many instances it may not be sufficient to guide your vehicle in 'noisy' environments (like a battlefield.) I expect advances made in this area to trickle towards civilian applications, helping to raise the safety of autonomous vehicle to a level sufficient for widespread use.

A "Survey of Different Economic Mechanisms for Reactive Power Services" will be of interest for anyone who lived through a power blackout! Someone has to ensure that sufficient voltage is maintained in the network ... How do Ontario, New Brunswick, and various US states do it?

I invite you to browse our Conferences page. In addition to IEEE Canada's annual events, CCECE and the Electrical Power & Energy Conference, the Region directly supports two more: The Teacher-In-Service Program (TISP), where you can learn how to contribute to pre-college teaching, and our first national Women in Engineering conference. You will also notice major international events such as the Conference on Autonomous and Intelligent Systems, the Symposium on Personal, Indoor and Mobile Radio Communications, and in 2012 the IEEE Conference on Communications, the IEEE International Magnetism Conference, and the Microwave Symposium (which draws around 12,000 attendees!)

(Continued on page 4)

Ceci est mon dernier éditorial pour la *Revue*, celle-ci ayant été démarrée à l'automne dernier (oui, ça prend du temps.) Dr Amir Aghdam va maintenant occuper le poste de rédacteur en chef. Je lui souhaite tout le succès possible et le remercie chaleureusement pour son aide ces dernières années.

Mille mercis à l'équipe de la *Revue* : Dr Shaahin Filizadeh, qui a mis en place notre pratique de revue par les pairs; Kexing Liu, qui a fait progresser notre processus publicitaire; les distingués chroniqueurs Terry Malkinson (Prix du Rédacteur en chef pour Contributeur d'articles le plus prolifique!) et Alexandre Abecassis; les adjoints à la rédaction Habib Hamam, Khelifa Hettak, Dave Kemp, Samuel Pierre, Camille-Alain Rabbath, Vijay Sood, Bin Wu et Alain Zarka sans qui il y aurait une sévère disette de contenu de qualité; Bruce Van-Lane et son groupe à Communications Matters, qui s'enorgueillissent à produire une mise en page et des images de qualité à chaque numéro; le conseil d'administration du IEEE Canada pour son support; et tous les auteurs et réviseurs qui ont donné généreusement de leur temps à la communauté IEEE.

Une pensée pour Théodore Wildi qui est décédé l'automne dernier. Ted était professeur emeritus à l'Université Laval et membre de l'Ordre du Canada, un auteur et inventeur prolifique. Il était un bénévole active de l'IEEE Canada et très apprécié par ses pairs et ses étudiants, un récipiendaire de la plus haute distinction de la Région en 1987, la médaille McNaughton, et a été rédacteur en chef de la *Revue* en 1992-1993.

Et maintenant, le contenu. « Stereo Ego Motion and Fault Tolerant State Estimation in Military Unmanned Systems », un long titre pour ce que j'appellerais Navigation au Pif pour Robots. Le GPS c'est bien, mais dans plusieurs cas il pourrait ne pas être suffisant pour guider votre véhicule dans un environnement 'bruyant' (tel un champ de bataille.) Je m'attends à ce que les progrès accomplis dans ce domaine percolent vers des applications civiles, aidant à hausser la sécurité des véhicules autonomes vers un niveau suffisant pour une utilisation plus répandue.

L'article « Survey of Different Economic Mechanisms for Reactive Power Services » sera d'intérêt pour quiconque a vécu une panne électrique majeure! Quelqu'un doit s'assurer qu'une tension suffisante sera maintenue dans le réseau ... Comment font l'Ontario, le Nouveau-Brunswick et divers états américains?

Je vous invite à parcourir la page des conférences. En plus des événements annuels de l'IEEE Canada, CCGÉI et la Conférence sur l'énergie électrique, la Région en supporte directement deux autres : Le Programme d'aide aux enseignants, où vous apprendrez comment contribuer à l'enseignement pré-universitaire, et notre première conférence national des Femmes en génie. Vous remarquerez aussi des événements internationaux majeurs tels la Conférence on Autonomous and Intelligent Systems, le Symposium on Personal, Indoor and Mobile Radio Communications, et en 2012 l'IEEE Conference on Communications, l'IEEE International Magnetism Conference, et le Microwave Symposium (qui attire environ 12,000 participants!)

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Dear Friends in IEEE Canada,

In my message in the last issue of the *Canadian Review*, I mentioned the IEEE Board of Directors (BoD) transformation/restructuring discussions. The proposals presented at the BoD meeting last November were refused, and thus the BoD continues as before.

The tagline under the IEEE logo reads "Advancing Technology for Humanity." To borrow from IEEE President Moshe Kam's recent message, it reflects the IEEE efforts to address Global Humanitarian Challenges. It represents recognition on the part of IEEE of the great potential of our members to provide effective assistance and leadership in regions with under-developed infrastructure, and in areas where it was damaged by natural or human-made disaster.



One action that IEEE has initiated in this direction is the launch, jointly with the American Society of Mechanical Engineers and Engineers Without Borders USA, of a new on-line platform called "Engineering for Change" (E4C). This platform provides engineers, technologists, computing and networking experts, non-governmental organizations and local community advocates with tools to collaboratively address humanitarian and global development challenges. I invite you to visit engineeringforchange.org; you may be tempted to join the E4C community and share information and expertise on humanitarian projects that match your individual professional profile.

In line with this effort, IEEE Canada established a Humanitarian Initiatives Committee (HIC) in 2010 to promote the IEEE core values, raise awareness of how IEEE Canada can best use its strengths to address societal problems, and provide leadership, encouragement and support to Sections and Chapters interested in humanitarian initiatives.

As its first undertaking, HIC set up a humanitarian student design competition open to undergraduate and master's students enrolled in a Canadian College or University. An abstract of the winner's work will be published in one of the IEEE publications and three prizes will be awarded. I am happy to report that the IEEE Canadian Foundation (ICF) has approved a grant of \$2,000 to support the student prizes and another \$3,000 to support students' travel and accommodation expenses.

This is just one example of the activities of the ICF in support of IEEE Canada, its members and especially its student members. I encourage all our members to make tax-deductible donations to ICF so that it can provide even greater support for such worthy causes.

In conclusion, please note that I welcome your comments and suggestions. My contact is maliko@iee.org. Wishing you all the best,

Dr. Om Malik, P.Eng., LFIEEE, FCAE, CEIC, FEIT, FEIC

2010-2011 IEEE Canada President and Region 7 Director

Editorial (cont'd from p. 3)

Alexei Botchkarev, keen volunteer of IEEE Toronto, reports on their success in promoting members to Senior grade, how important such titles are for professional recognition, and proposes that IEEE could do as well as—or better than—other organisations by introducing a 'Certified' grade. Branislav Djokic reports on a series of very successful workshops held in Ottawa on the subject of Instrumentation and Measurement, including a lively interview with Kim Fowler, president, I&M Society.

Columnist Terry Malkinson feels concerned about the health of fellow engineers. As he says, "We are all biological beings for whom physical activity is an essential ingredient for effective functioning. We can improve our resilience to stress and as a result be better engineers." Exercise regularly, get in shape, live long and prosper. This is what I wish you for 2011, and thereafter.

Chers amis de l'IEEE Canada,

Dans mon message du dernier numéro de la *Revue canadienne*, j'ai mentionné les discussions en cours sur la transformation/restructuration du Conseil d'administration (CA) de l'IEEE. Les propositions offertes à la réunion du CA en novembre dernier ont été refusées, et donc le CA fonctionnera comme avant.

La légende sous le logo de l'IEEE se lit "Advancing Technology for Humanity" (Trad.libre : Faire progresser la technologie pour l'humanité.) Comme le mentionnait le président de l'IEEE Moshe Kam dans un message récent, cela reflète les efforts de l'IEEE à s'attaquer aux défis humanitaires globaux. Cela représente une reconnaissance par l'IEEE du grand potentiel de nos membres à fournir une aide et un leadership efficaces dans des régions aux infrastructures sous-développées, et des zones où elles ont été endommagées par des désastres naturels ou causés par l'homme.

Une mesure que l'IEEE a entreprise dans cette direction est le lancement, conjointement avec l'American Society of Mechanical Engineers et Engineers Without Borders (Ingénieurs sans frontières) USA, d'une nouvelle plate-forme en ligne nommée "Engineering for Change" (E4C). Cette plate-forme fournit des outils aux ingénieurs, technologistes, experts en informatique et réseautique, porte-parole d'ONG et de communautés locales, pour s'attaquer collectivement aux défis humanitaires et de développement global. Je vous invite à visiter engineeringforchange.org; vous pourriez être tenté(e) de rejoindre la communauté E4C et offrir information et expertise pour des projets humanitaires qui conviennent à votre profil professionnel individuel.

De concert avec cette activité, IEEE Canada a établi un Comité d'initiatives humanitaires (CIH) en 2010 pour promouvoir les valeurs fondamentales de l'IEEE, sensibiliser sur comment l'IEEE Canada peut le mieux utiliser ses forces pour aborder les problèmes sociaux, et fournir du leadership, des encouragements et du support aux sections et chapitres intéressés par les projets humanitaires.

Comme première activité, le CIH a lancé une compétition étudiante humanitaire de design ouverte aux étudiants de premier et second cycle des universités canadiennes. Un sommaire du travail gagnant sera publié dans une des publications de l'IEEE et trois prix seront remis. Je suis heureux de vous apprendre que la Fondation canadienne de l'IEEE (FCI) donnera 2 000 \$ pour financer les prix aux étudiants et un autre 3 000 \$ pour supporter les dépenses de voyage et hébergement des étudiants.

Cela est juste un exemple des activités de la FCI en appui au IEEE Canada, ses membres et spécialement ses membres étudiants. J'encourage tous nos membres à faire un don déductible d'impôt à la FCI pour qu'elle puisse fournir un support encore plus important à de telles causes méritantes.

Pour conclure, veuillez noter que j'accueillerai avec plaisir vos commentaires et suggestions. Mon adresse est maliko@iee.org. Sincères salutations,

Éditorial (Suite de p.3)

Alexei Botchkarev, volontaire par excellence d'IEEE Toronto, fait rapport de leur succès dans la promotion des membres au grade Senior, à quel point ces titres sont importants pour la reconnaissance professionnelle, et suggère que l'IEEE puisse faire aussi bien—sinon mieux—12que d'autres organisations en introduisant un grade 'Certifié'. Branislav Djokic relate une série d'ateliers tenus avec succès à Ottawa sur le sujet de l'Instrumentation et mesures, incluant une entrevue colorée avec Kim Fowler, président, I&M Society.

Notre chroniqueur Terry Malkinson prend à cœur la santé de ses collègues ingénieurs. Comme il dit (trad.libre), « nous sommes tous des êtres biologiques pour qui l'activité physique est un ingrédient essentiel pour bien fonctionner. Nous pouvons améliorer notre résistance au stress et ainsi être de meilleurs ingénieurs. » Faites de l'exercice régulièrement, mettez-vous en forme, longue vie et prospérité. C'est ce que je vous souhaite pour 2011 et les années suivantes.

Eric Holdrinet, SMIEEE

Editor-in-Chief 2005-2010 / Rédacteur en chef 2005-2010

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A View from the West

On: Engineering Entrepreneurship, Lumber, Animation, The Future, Alberta 2010 Awards, Biotechnology, Investing in Saskatchewan, Mining, and MIT's 150th.

◆ British Columbia

Andrew Findlay describes an innovative program between the University of Victoria and Wesley Clover International Corporation in "The New Partner" [BC Business, October 2010]. The Engineering Entrepreneurship@UVic master's program [http://www.ece.uvic.ca/~eemp/] takes a problem or opportunity that consumers or businesses have identified and then focuses research activity to finding a marketable solution. The article provides considerable food for thought on university-industry collaboration to foster innovation and commercialization of research.

The Chinese market is developing into a booming export opportunity for lumber and other value-added forestry products. The BC Forestry Innovation Investment Ltd agency estimates that from 2007 to 2009 lumber sales to China has tripled to more than \$327M. Treena Hein describes this growing market, its challenges and its opportunities in "China Comes Knocking" [Canadian Forest Industries, September/October 2010; www.canadianforestindustries.ca].

The Vancouver animation industry has historically been dependent on work outsourced from Hollywood ["The Gold Rush", Peter Severinson, BCBusiness, November 2010]. Many now believe that with the development of several mature Canadian animation studios employing hundreds of skilled animators, the time has come to create our own world-class animation content. Challenges and opportunities in this competitive and growing business sector are discussed.

The World Future Society will be holding in mid-July in Vancouver its annual conference under the theme "World Future 2011: Moving from Vision to Action" [www.wfs.org/content/worldfuture-2011]. A thousand futurists from around the world are expected to attend and deliver presentations on technology, education, health, business, families, communities, work trends, social change, the environment, resources, globalization, education, governance, futures methodologies, and many other topics. The World Future Society is a nonprofit educational and scientific organization founded in 1966, with members from all walks of life in more than 80 countries. The November/December 2010 issue of The Futurist includes a 9-page insert "Outlook 2011" which offers glimpses of what might occur in the decade ahead.

◆ Alberta

Canadian industry is doing what it can to improve our trade-deficit position. Global competition is fierce and the business of selling goods and services abroad is challenging; however there are many success stories. Category winners in the 2010 Alberta Export Awards are profiled by Geoff Morgan and Cailynn Klingbeil in the December 2010 issue of Alberta Venture. Also profiled is Alberta's 2010 Business Person of the Year: Don Lowry - President and CEO of Epcor Utilities Inc. We can all learn from such successful individuals and apply these lessons to achieve our own success.

Biotechnology is believed to be an important and growing industry as the base of the world economy changes. Marzena Czarnecka reports on Alberta's biotechnology industry in "Growing Pains" [Alberta Venture, October 2010]. Even with all of the necessary ingredients of world-class universities, technical institutes, and intellectual talent "the formula for turning opportunity into tangible success remains elusive". An in-depth analysis of possible reasons for this is presented.

◆ Saskatchewan

The Fraser Institute [www.fraserinstitute.org] recently ranked Saskatchewan second in the nation in its "Canadian Investment Climate 2010 Report". Eight major economic forecasters are predicting that

By Terrance Malkinson



Saskatchewan will have the fastest growing economy in Canada in 2011. Paul Miller presents a ranking of its Saskatchewan's top 100 companies in "Go for the Gold" [Saskatchewan Business Magazine, September 2010; saskatchewanbusinessmagazine.com], and points out the importance that leadership plays in organizational success. Leading the ranking is Viterra Inc, followed by Federated Co-Operatives Ltd and PotashCorp - the latter having been recently recognized with four awards from the Canadian Institute of Chartered Accountants, and been much in the spotlight during BHP Billiton's recent acquisition attempt. An article on Enterprise Saskatchewan, the province's economic promotion organisation, is provided by Shirley Callingridge in the subsequent issue of the magazine.

◆ Manitoba

Bob Armstrong and Richie Gage provide a compilation of interviews with many of Manitoba's business leaders on how the economy has affected their companies and offering their insights on the recovery "Exclusive Interviews with Corporate Executives: who got hurt and who didn't. CEO's talk about the economy", Manitoba Business, August-September 2010]. In the same issue brief portraits of 56 leading Manitoba businesses provide insights into their scope of activities and success. The mining sector in Manitoba as discussed by James Paris is experiencing growth as the world commodity prices for previous and base metals grow in value ["The Search for New Ore", Manitoba Business Magazine, October/November 2010].

Further East: MIT's 150th Anniversary

2011 marks the 150th anniversary of the founding of the Massachusetts Institute of Technology [http://mit150.mit.edu/]. As described by Michael Geselowitz in January's issue of IEEE-USA Today's Engineer ["IEEE & MIT"; www.todayengineer.org], MIT has many historical intersections with the IEEE. Founded in 1861 by William Barton Rogers and located in Cambridge, Massachusetts, MIT has played a pivotal role in educating generations attracted from around the world, including the article's author. It places a strong emphasis on engineering, science and technology as well as innovative research and entrepreneurship. Many MIT alumni have won a Nobel Prize or been selected as Rhodes Scholars. In 2009 MIT enjoyed an \$8.0 billion endowment, spent \$718.2 million in research expenditures, and awarded more than 2,000 graduate degrees.

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, associate 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 420 publications, and an accomplished triathlete.

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Call for Papers

IEEE EPEC 2011 Electrical Power and Energy Conference *Advanced Technologies for Emerging Power Systems*

October 3—5, 2011, Winnipeg, MB, Canada

The annual Electrical Power and Energy Conference (EPEC 2011) will take place in Winnipeg, Manitoba, Canada, from October 3 to 5, 2011. Located in the center of Canada, Winnipeg is a culturally diverse, creative and cosmopolitan city with a warm, welcoming spirit. The objective of EPEC 2011 is to provide a forum for experts in Electrical Power and Energy to disseminate their recent research outcomes and exchange views on future research directions. This year we are working with The Energy Services Alliance of Manitoba to bring in renowned experts to give keynote speeches related to the Smart Grid. Bring your family with your research findings to EPEC2011, enjoy our programs and appreciate the history of Winnipeg.

<http://www.ieee.ca/epec11/>

Topics:

Papers are invited on all topics of interest related to electric power and energy and especially papers with the following focus:

HVDC & FACTS

- Project developments, including voltage source converter (VSC) dc transmission
- Application for renewable energy systems
- Advances in study and analysis tools
- Power quality issues and solutions
- HVdc supergrids

Wind Power & Solar

- Challenges with integration of variable generation
- New technology development

Smart Grid

- Smart Grid concepts and pilot projects
- Electric vehicles (grid impacts, standards)
- Advanced metering infrastructure
- On-line dynamic security assessment
- Smart sensors including dynamic equipment rating and condition assessment methods
- Applications of phasor measurement units
- Energy Storage
- Distribution system automation and control

Computational Methods

- Computational methods in power system planning, operation and control
- Probabilistic planning and risk analysis
- Reliability centered maintenance and asset management

Advanced Technology Developments

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Stereo Ego Motion and Fault Tolerant State Estimation in Military Unmanned Systems

1.0 Introduction

Though unmanned systems potentially provide armed forces with cost-effective standoff capabilities, unmanned air vehicles (UAVs) enjoy particular success as sensor and weapons platforms thanks to an uncluttered environment, robust command links, and consistent global positioning (GPS). Unfortunately, these services become increasingly unreliable where vegetation and structures complicate navigation and obstruct communications including global positioning.

To overcome these limits, Defence R&D Canada (DRDC)* has investigated a vehicle state estimator that fuses multiple sensors based on quality, availability, and fault condition. This paper outlines a sensing technique exploiting stereo imagery in Section 2 and a novel Fault Tolerant State Estimation (FTSE) system in Section 3. Using collected field trial stereo, GPS, and Inertial Measurement Unit (IMU) data, Section 4 presents preliminary off-line results comparing stereo based relative pose estimation to GPS-IMU results and the performance of the FTSE module. Finally, some preliminary conclusions are presented in Section 5.

2.0 Ego-motion through Stereo-based Relative Pose Estimation

Near the ground, unmanned systems can lose GPS lock. Other navigation sensors can help localize the vehicle such as magnetometers, gyroscopes, and accelerometers. Ground vehicles can also use wheel or track odometry, though bumping or sliding can produce errors [13]. However, imagery can also supplement these sensors with ‘visual’ odometry or ego-motion. While the overall approach is based on [11], modules such as feature selection, stereo-pair matching and initial relative pose estimator have been replaced for better accuracy and efficiency.

Figure 1 depicts the stereo camera perspective assumption where P is the position of a point in 3D space, q_l and q_r are the projections of P on the left and right images, C_l and C_r are the camera focal points, and C_v the camera coordinate system’s origin. For commercially available cameras, the perspective projection assumption may be invalid and lens distortion correction becomes necessary. Figure 2 depicts the steps of the stereo image-based relative pose estimation procedure described as follows:

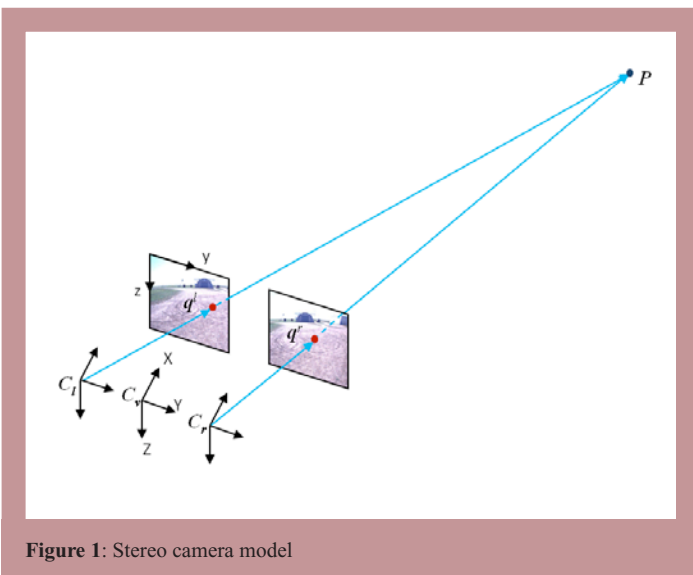


Figure 1: Stereo camera model

*The authors gratefully acknowledge funding support from DRDC’s Technology Investment Fund, specifically Program 12pz18: Self-Healing Networked Control Systems For Enhanced Reliability And Safety Of Multivehicle Missions.

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Abstract

Since military unmanned systems will need to navigate in GPS-denied environments, defence research must investigate reliable vehicle localization techniques that both fuse position sensor data and compensate for the sensor quality, availability, and fault state. This work describes a stereo ego-motion system for GPS-denied environments and a novel, scalable Fault Tolerant State Estimation (FTSE) system that fuses navigation sensing while rejecting erroneous measurements. The paper discusses encouraging preliminary results collected during field trials at DRDC Suffield.

Sommaire

Étant donné que les systèmes militaires sans pilotes devront évoluer dans des environnements sans GPS, les chercheurs doivent élaborer des techniques fiables de localisation de véhicules qui fusionnent les données des capteurs de positions et compensent pour l'imprécision, l'indisponibilité ou le non-fonctionnement des capteurs. Cet ouvrage décrit un système d'ego-mouvement stéréo pour environnements sans GPS et un système novateur et échelonné d'Estimation d'état tolérant aux fautes (EETF) qui fusionne les données des capteurs de mouvements tout en rejetant les mesures erronées. L'article discute de résultats préliminaires encourageants recueillis pendant des essais de terrain à RDDC Suffield.

Feature selection: Image feature points are selected in this step. The algorithm computes the second derivative of image intensities using a Sobel operator. A feature is identified wherever the minimum eigenvalue of this derivative matrix exceeds a preset threshold [12].

Stereo pair matching: The system computes a feature point position estimate by matching and triangulating feature points for the initial stereo pair.

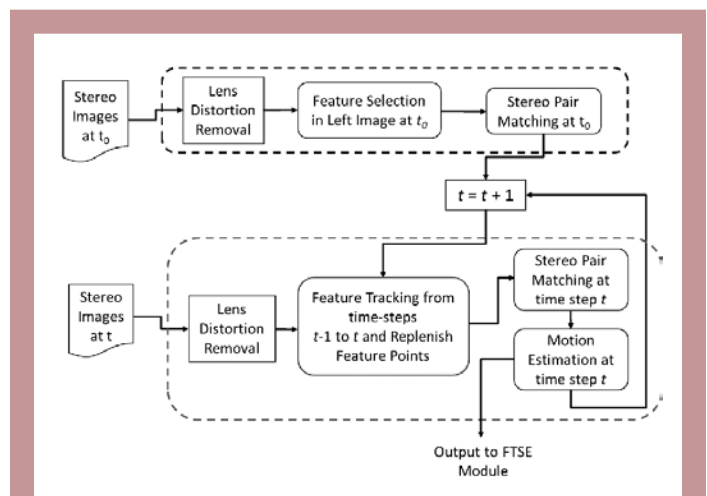


Figure 2: Flowchart of stereo camera based relative pose estimation algorithm

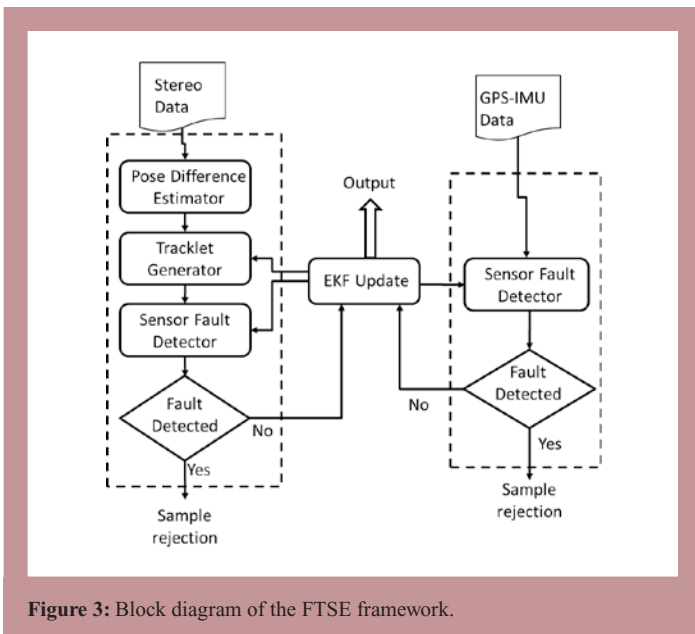


Figure 3: Block diagram of the FTSE framework.

This procedure searches the stereo pair's right image to find the selected feature points in the left image using Lucas-Kanade optical flow computation[8] aided by a multi-resolution pyramid construction[2]. Triangulation is performed using the known relative position between the cameras and determines the 3D position with respect to the camera frame. This step also provides a covariance matrix [9] that models the 3D position estimate error.

Feature Tracking: Left image feature points of one stereo pair are found in the subsequent stereo left image using a method analogous to the stereo pair matching process. Since relative camera positions corresponding to the two left images are not known, there is greater uncertainty in the match location and the match is not constrained to lie on a one-dimensional epipolar line. Thus the search for correct match is more challenging than stereo pair matching. Again, Lucas-Kanade optical flow computation is used in this step. After feature tracking, the algorithm repeats the feature selection procedure to replenish the feature set after the rejection of features during stereo pair matching and feature tracking.

Relative pose estimation: Using two sets of matched 3D points obtained from consecutive stereo pairs, the algorithm obtains an initial estimate of the relative pose using Horn's unit quaternion procedure [6] and iteratively improves the initial estimates using Matthies' maximum likelihood (ML) pose estimation procedure [9]. Both procedures provide solutions to the least square problem of estimating change in orientation from matched 3D points. Horn's unit quaternion procedure provides a closed-form solution, which may be corrupted by incorrectly matched 3D points.

Matthies' procedure re-models the least square problem into an ML one by incorporating Gaussian error distributions of the matched 3D positions. Robustness is achieved by eliminating highly unlikely 3D pairs during the iterations of the ML procedure.

3.0 Fault Tolerant State Estimation Concept

To cope with highly nonlinear signals caused by sensor faults and/or complete signal loss, data fusion techniques can combine fault detection, identification, and rejection (FDIR) with linear Kalman-like filters.

This section describes a scalable Fault Tolerant State Estimation (FTSE) that fuses the measurements from a Novatel SPAN GPS-IMU unit with relative pose estimates from a stereo ego-motion algorithm to estimate 3D pose of a UGV. Referring to Figure 3, the FTSE block diagram, a GPS-IMU passes the absolute Universal Transverse Mercator (UTM) pose coordinates through a fault detection process to an Extended Kalman filter (EKF) module. If a measurement is rejected, the FTSE does not update the pose estimate and waits for the next measurement. To similarly process the relative stereo ego motion, the algorithm generates ego-motion tracklets [4]. Figure 4 shows the signal flow in an FTSE timing diagram. The following sections describe the FTSE technique's main procedures.

3.1 State Prediction

Using an EKF, FTSE predicts and updates a 9-dimensional state vector: a 3 element position vector (in UTM coordinates), a 4 element orientation quaternion, forward velocity and yaw rate. In traditional estimators, a 6-element vector is used for tracking the rate of change of pose: three components corresponding to velocity and three components corresponding to rate of change of orientation. However, in the UGV's body frame (Figure 5), only forward velocity and yaw rate are linked to UGV control and the rest result from surface interaction that act like noise that cannot be tracked. Moreover, an attempt to track the additional components will result in random estimation errors [5]. Estimating only forward vehicle and yaw rate achieves a simpler state transition model as well as better estimation performance. FTSE reports 6-Degrees of Freedom (DOF) pose, a position vector and roll-pitch-yaw angles, and 6-element pose rate (three-element velocity and three-element angle rates).

3.2 Update using GPS-IMU measurements

The χ^2 distance between the measured value and FTSE predicted value is obtained for each GPS-IMU 6-DOF pose measurement. If this distance is greater than 99% of the χ^2 density, the measurement is rejected. Otherwise, an EKF procedure updates position and the three vector quaternion components. The quaternion's scalar component and corresponding covariance terms are computed after the EKF update.

3.3 Update using relative pose estimates

Relative pose estimates derived from stereo data cannot be used directly as measurements in a Kalman filtering architecture. Many authors[1, 7] use relative measurements, like relative pose, as control inputs to predict vehicle position. This approach does not use the estimator's ability to predict state without measurement and thus generates suboptimal results. In this work, the relative pose estimates are used to generate tracklets [4], pseudo-measurements uncorrelated to past estimates. This permits an identical procedures for both GPS-IMU and tracklet data.

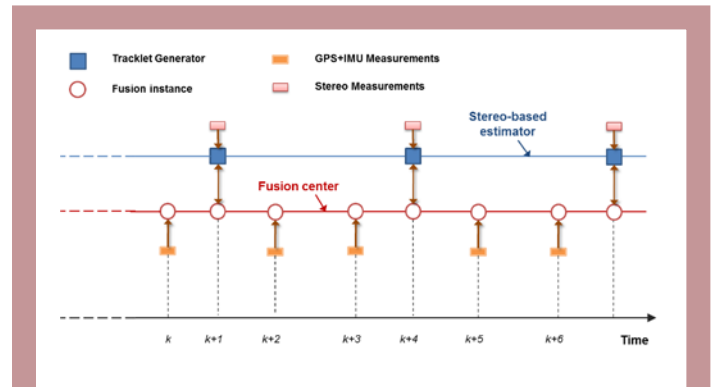


Figure 4: Timing diagram of the FTSE framework.



Figure 5: UTM and UGV body coordinate systems

4.0 Off-line Processing Results

DRDC used an instrumented Raptor UGV [10] to exercise Stereo Ego-motion and FTSE algorithms off-line in preparation for future real-time field trials. A NovAtel SPAN provided 10Hz GPS-IMU pose data and a Point Grey Bumblebee XB3 stereo camera provided 2Hz stereo image pairs. DRDC's version of the Middleware for Robotics (MIRO)[3] harvested and synchronized these data streams for off-line FTSE processing during trials conducted at DRDC Suffield's Experimental Proving Ground (EPG). The following section presents Stereo pose estimation and data fusion results obtained using two sets of data scenarios collected over durations of 1.1 and 2 minutes, respectively.

4.1 Relative Pose Estimation Results

Figure 6 shows a typical pair of raw stereo images prior to lens distortion correction. When compared with GPS-IMU pose, the stereo relative pose results revealed a large bias in the gravity direction (Z direction) and a relatively small bias in the UGV's forward motion direction (X direction), explained by the camera's downward tilt with respect to the UGV body frame (see Figure 7).



Figure 6: The first pair of stereo frames from Sequence 1.

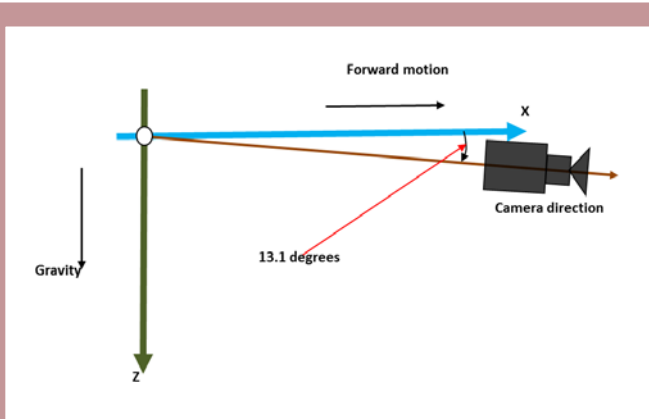


Figure 7: Camera orientation in the UGV body frame.

An initial estimate of the stereo camera tilt, obtained from the correlation between X and Z translation data, is both improved by iteratively reducing the bias along z axis and corrected before further processing.

Figures 8(a)-8(d) depict the error between the relative stereo relative pose and interpolated GPS-IMU data for the same interval in scenario 1. Figure 8(a) and (b) show that the error between the two types of data appear bounded within $\pm 6\text{cm}$ for in translation. Figure 8(d) shows yaw error between the two measurement streams remains within $\pm 0.5^\circ$ bounds. Though not depicted here, relative pose data from stereo and GPS-IMU measurements from sequence 2 show very similar estimates as sequence 1.

4.2 FTSE results

Figures 9(a) and 9(b) compare the FTSE position estimates with GPS-IMU measurements for scenario 1. Stereo-only position estimates are also shown. As the latter cannot obtain absolute UGV position, the stereo data-based pose estimator is initialized using pose prediction by FTSE. In Figure 9 (a), the FTSE estimates and GPS-IMU measurements over-

lap. The stereo-only estimates track ground truth, error accumulates to become a significant estimation bias at the end of trajectory. The GPS-IMU measurements rejected by FTSE, for large negative bias along

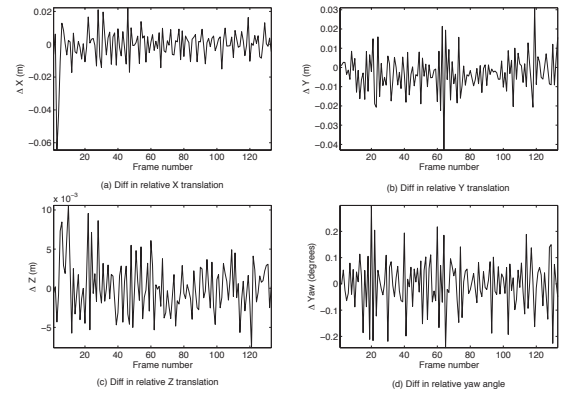
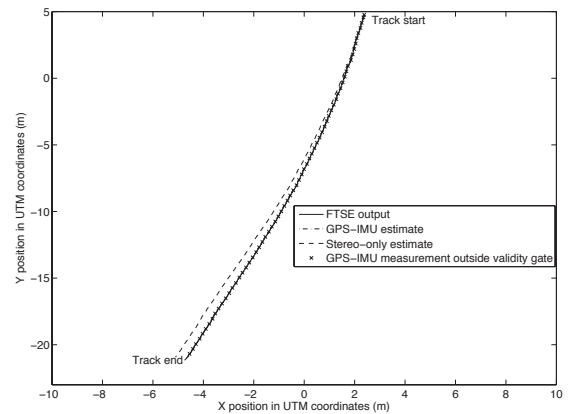
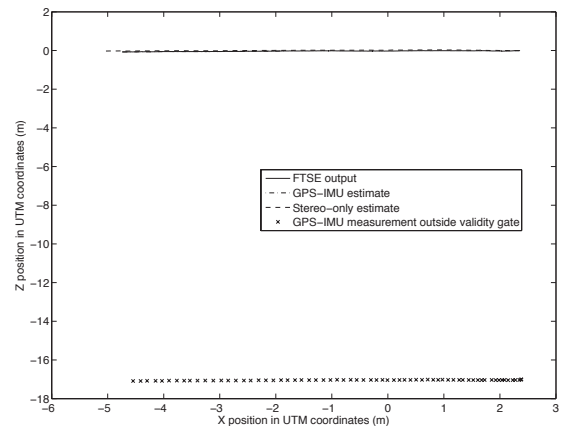


Figure 8: Scenario 1: the pose difference between GPS-IMU and stereo data.



(a) UGV position in UTM X-Y plane.



(b) UGV position in UTM X-Z plane.

Figure 9: Scenario 1 UGV position obtained using GPS-IMU and stereo data.

Z-axis, are also shown in Figure 9 (a). The negative bias in rejected measurements, which are outside the validity gate of FTSE, can be seen in Figure 9 (b). In this scenario, none of the stereo measurements are rejected.

To test the capability of FTSE to run using inputs from only a stereo sensor, in the second scenario GPS-IMU is made unavailable for about 36 seconds. Figures 10(a) and 10(b) show the position estimates based on FTSE, GPS-IMU measurements and stereo measurements. It can be seen that the FTSE performs well even when no GPS-IMU measurements are available and seamlessly switches back to normal mode when GPS-IMU becomes available again.

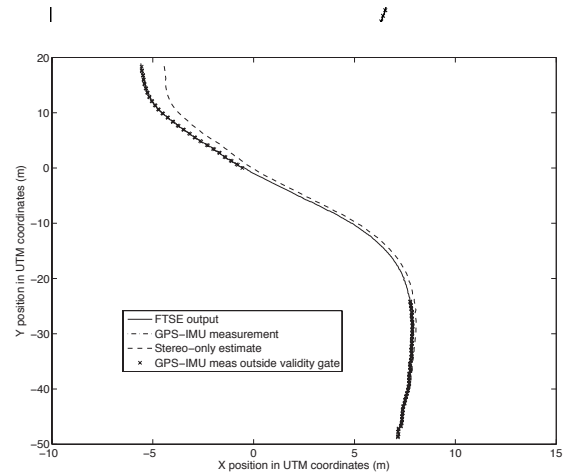
The rejection of some of the GPS-IMU measurements are explained by their large negative bias along Z-axis (Figure 10(b)), later found to be a fault in DRDC's SPAN system. Figure 11 shows that all rejected GPS-IMU measurements have small biases along Y. The rejection of GPS-IMU measurements shows that the FTSE can detect sensor faults of different magnitudes.

5.0 Conclusion

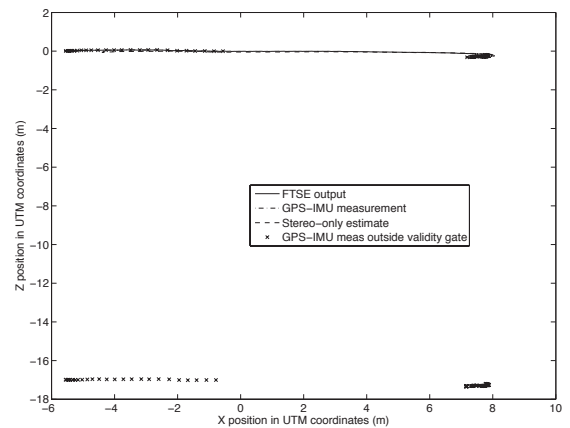
Information from multiple sources is essential for robust vehicle navigation. In this preliminary work, a novel and scalable Fault Tolerant State Estimation system is described using a Kalman filtering framework that fuses both GPS-IMU pose and stereo ego-motion relative pose. In addition, the FTSE module also detects sensor faults, and rejects the corresponding measurements. Robust processing of stereo images ensure that high quality relative pose information is available to the FTSE system. Using captured field trial GPS-IMU and stereo imagery, off-line testing of both the stereo ego-motion and FTSE modules suggest promising capabilities for a real-time system. In the future, more sensors will be incorporated into the FTSE system, and the vehicle motion model will be extended to include autonomous airborne and underwater vehicle motions.

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(a) UGV position in UTM X-Y plane.



(b) UGV position in UTM X-Z plane.

Figure 10: Scenario 2 position data obtained using GPS-IMU and stereo data

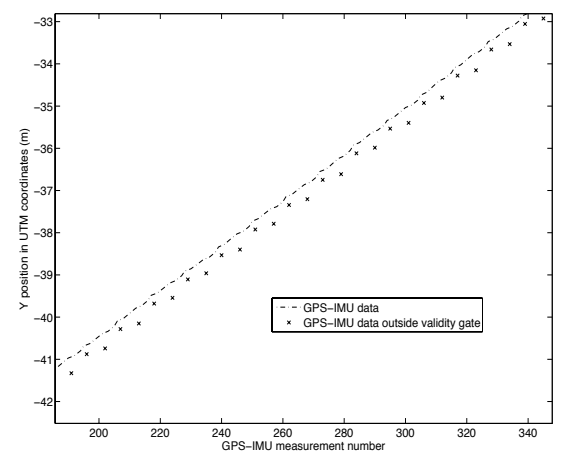


Figure 11: Y position of UGV in UTM coordinates using GPS-IMU data.

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[13] Sebastian Thrun and M. Beetz and Maren Bennewitz and Wolfram Burgard and A.B. Creemers and Frank Dellaert and Dieter Fox and Dirk Hahnel and Chuck Rosenberg and Nicholas Roy and Jamieson Schulte and Dirk Schulz. Probabilistic Algorithms and the Interactive Museum Tour-Guide Robot Minerva. International Journal of Robotics Research, 19(1):972-999, 2000.

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Survey of Different Economic Mechanisms for Reactive Power Services

1.0 Introduction

Ancillary services are those services that are necessary to support the transmission of capacity and energy from resources to loads while maintaining reliable operation of the transmission provider's transmission system in accordance with a Good Utility Practice. There are six ancillary services defined by the U.S. Federal Energy Regulatory Commission (FERC) [1]. These are:

- 1) Scheduling, System Control and Dispatch;
- 2) Reactive Supply and Voltage Control from generation services;
- 3) Regulation and Frequency response services;
- 4) Energy Imbalance service;
- 5) Operating reserve—synchronized reserve services; and
- 6) Operating reserve—supplemental reserve services.

Voltage Support Service or Reactive Supply and Voltage control Service—as named by FERC—is one of those ancillary services that is essential for the transfer of energy in the form of real power over a transmission system and is vital for maintaining the voltage stability of the system. The final report of the U.S.-Canada Power System Outage Task Force [2], which was released in April 2004, stressed this fact when it pointed out that insufficient Reactive Power was one of the causes of the August 2003 Blackout; the shortage of reactive power or the inability of a system to meet the reactive power requirement contributes to the voltage instability and may lead to voltage collapse of the transmission system.

Generation facilities and non-generation resources capable of providing this service are operated to produce (or absorb) reactive power under control area operators. The amount of reactive power that must be supplied will be determined based on the necessity in order to maintain transmission system voltages within limits that are generally accepted in the region and consistently adhered to by the Transmission Provider. Nowadays, an ISO not only looks for voltage security by way of adequate operational reactive power reserves, but also for a financially efficient optimal procurement mechanism for securing reactive power supply.

2.0 Power System Operators

In this section a survey of reactive power markets operated by six transmission systems is presented. The methods and forms by which ISOs procure reactive support service from generation resources are studied for the transmission systems operated by the following ISOs:

- New York ISO,
- New England ISO,
- Provinces of New Brunswick (NBSO)
- Province of Ontario (IESO)
- States of Pennsylvania-New Jersey-Maryland Area (PJM)
- State of California (CAISO).

Further, methods of charging customers for providing reactive power supply and voltage control services by various ISOs are discussed.

2.1 New York independent system operator

Ancillary services in the New York area are either provided by the New York ISO (NYISO) or procured by the Transmission Customers and the Suppliers themselves [3]. There are two pricing methods for these ancillary services depending on the nature of the service. While some of them are provided at market-driven prices, others are provided at embedded actual costs. Table 1 shows a summary of the NYISO Ancillary services, how they are provided and the pricing method of each.

The Coordination and Scheduling of the Voltage Support Service (VSS) are the responsibility of the NYISO. NYISO directs VSS suppliers to maintain a specific voltage level under both steady-state and post-contingency operating conditions subject to the limitations of the resource's tested reactive capability.

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Abstract

This paper surveys economic mechanisms used for the service of voltage support and reactive power supply. It discusses the methods of procurement of reactive power by Independent System Operators (ISOs) in six different systems from generation facilities and non-generation resources. It studies the parts of payments and different types of compensations given to these resources. It also highlights the ways by which the customers of reactive power and voltage support services are charged for availing this service. We also present the importance of this ancillary service in Electric Power Transmission in the introduction.

Sommaire

Cet article présente une revue des mécanismes économiques de maintien de la tension et de la production de puissance réactive dans les réseaux électriques. Il discute des méthodes de production de la puissance réactive par les gestionnaires de réseaux indépendants pour six différents systèmes allant des installations de production aux équipements périphériques. Il étudie le rôle des paiements et des différents autres types de compensation alloués à ces ressources. Il souligne aussi les façons par lesquelles les clients sont facturés pour la puissance réactive et le support de la tension. L'introduction traitera aussi de l'importance de ce service auxiliaire pour les réseaux de transmission d'énergie électrique.

Ancillary Service	Who provides the service?	Pricing Method
Scheduling, System Control and Dispatch Service	NYISO	Embedded
Voltage Support Service	NYISO	Embedded
Regulation and Frequency Response Service	NYISO or Self Supplied	Market-based
Energy Imbalance Service	NYISO	Market-based
Operating Reserve Service	NYISO or Self-Supplied	Market-based
Black Start Capability service	NYISO	Embedded

Table 1 Ancillary services summary

2.1.1 Payment of the Service

The pricing method of the reactive power and voltage support service is based on embedded cost and it includes three parts: Annual payment of voltage support service; lost opportunity costs; and, other payments to synchronous condensers and qualified non-generator resources.

1) Annual Payment of Voltage Support Service

This is calculated as:

$$P = A \times B \quad (1)$$

where P is the Payment, A currently equals \$3919/Mvar and B is the tested reactive power capacity of the generator or synchronous condenser in Mvars [4], [16]. If the supplier's generator is not under contract to supply installed capacity the payment will be pro-rated as follows:

$$P = A \times B \times H \div H_m \quad (2)$$

where H is the number of operation hours in the month as recorded by NYISO and H_m is the number of hours in that month.

Non-utility generators will receive a monthly payment calculated as follows:

$$P = \frac{1}{12} \times A \times C \quad (3)$$

where C is the lesser of the tested reactive power production capability of the non-utility generator or the contract reactive power capability. Similar to above, in the event these generators do not provide installed capacity, the monthly payment will be as follows:

$$P = \frac{1}{12} \times A \times C \times H \div H_m \quad (4)$$

2) Lost Opportunity Cost

Lost Opportunity Cost (LOC) is the payment received by a supplier of voltage support Service when it is dispatched or directed to reduce its real power output in order to absorb or produce more reactive power. Calculation of LOC depends on:

- 1) Real-Time Local Based Marginal Price (LBMP),
- 2) Original dispatch point,
- 3) New dispatch point,
- 4) Bid Curve for generation supplying VSS.

LOC can be calculated using the formula in equation (5).

$$LOC = P_{RT} (D_1 - D_2) - \int_{D_2}^{D_1} f(E) dE \quad (5)$$

where

P_{RT} is real-time LBMP,

D_1 is the original dispatch point, which shall be equal to the generator's economic operating point,

D_2 is the new dispatch point, which shall be the greater of the generator's real-time scheduled energy injection or actual energy injection, and the amount of energy the generator is scheduled to produce for the hour in the day ahead market,

E is the real power (electricity) generated and

$f(E)$ is the bid curve for generation supplying VSS shown in Fig. 1.

The integral term represents the generator's energy bid for the reduced output of the generator.

3) Other Payments to Synchronous Condensers and Qualified Non-generator Resources

The ISO shall compensate those kinds of facilities for the cost of energy they consume to energize converters and other equipment necessary to provide the VSS, when they are requested by the ISO.

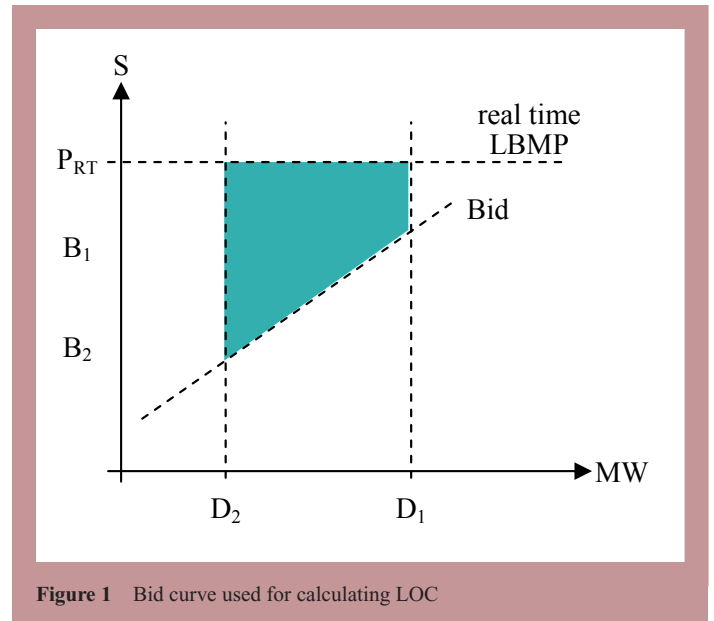


Figure 1 Bid curve used for calculating LOC

2.2 New England Independent System Operator

In the New England transmission system, transmission customers must purchase reactive power service for the support of transmission voltages [5]. According to the tariff schedule of New England Independent System Operator (ISO-NE), transmission system customers, who receive regional network service, shall pay an hourly charge towards reactive power support.

If the reliability of a multi-region transmission system is being improved by reactive power services, the cost associated is first allotted equally to affected regions and further the customers are charged on pro rata basis of that region.

Reliability regions are those regions identified on the ISO's website and they serve two primary purposes under the current New England market's structure [15]. They aggregate costs for pricing energy for load and they are used as the basis for allocating reliability costs. ISO-NE pays the suppliers of the VSS for four different kinds of costs: *Capacity Cost*, *Lost Opportunity Cost*, *Cost of Energy Produced*, and *Cost of Consumed Energy*. Then these charges are distributed among the transmission customers.

The following formula determines the reactive power supply service charges of the ISO-NE:

$$CH = (CC + LOC_O + CEC_O + CEP_O) \left(\frac{HL_1 + RC_1}{HL + RC} \right) + (LOC_{HV} + CEC_{HV} + CEP_{HV}) \left(\frac{HLR_1}{HLR} \right) \quad (6)$$

where

CH is the amount to be paid by the transmission customer per hour.

CC represents the capacity costs per hour and it equals to the reactive power revenue requirement divided by the number of hours in the month.

LOC represents the lost opportunity costs per hour for a dynamic reactive power resource.

CEC is the cost of energy consumed per hour by a dynamic reactive power resource in order to supply reactive power service to meet reliability criteria in the reliability region (for example the CEC associated with hydro and pumped storage generating units that are motoring for the provision of reactive power service will equal the cost of energy to motor).

CEP is the cost paid per hour for energy produced by a dynamic reactive power resource to meet reliability criteria in reliability regions (For example, the CEP associated with thermal generating units that are brought on-line for providing reactive power service shall equal the portion of the total NCPC (Net Commitment Period

Compensation) to be paid to that resource for a day that is attributed to the hour(s) during which the resource is run to provide reactive power service. This is in accordance with Market Rule “1” that governs the operation of New England’s wholesale electric power markets. [6].

Subscript HV represents costs for reactive power service that is supplied exclusively to address high voltage conditions within one or more reliability regions

Subscript O refers to the remaining costs (i.e., excluding those for the reactive power service, etc.)

HL is the aggregate of the regional network loads of all the transmission customers per hour.

HLR is the aggregate of all the regional network loads of all the transmission customers within a reliability region where reactive power service charges per hour were a result of reactive power service provided exclusively to meet reliability criteria that address high voltage conditions,

RC is the aggregate reserved capacity for out service of all transmission customers per hour.

Subscript I refers to a specific transmission customer.

2.3 New Brunswick System Operator

Based on the reactive power support necessary to maintain transmission voltages on the transmission provider’s transmission facilities, within limits that are generally accepted in the region and consistently adhered to by the transmission provider, the amount of reactive supply and voltage control service needed to be supplied will be determined [7]. Generation facilities and non-generation resources capable of providing this service, and which are in the control area where the transmission provider’s transmission facilities are located, are operated to produce (or absorb) reactive power.

The transmission provider provides the VSS either directly (if it is the control area operator), or indirectly by making arrangements with the control area operator that performs this service for the transmission system. The transmission customer will purchase this service from the provider or the control area operator according to a flat rate charge equalling:

$$Charge = \frac{Customer\ Usage}{Total\ Usage} \left(\frac{1}{12} \frac{of\ Annual\ Revenue}{Requirement} \right) \quad (7)$$

Customer Usage is expressed as an equivalent NCP (non-coincident peak) value, *Total Usage* is the sum of all Customer Usage expressed as an equivalent NCP value, *Annual Revenue Requirement* is that dollar value for which the Board has granted each year, with approval to the transmission provider for recovery from the reactive power service provided. Equivalent NCP values are calculated as shown in Table 2. Table 3 shows the charges after calculation.

Note: On-Peak days are Monday to Friday, and On-Peak hours are between 09:00 and 24:00 Atlantic time, Monday to Friday.

2.4 PJM Interconnection

Of the six ancillary services defined by FERC, the Pennsylvania-New Jersey-Maryland (PJM) interconnection provides three services through market-based mechanisms. These are regulation and frequency response service, energy imbalance service, and operating reserve—synchronized reserve service. It also provides the remaining ancillary services including reactive supply and voltage control service on a cost basis.

The organization of the reactive power market in PJM is very similar to that of the NBSO with the exception that the VSS service is only provided by the transmission provider [8]. So transmission customers must purchase the service from the transmission provider.

The purchasers of the VSS service, who are serving network loads in a zone with no revenue requirement for reactive supply and voltage control from generation or other sources service (Non-Zone Load), pay the following charge:

$$Charge = Allocation\ Factor * Total\ Generation\ or\ other\ source\ Owner\ Monthly\ Revenue\ Requirement$$

Allocation Factor is the monthly transmission use of each network customer or transmission customer on a MW basis divided by the total

POINT-TO-POINT	NCP VALUES
Yearly Delivery	(1*equivalent NCP MW value)/MW of Reserved Capacity per year
Monthly Delivery	(1*equivalent NCP MW value)/MW of Reserved Capacity per Month
Weekly Delivery	(0.231*equivalent NCP MW value)/MW of Reserved Capacity per week
On-Peak Daily Delivery	(0.046*equivalent NCP MW value)/MW of Reserved Capacity per day
Off-Peak Daily Delivery	(0.033*equivalent NCP MW value)/MW of Reserved Capacity per day
On-Peak Hourly Delivery	(0.003*equivalent NCP MW value)/MW of Reserved Capacity per hour
Off-Peak Hourly Delivery	(0.001*equivalent NCP MW value)/MW of Reserved Capacity per hour

Table 2 Equivalent NCP values

POINT-TO-POINT	CHARGE
Yearly Delivery	One twelfth of C\$1,613.00/MW of Reserved Capacity per year
Monthly Delivery	C\$134.42/MW of Reserved Capacity per Month
Weekly Delivery	C\$31.02/MW of Reserved Capacity per week
On-Peak Daily Delivery	C\$6.20/MW of Reserved Capacity per day
Off-Peak Daily Delivery	C\$4.43/MW of Reserved Capacity per day
On-Peak Hourly Delivery	C\$0.39/MW of Reserved Capacity per hour
Off-Peak Hourly Delivery	C\$0.18/MW of Reserved Capacity per hour

Table 3 Monthly payable charges of VSS

transmission use on a MW basis. In case of serving zone load, charge would be:

$$Charge = Allocation\ Factor * Zonal\ Generation\ or\ other\ source\ Owner\ Monthly\ Revenue\ Requirement * Adjustment\ Factor$$

Adjustment Factor is the sum of the total monthly transmission use in the PJM region excluding such use of Customers serving Non-Zone Load, divided by the total monthly transmission use in the PJM region on a MW basis.

On the VSS supply side, the transmission provider compensates generators or other source owners for providing reactive power. In order to qualify for this compensation, the supplier must be under the control of the control area operator. Each month, the transmission provider must pay the supplier an amount equal to their monthly revenue requirement. In case a supplier was directed to reduce real power output to produce or absorb reactive power, lost opportunity cost payments should also be provided [9].

2.5 California Independent System Operator (CAISO)

In California, a Scheduling Coordinator (SC) determines on behalf of each utility to either self-provide or purchase from the CAISO its share of Ancillary Service responsibility [14]. A SC can offer to sell the utility’s excess generating capacity into CAISO’s Ancillary Service market. If a SC of a utility chooses not to self-provide its A/S responsibility

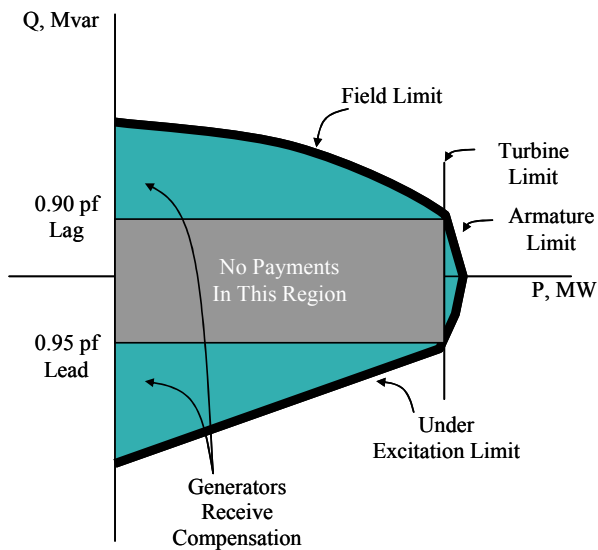


Figure 2 The mandatory range of power factors within which generators receive no financial compensation and the range where generators receive

Operator	Contract	Lost Opportunity Cost (LOC)
NYISO	Some Generators are under annual contract to supply installed capacity while others are not. Other resources that are not contracted include synchronous condensers and qualified non-generator resources.	✓
ISO-NE	N/A	✓
NBSO	N/A	X
PJM	N/A	X
CAISO	Long term contract (annual)	✓
IESO	Long term contract (not longer than 18 months)	✓

Table 4 Comparison between ISOs from Contracts and Lost Opportunity Cost Points

ity, then CAISO provides it at a cost. Currently, the voltage control service is not running in auction via Scheduling Infrastructure System.

CAISO determines on hourly basis for each day the quantity and location of voltage support required to maintain voltage levels and reactive margins within reliability standards using a power flow study based on the quantity and location of scheduled demand [10],[13]. The ISO shall issue daily voltage schedules to participating generators and participating Transmission Operators.

For all participating generating units, the minimum power factor range will be within a band of 0.9 lag (producing Reactive Power) and 0.95 lead (absorbing Reactive Power) power factors as indicated in Fig.2. Participating generators receive no compensation for providing reactive power within these specified ranges. If additional voltage support is required, CAISO shall procure it either through reliability must-run contracts or, if no other sources are available, by instructing a generator to move its reactive power output outside its mandatory range. The generator will get opportunity cost compensation only if in order to comply with instruction, i.e., it must reduce its real power [10].

2.6 Independent Electricity System Operator (Ontario, Canada)

Voltage control and reactive power support service is one of the principal ancillary services that are contracted by the Independent Electricity System Operator of Ontario (IESO) [12]. It includes reactive support provided by generation units, as well as by synchronous condensers, capacitors and other electrostatic equipment that is often owned and operated by transmitters.

Generators should be able to supply reactive power within the range 0.9 lagging (overexcited) to 0.95 leading (underexcited) power factor based on rated active power at rated voltage. A specific payment might be made to a generator only when this generator, in order to be capable of producing and absorbing reactive power, must make an investment incremental to that required to be a producer of real power (within the standard power factor range).

If the generating unit was directed to work out of this range it shall receive a compensation of opportunity cost in case of being obliged to reduce its active power output. This compensation is based on the reduction in real power output and the market clearing energy price (\$/MWh).

Another type of compensation payment for real power losses will be reimbursed to generating units operating with a non-unity power factor, whether within or outside the standard power factor range. This compensation is based on calculated losses (MWh) and the market clearing energy price (\$/MWh) for the period in question and it represents payment for the opportunity cost for the lost energy.

The IESO shall recover the costs of Reactive Support and Voltage Control service through a uniform charge in \$/MW paid by the market participants on a pro-rata basis.

3.0 Conclusion

From the previous section it is clear that there are various methods for providing the reactive support service. Although the discussed regions are all in North America and some of them are very close, they have different techniques in procurement of reactive power from available resources.

For example, a part of the service payment by some operators like NYISO and ISO-NE is for capacity cost. Also these two operators compensate the generation resources for lost opportunity cost under any condition if they reduce their active power generation, while IESO and CAISO do not compensate except if the generator is working outside the specified range.

Furthermore, CAISO does not compensate the generation resources at all for providing reactive power within a specified range of power factors. NBSO and IESO impose a flat rate uniform charge in \$/MW on customers of reactive power to recover the costs of this service. In PJM, unlike other regions, the responsibility of providing reactive power region lies on the transmission provider not the operator. Table 4 shows the status of contracts of reactive power service and lost opportunity cost component in payments by the different operators.

Therefore, the diversity of ways of organizing reactive power markets is clear. These different ways should be re-studied from both economical and electrical points of view looking for optimality without compromising the reliability standards. Reactive power markets are seeking the most economic and most efficient form of market that will minimize the cost of providing ancillary services.

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About the Authors

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Community News / Nouvelles de la communauté

UBC student lab switched on with help from ICF Grant

Engineering students at the University of British Columbia's Okanagan campus have received \$5,000 to establish a lab space for electronic prototyping, of which \$3,750 is from the IEEE Canadian Foundation's McNaughton Learning Resource Centre Grant program.

"The McNaughton Centre will provide electrical engineering students with the capability to tinker with and actually prototype electronics that they create themselves," says Emily Landry, Vice-Chair of the newly formed UBC Okanagan Campus IEEE Student Branch. "It will also facilitate peer-to-peer learning and provide students with resources that help them achieve greater levels of success in curriculum-related design projects and engineering competitions."

The Student Branch also received \$1,250 for the Centre's lab from the School of Engineering's Engineering Professional Academic Fund. Jonathan Holzman, Engineering Professor at UBC's Okanagan campus, says Landry was instrumental in establishing the Centre, one initiative among many she has spearheaded. Her efforts in advancing the engineering undergraduate program at UBC have been simply incredible, Holzman says.

"When Emily witnesses a challenge it is typically only a matter of time before she has developed a plan of action and is proceeding with a solution," he says. "Her incredible drive in overcoming challenges is an inspiration for us all. And we can expect to see some incredibly interesting ideas unfold in this new facility as young minds go to work." Landry is already bringing some of those ideas to light across the campus, sitting as the Applied Science Student Representative on UBC's Okanagan Senate. But global issues intrigue her too; Landry is the founding member and former president of the Okanagan campus chapter of Engineers Without Borders.

Originally from Toronto, Landry came to the Okanagan from Edmonton, and says she chose UBC's Okanagan campus as a place to shape her education.

"I've loved the university from the first moment I came here," says Landry. "There is such an exciting atmosphere and it really feels like, as students, we can contribute and make it into anything we want it to be.

"Learning should be driven by curiosity and a desire to explore the unknown," she says. "If students are given an outlet to exercise curiosity and apply what is learned in the classroom, it helps develop the ingenuity required as we head out into the world as graduates."

Helping make that next step is a key role for a campus IEEE Student Branch, notes Landry. "It gives them access to people who are already in the industry. Mentorship is a big part of it." IEEE Canada Student Representative Kanishka Jayawardene reinforces the point.

"The interaction with Section members is a great opportunity to gain some of the softer skills needed for career development," Jayawardene says. No stranger to such collaboration, Jayawardene was one of the drivers of the Innovation for Humanity design competition, organized by University of Calgary Student Branch members in March 2010 with the support of the IEEE Southern Alberta Section and the IEEE Canadian Foundation.

Now afforded a national perspective, Jayawardene can report how a McNaughton Centre helps a typical Branch expand membership. "The Centre provides a focal point for Branch activities," he explains. "The equipment and resources bring students into the Centre. Then, the camaraderie and activities planned there often inspire them to join."

Having first crossed paths with Landry at CCECE 2010 in Calgary, and then again at the Student Branch Congress later that year, Jayawardene echoes UBC's Holzman in lauding her remarkable drive.

"Emily was keen on learning from the best practices of other Student Branches across the country to kick start the newly formed Student Branch at Okanagan. Not only was she the driving force behind the establishment of the McNaughton Centre, she also had her Student Branch involved in activities such as the Microprocessor Group — a series of micro-controller workshops whose participants included several other Canadian universities such as Calgary, Ottawa, Lakehead, Manitoba, and McGill. Given her experience with, and contributions to IEEE and also Engineers Without Borders, I am certain that she will continue to be a model IEEE member who lives up to IEEE's core purpose of fostering technological innovation and excellence for the benefit of humanity."



Photo Courtesy of UBC

Student Branch Vice-Chair Emily Landry spearheaded the initiative that secured \$5,000 funding to create an electronics prototyping lab at UBC's Okanagan Campus.

Statistics Reveal It All: IEEE Senior Membership

1.0 Introduction

IEEE senior membership has two aspects. It is a type of IEEE member grade, and a tool for professional recognition of technical and professional excellence. Promoting senior membership is a high-priority activity on the IEEE Regions' and Sections' agendas.

The purpose of this article is to analyze recent statistics of senior member elevations and identify worldwide and regional trends, with an emphasis on the Region 7 (Canada).

Having had the privilege of serving as Toronto Section chair for 2008 and 2009, and being deeply involved in the section's senior membership recruitment campaigns, I wish to share some thoughts on the limitations of the current grade scale and make suggestions on possible improvement to the process.

The article is structured as follows: Section 2.0 presents an analysis of senior member elevations statistics. Section 3.0 describes "Structured Significant Performance Abstract" - a tool that has been used by Toronto Section to improve the quality of the elevation campaigns. Section 4.0 contains a proposal for a new IEEE certification - Certified Distinguished Member.

2.0 Senior Membership Statistics Analysis

Our analysis of the worldwide data of senior member elevations for 2006 - 2009 (based on the information available on the IEEE A&A website [1]) shows the following picture:

The total worldwide number of newly elevated senior members (SM) during this period was 8,939 and the annual average 2,236. Figure 1 shows the number of elevations by year.

Figure 2 shows the number of senior members elevated in 2006 - 2009 by Region. Region 8 was the leader with 1,777 elevations. It was followed by Regions 6 and 10, each with about 1,500 new SMs. All other regions are elevating two to three times less SMs than the leader.

A more detailed view of the performance of the Regions is presented in Figure 3. The chart shows regional numbers of elevated senior members, broken down by years. Generally, performance of most regions follows the overall IEEE pattern: Most regions (except 6 and 7) performed well in 2006 and experienced a drop in 2007 - 2008. Many regions displayed signs of revival in 2009, except Regions 1, 5 and 9. Although the decline stopped in 2009, only one region exceeded its 2006 - 2007 positions - by one (1) senior member: Region 7 (Canada) was the only one which was not affected by the overall decline, and has demonstrated a small growth year over year through the analyzed period (Figure 4).

Let's take a closer look at some Canadian Sections' performance in 2006 - 2009: Figure 5 presents Sections with over 20 elevations during the period. Three sections are showing the highest results: Montreal, Ottawa and Toronto, with the latter outstanding in absolute numbers. Even when one considers relative numbers, i.e., SM elevations per number of mem-

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Abstract

IEEE Senior Member is one of several grades of IEEE membership and an important tool for professional recognition. The article presents an analysis of recent trends in senior member elevations in the various IEEE regions. Comparative numbers are provided on how similar recognition tools are used by other professional organizations. Suggestions are made about improving the quality of the senior membership processes with the Structured Significant Performance Abstract. A new IEEE certification - Certified Distinguished Member - is proposed and the framework of its main features described.

Sommaire

« Membre Senior » est un parmi plusieurs grades de membres IEEE et un outil important de reconnaissance professionnelle. Cet article présente une analyse de tendances récentes de promotions vers le grade senior dans diverses régions IEEE. Des chiffres comparatifs sont fournis sur la façon dont des outils de reconnaissance similaires sont utilisés par d'autres organisations professionnelles. Des suggestions sont offertes sur comment améliorer la qualité du processus de promotion vers le grade senior avec un *Sommaire structuré de performance significative*. Une nouvelle certification IEEE, « Certified Distinguished Member », est proposée et le cadre de ses caractéristiques principales est décrit.

bers, Toronto leads the group of large sections with 5% elevation. Two smaller sections did even better for their size with almost 6% conversion rate: Kingston and New Brunswick. However, the arguments in this article pertain mostly to larger sections and the impact of SM elevation campaigns.

2.1 Admission & Advancement Meetings

An effective tool Toronto Section has used in its Senior Membership campaign has been the Admission & Advancement meeting. In May 2008, at the peak of the campaign, 37 section members were elevated at

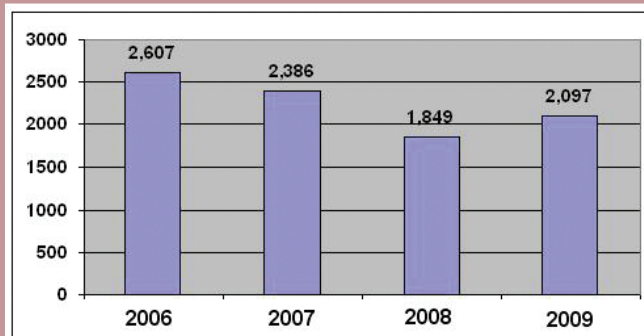


Figure 1: Number of senior members elevated worldwide by year

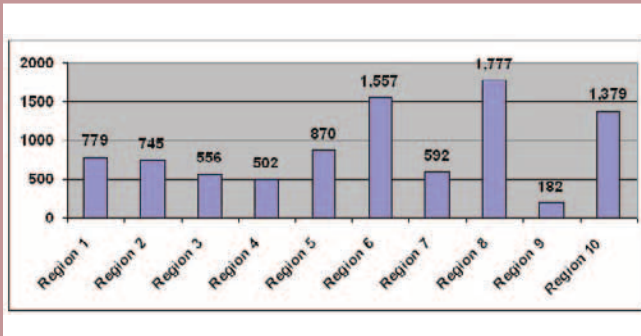


Figure 2: Number of senior members elevated by Region in 2006 - 2009

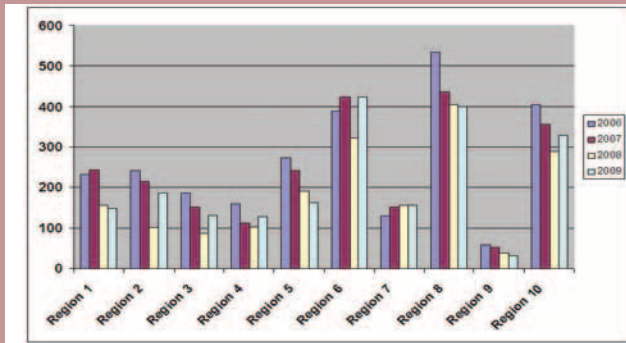


Figure 3: Number of senior members elevated by Region by year in 2006 - 2009

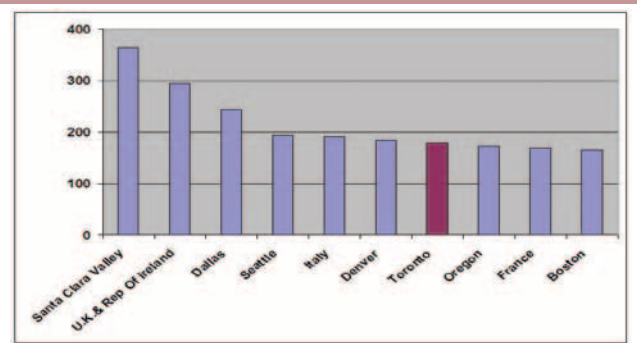


Figure 6: Number of SM elevations by top 10 sections worldwide in 2006 -2009

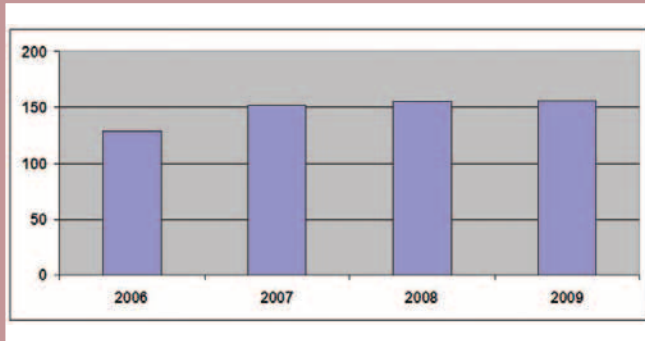


Figure 4: Number of senior members elevated by Region 7 by year in 2006 - 2009

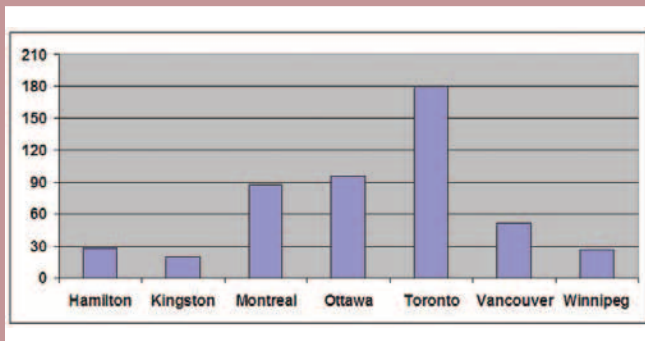


Figure 5: Region 7 Sections with more than 20 elevations in 2006 - 2009

a single Admission and Advancement (A&A) meeting. Montreal Section has also found this tool to be effective — 22 senior members at one A&A session in August 2007. (NB Montreal Section has generously shared their experiences with Toronto for the success of this initiative.) An A&A session in a Canadian Section usually yields around 10 new senior members. Using the A&A meeting and other approaches, the number of Toronto Section new senior members was 63 in 2008 and 47 in 2009. These numbers are twice the average annual results for the Region, albeit in absolute terms. More detail on how Toronto Section achieved its results are described in Section 3.0 of the article.

2.2 IEEE World-Wide Senior Member Elevation

Returning to the IEEE worldwide stage: Figure 6 shows SM elevation results of the top-10 IEEE sections in 2006 - 2009. Toronto Section holds 7th place. Three other Canadian sections: Ottawa, Montreal, Vancouver placed respectively 22nd, 26th and 52nd.

During the current decade (2000 - 2010) the total number of senior members exhibited modest growth, going from about 26,000 to 31,000.

It can be revealing to compare these results with the achievements of other professional organizations in the recognition of their members'

professional qualifications. Although here are no identical or even very similar organizations and their respective recognition tools - member grades or professional certifications., the purpose and the goals of the recognition are very much alike. That makes high-level comparison of approaches and results possible.

The Project Management Institute (PMI) is a non-profit professional organization whose purpose is the advancement of project management practices. PMI is a relatively young organization established in 1969. Until recently (1999), its membership was around 50,000. PMI offers several professional certifications in the field of project management; their most popular and successful certification is Project Management Professional (PMP). The number of PMPs worldwide grew from 27,000 to 393,000 in the last ten years (according to Wikipedia [2]). Monthly growth rate of new PMPs is 4,300 individuals. This is comparable to the number of new IEEE senior members over two years.

In light of the above comparison, the humble growth of IEEE senior member ranks does not look very impressive. One conclusion is that IEEE should use its huge potential to achieve similar results. Improvements can be sought both at tactical (see Section 3.0) and strategic (see Section 4.0) levels.

3.0 Tactical Fix

By tactical fixes we mean improvements that can be implemented immediately. Other changes are of a strategic nature and require changes to IEEE official documents and processes.

For example, one of the concerns regarding the senior membership program is that requirements to achieve senior member grade (especially regarding significant performance) are formulated rather vaguely and allow a variety of interpretations. However, changing this situation would require a long process of updating IEEE official operating documents, and hence would take a long time. These improvements are referred to as strategic changes.

The most important issue in the senior membership program is the way significant performance is described by the candidates in their applications. Their lack of clarity most often result in elevation rejection or lead to delays when additional supporting materials are requested by the A&A Review Panels. The current "free-style" format of the significant performance abstract often presents difficulties for Panel members in evaluating applications and making decisions. They end up going back and forth between the significant performance abstract and the candidate's resume - often prepared for a different purpose and lacking reference to the IEEE senior member requirements criteria.

A&A reviewers often qualify their decision with the following statement: "(The reviewers) feel that the candidate is presently short the required number of years of significant performance". Unfortunately, the term "feel" is very adequate for the type of decisions made, but serious business processes should not be founded on such vagueness.

The quality of the process could be significantly improved by using a structured significance performance abstract (SSPA). Toronto Section developed a guide (a template and a sample) to help candidates in documenting their significant performance (see samples in Fig. 7a and 7b).

The SSPA has a table format. A table allows detailing of the candidate's accomplishments and integrating them with dates and positions held. Each position candidate hold (with dates and a title) is given a separate section (several rows). A separate row(s) is given to provide information pertaining to each of the significant performance indicator/criteria

STRUCTURED SIGNIFICANT PERFORMANCE ABSTRACT: Position 1

First Name: John Last Name: Smith IEEE Member Number: 123456789
Total Duration of Significant Performance: 7.5 years (seven years and six months)

Start Date: Sep. 2006	Position:	Associate Professor		
End Date: Present (Sep. 2010)	Organization:	Deep Lake University Toronto, Ontario, Canada		
Duration: 4 (four) years				
Evidence of Significant Performance				
No.		Start	End	Duration, months
<u>Substantial engineering responsibility or achievement</u>				
1	Principal investigator of a project funded by Natural Science and Engineering Research Council of Canada. Research grant \$100,000. Invented a new technique for failure recovery in optical long haul networks based on network hierarchical trees. A US patent was granted in 2009. Invention has been implemented in Northern Network Utilities.	2006	2009	23
<u>Publication of engineering or scientific papers, books, or inventions</u> List your papers (if you have more than 3 – 5 – attach a separate list).				
2	Published 15 scientific papers in the peer-reviewed journals, two patents. List of publications attached.	2008	2010	
<u>Technical direction or management of important scientific or engineering work with evidence of accomplishment</u>				
3	Co-founder of the company (spin-off from the Deep Lake University) for the commercialization of large-scale cognitive networking technologies. The company supplies technology licensing and radio modules. The major responsibilities include leading the technology and product development teams.	2007	2010	39
<u>Recognized contributions to the welfare of the scientific or engineering profession</u>				
4	Member, IEEE Technical Standard Committee on Smart Grids	2008	2009	24
5	EIC The Excellence in Education Award – February 2010			
6	IEEE Toronto Section Appreciation of Service Award – October 2009 (volunteer)	2007	2008	24
<u>Development or furtherance of important scientific or engineering courses that fall within the IEEE designated fields of interest</u>				
7	Developed and taught several courses in the Bachelor of IT and Master of IT Security programs at the university: • Introduction to Networking • Advanced Network Design (Graduate Course)	2006	2010	37
8	Chair of the Curriculum Committee, Faculty of Engineering: Main contributor to development of a new bachelor program in Information Technology with concentration in Networking and IT security. Contributed to development of the M.Sc. program in Computer Science and the one-year Master program in IT Security.	2009	2010	20

Figure 7a: Sample Structured Significant Performance Abstract (SSPA) for candidate’s most recent position

applicable to the candidate:

- Substantial engineering responsibility or achievement.
- Publication of engineering or scientific papers, books, or inventions.
- Technical direction or management of important scientific or engineering work with evidence of accomplishment.
- Recognized contributions to the welfare of the scientific or engineering profession.
- Development or furtherance of important scientific or engineering courses that fall within the IEEE designated fields of interest.
- Contributions equivalent to those of the above in such areas as technical editing, patent prosecution or patent law, provided these contributions serve to advance progress substantially in IEEE designated fields.

The use of the SSPA can be started immediately as it doesn’t conflict with the “free-style” current abstract. Obviously, preparation of the SSPA requires more time than a currently used abstract. But it’s worth it. The use of the SSPA will save a lot of time for reviewers, make decisions more objective and accurate, and avoid elevation delays caused by requests for additional supporting information. The SSPA has already helped Toronto Section to resolve several senior member cases, which were initially rejected.

4.0 Strategic Re-direction

Tactical fixes, as the Structured Significant Performance Abstract, can be very valuable tools in making current processes more efficient. However, they will not be able to drive organization to the drastically higher level of performance.

PMI certification success story, and certification statistics mentioned in

Section 2.0, deserves to be explored in great detail. Use of the best practices proven by other organizations can provide a foundation for the strategic improvements in membership growth and member satisfaction for the IEEE.

Here are a couple of high-level observations and comparisons between the IEEE senior member and PMI PMP.

IEEE SM is almost exclusively an internal product. It is practically unknown and rarely appreciated outside the IEEE. No visible efforts are undertaken by the organization to communicate the professional status of senior members to the companies which employ them.

PMI success, conversely, is based on two pillars: Delivering a quality product (certified Project Management Professionals - PMP), and - arguably even important - Communicating with potential employers and convincing them that PMP has a great value for the organization. As a result of the PMI’s marketing efforts, their certification has become a standard human resources requirement for project management positions (at least in North America). In many job ads for project managers, PMP certification is stated to be a mandatory condition of employment. Through the value perceived by employers, certification became a real tool for the thousands of PMP holders in career advancement. It is the success of the PMP holders that brings PMI new waves of members and certification candidates counted in thousands.

Based on PMI best practices, I believe IEEE would greatly benefit in introducing a new credential. I propose adopting a certification with the working title IEEE Certified Distinguished Member (CDM).

I suggest the following framework of features/characteristics for the CDM:

- In the hierarchy of the IEEE credentials, CDM should be placed higher than Senior Member but lower than Fellow. Only senior members in good standing should be eligible to apply for CDM.

STRUCTURED SIGNIFICANT PERFORMANCE ABSTRACT: Position 2

First Name: John Last Name: Smith IEEE Member Number: 123456789

Start Date: Apr. 2003	Position: Program Manager		
End Date: Aug. 2006	Organization: Electric Grid, Inc.		
Duration: 3.5 years (42 months)	Toronto, Ontario, Canada		
Evidence of Significant Performance			
No.	Start	End	Duration, months
<u>Substantial engineering responsibility or achievement</u>			
9	Technical Lead in the development of fuzzy logic and neural networks for the energy applications. Achieved 20% improvement in control performance.		24
<u>Publication of engineering or scientific papers, books, or inventions</u> List your papers (if you have more than 3 – 5 – attach a separate list).			
10	John Smith, "Performance Study of a Self-Repairing Protection Devices in Networks", IEEE Broadnets 2007, October 2007, USA. John Smith, "Hierarchical Protection Scheme for Networks", 2006. US Patent Number 7,654,321		2008
<u>Technical direction or management of important scientific or engineering work with evidence of accomplishment</u>			
11	Project: Day-Ahead Market (DAM) - major evolution in the Ontario electricity system and market. Budget: \$50M. Role: Project Manager. Managed a team of 12 members.		12
12	Project: Wireless Monitor with Interference Robustness Budget: \$750,000 Role: Project Leader. Led and coordinated a project team of 20 members.		12
13	On-going management of a department responsible for the product development and engineering support of network products. Budget: Annual revenues of approx. \$25 million. Role: Senior Manager. Managed department of 10 (on average) engineering and product staff.		33
<u>Recognized contributions to the welfare of the scientific or engineering profession</u>			
14	Member, International Council On Large Electric Systems (CIGRE) Working Group C6.16 – Rural Electrification		24
15	Employee of the Year award for contributions in network performance – October 1985		
16	Chair, Conferences Committee, IEEE Canada (volunteer)		24

Figure 7b: Sample Structured Significant Performance Abstract (SSPA) for candidate’s immediately prior position

Commitment to the organization should be confirmed by a number of years of membership and involvement in IEEE volunteer work.

- CDM should target IEEE members across all societies.
- CDM candidates should demonstrate continuous significant performance for several years after being elevated to senior members.
- CDM candidate should hold at least one professional certification in the IEEE or related fields for at least one year prior to applying for the CDM certification. A list of professional certifications should be developed. It should include both IEEE certifications, e.g. Certified Software Development Professional, Certified Biometrics Professional, etc., and external to IEEE (but reliable) industry-accepted certifications such as PMI PMP, Professional Engineer (protected designation granted by the 12 constituent associations of Engineers Canada), etc. This point will ensure that a candidate has passed a rigorous exam (on top of other certification requirements), which is a vital requirement for any respected certification.
- Certification should be granted for a certain number of years and should require holders to continuously demonstrate significant performance and dedication to professional development in order to renew certification.
- IEEE must clearly identify CDM value to potential employers. It should include not only a clear description of the value and high caliber of the CDM holders, but also possible tangible incentives targeting employers directly as e.g. discounts for corporate Xplore subscriptions for companies employing a certain number of CDMs. IEEE should commit to the extensive use of its resources, including financial, to promote CDM to potential employers in the industry and academia. One of the goals of this campaign should be the eventual recognition of CDM as a criterion for full professor appointments in academia, and similar responsibility positions in the industry (in IEEE fields).

A more detailed description of the proposal has been submitted in 2010 to *The Institute* magazine.

With the CDM certification, I believe, IEEE will make a direct positive impact on the career advancement of its members. That will not only be a fulfillment of the prime function of the professional association, it will also bring an avalanche-like effect on the growth of membership and improvement of the IEEE financial situation.

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[1] IEEE A&A website. Newly Elevated Senior Members. http://www.ieee.org/membership_services/membership/senior/new_senior_members.html
 [2] "Project Management Professional", Wikipedia, http://en.wikipedia.org/wiki/Project_Management_Professional

About the Author

Dr. Alexei Botchkarev is a Senior Information Management Advisor with the Knowledge Management Branch, Ministry of Health and Long-Term Care (Government of Ontario), and an Adjunct Professor at Ryerson University (www.gsrc.ca). He has more than 30 years of experience in project management, systems analysis, modeling and simulation, business processes analysis, information systems solutions, requirements analysis and scientific research. He was Chair of the IEEE Toronto Section and a member of the IEEE Canada Board of Directors in 2008–2009. He was founding member of the IEEE TIC-STH 2009 Organizing Committee.



Health and Wellness for Engineers

By Terrance Malkinson

Our lives are increasingly complex. Information and activity overload, decision-making under uncertainty, employment competition, lack of respect, incivility, changing gender roles, globalization, loss of control, conflicting demands, blending of cultures, and overcrowding in a world whose population is projected to reach seven billion people in 2011 are but a few of the challenges we all face. This affects us all, regardless of how skilled and experienced we are.

The workplace, in particular, has become increasingly challenging with demanding workloads, downsizing, and loss of job security. For many engineers, long hours seated at a computer induce physical and mental tension. These challenges result in stress. Over a certain amount, harmful physical and emotional responses will result. Regardless of one's position or wealth, this will lead to performance loss, increased probability of illness and reduced life expectancy.

Unfortunately we can do little about the stressors, but we can control how we respond. We can engage in mitigating activities to improve our resilience to stress and as a result be better engineers. We are all biological beings for whom physical activity is a natural and essential ingredient for effective functioning. Regrettably, physical education has been removed from the curriculum of many primary and secondary educational institutions. Fewer people now have learned at an early age to make exercise an essential part of their weekly routine, or even learned how to exercise effectively.

Still, there is hope. With the increasing recognition of the value of a balanced life and its relation to well-being, home and work-site fitness programs are gaining in popularity. Participation has been proven to improve health, lower absenteeism, increase productivity, enhance morale, reduce professional burnout, and increase job satisfaction. For a small investment of time and effort in regular and effective exercise you will increase your probability of achieving a long and successful life. An additional benefit is cost-savings - you will actually save money and time by maintaining your health. Your insurance will never cover all the costs of illness or subpar health.

Always have a discussion with your physician prior to starting a fitness program, and it is a good idea to obtain guidance from a health and wellness professional. Their training



Preparing to rappel during the author's Outward Bound Canada expedition.



The author at the successful completion of Ironman New Zealand in 2007.

and experience will help you set an appropriate and realistic program that will facilitate meeting your objectives, and avoid mistakes that may cause injury; it is not necessary to hurt the muscle in order to condition the body. There is a wealth of authoritative information to assist you when setting up your personalized fitness program. Most communities have providers of individual and group fitness training. You should verify the credentials of the fitness provider, to ensure you receive authoritative information and guidance.

You can work-out alone or in a group, anywhere and anytime your schedule permits. Depending on your goal the program may be as simple as a regular daily walk. Include those three basic items: into your plan: strength,

Canada, Stress and Physical Fitness

Canada is a leader in stress research. Dr. Hans Hugo Bruno Selye, (1907 - 1982) was a renowned endocrinologist who investigated stress. Much of this research was done in Canada. Born in Vienna he became a Doctor of Medicine and Chemistry in Prague followed by time at Johns Hopkins University and McGill University. In 1945 he joined the Université de Montréal. The author of 1,700 research papers, 15 monographs and seven books, his work has been cited in more than 362,000 scientific papers. The Canadian Institute of Stress [<http://www.stresscanada.org/>] he founded in 1979 focuses on research and development, education, clinical and preventive applications as well as international academic, clinical and research partnerships.



Animal research by Dr. Hans Selye at Université de Montréal revealed the physiology of the stress response. Photo Credit: The Canadian Medical Hall of Fame.

Canada is also a leader in physical fitness. The Weider brothers (Ben and Joe) of Montreal helped to grow the worldwide fitness revolution and legitimize bodybuilding. They encouraged training with weights to build strength and musculature for athletic conditioning. The International Federation of Bodybuilding and Fitness, founded by the Weider's in 1946, has 173 member national federations worldwide and sanctions thousands of amateur and professional competitive events.

Canada has a proud history of competing in and hosting international sporting events such as the summer and winter Olympics, the Commonwealth Games and many other athletic professional, amateur, and recreational world championships. Our post-secondary education system has a growing national student-athlete participation rate and support network [<http://cis-sic.ca/>]. Engineers have played an important role in the design and building of athletics infrastructure. Canada's research establishment has a proud history of achievement with many world-class scientists and technologists advancing knowledge in health and wellness, bio-engineering, and sports medicine.

N.Ed. Reduced rates for engineers at fitness centers! The Engineering Institute of Canada - of which IEEE Canada is a component - has made an agreement for reduced rates for its members with GoodLife Fitness, Energie Cardio in Quebec and Nubody in BC. See <http://www.engineergoodlife.ca>.

N.Ed. Taux réduits pour les ingénieurs dans les centres de conditionnement physique! L'Institut canadien des ingénieurs - dont IEEE Canada est une composante - a conclu un accord avec GoodLife Fitness, Énergie Cardio au Québec et Nubody en C.B. Voyez <http://www.engineergoodlife.ca>.

flexibility, and endurance. Your fitness program does not need to be expensive - equipment can be as simple as a piece of elastic tubing.

Consider this to be a managed engineering project. Create a project plan with a goal and milestones just as you would do with your engineering employment tasks - failure is not an option. Important to remember: Do not compare yourself with others! Set your own goals and do not abandon or stray from your plan by allowing others to discourage you.

Canada has an excellent athletics infrastructure and human resource base for you to enjoy. One great feature of our country is that it has a diverse geography and changing seasons that provides a variety of outdoor activities to suit everyone. To resume: Determine your health and wellness goals, create a realistic plan, implement the plan, and do not stray from your goals - just as you would do with your engineering projects. You will be a better person and better engineer, avoid lifestyle-induced disease, and effectively surmount the challenges of a complex and stressful world.

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, associate 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 420 publications, and an accomplished triathlete.
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- Are you...** interested in improving the exposure of young people in Canada to Engineering and Technology?
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About the TISP Training Workshop

The workshop will be held on 28-29 April 2011 at the Delta Meadowvale Resort & Conference Centre, Mississauga, Ontario, Canada. The purpose of this workshop is to help IEEE members improve the teaching of engineering and engineering design in pre-university schools (primary schools, middle schools and high schools). In this workshop, IEEE members will learn how to work with teachers of pre-university schools, and how to conduct hands-on sessions for these teachers on engineering topics. The teachers will then use these sessions on a regular basis with their own students.

The expectation is that IEEE members who complete the workshop will contact local schools in the future, and work with their teachers on lesson plans that demonstrate engineering and engineering design. Examples of lesson plans are available at <http://www.tryengineering.org/lesson.php>

The workshop is held for one and a half days, and it provides attendees with examples of lesson plans, suggestions on the best way to contact and work with the pre-university school system, and description of successful management of a TISP program in an IEEE Section. **The event is free of charge for all IEEE members and invited educators.** IEEE will reimburse all reasonable travel-related expenses for this workshop. Travel-related expenses include up to a one night hotel stay and transportation to and from the workshop location.

Workshop Registration

Organized Jointly By:

IEEE Educational Activities Board
IEEE Region 7 TISP Committee

To Register, Please Go To:

<http://guest.cvent.com/d/mdqtbn/1Q>

Please Register By:

7 April 2011

Questions:

For more information, please contact
Lynn Bowlby, +1 732.562.5496,
l.bowlby@ieee.org

Workshop Agenda

Thursday, 28 April, 4:30pm to 7:00pm

Program background and scope, hands-on presentation

Thursday, 28 April, 7:00pm

Networking/Dinner

Friday, 29 April, 9:00am to 4:00pm

Challenges and opportunities in Canada schools; hands-on presentation, a question-and-answer period; discussion on topics such as: costs and resources, how to make contact with local pre-university schools, aligning a TISP session with education standards used in Canada schools; and break-out groups to discuss next steps

The Future of Instrumentation and Measurement

Workshop series and interview with IMS President Kim Fowler

By Branislav Djokic

A well attended workshop series on Instrumentation and Measurement, with a special focus on biomedical engineering, has been held for a number of years in Ottawa. It offers a good example of what volunteers from academic, government and industry research can accomplish with modest funds, inquisitive minds and unlimited enthusiasm. Following is a summary of these themed workshops from 2006 to 2010, with key observations where applicable.

2006 Workshop — *Future of Instrumentation & Measurement*

Our inaugural workshop was organized jointly by several components of the IEEE Ottawa Section (IMS Chapter, Educational Activities, Power & Energy Society and Reliability Society Chapters), along with the Institute for National Measurement Standards (INMS) of the National Research Council of Canada (NRC).

<http://ottawa.ieee.ca/ims/IMSWorkshop2006.html>

Four speakers and several attendees came from the US and took the event out of local boundaries. Scientists from INMS/NRC, University of Ottawa, Agilent Technologies, Communications Research Centre of Canada (CRC), and Defence Research and Development Canada (DRDC) explored the subject. The topics covered a number of technical areas: highest accuracy metrology in National Measurement Institutes (NMIs) such as INMS, intelligent sensor agents for infrastructures and environment monitoring, I&M industry trends, embedded testing of VLSI/Systems on a Chip, optical instruments for optical communications, microwave antenna measurements, fast and selective detection of chemical and biological agents, and military applications of data acquisition and signal processing systems.

The event had over 80 people in attendance and was very well received. The workshop kept the expenses at a minimum and was revenue neutral. Modest registration fees were further discounted for IMS members — an incentive for non-members to join!

2007 Workshop — *Non-invasive Blood Pressure Measurements and Standardization*

The subsequent year, a workshop on Noninvasive Blood Pressure Measurements & Standardization was organized in conjunction with INMS/NRC and held at NRC. Beside IEEE Ottawa, the sponsors of the event were Biosign Technologies, Carleton University, and University of Ottawa. The presenters were from industry: Biosign Technologies, Canamet Inc., a spin-off of DRDC, and the Canadian NanoBusiness Alliance; regulatory and research institutions: Health Canada, NRC Institute for Biomedical Diagnostics (IBD) and King/Drew Medical Center, Los Angeles; and Academia: Lancaster University in UK, Royal University of Groningen in the Netherlands, University of Ottawa, Carleton University, and Concordia University.

The workshop had an international presence as not only some of the twelve speakers came from US and Europe but also many attendees came from abroad. Two panel sessions addressed the question “One Hundred Years Later: Are We Really Measuring Blood Pressure?” Dr. Voicu Groza, professor at the University of Ottawa and IMS Ottawa Chapter Chair, and Dr. Radu Leca, President and CEO of Biosign Technologies, an MD by training and an inquisitive mind strongly oriented towards science and engineering in the biomedical field, spearheaded an IEEE Initiative on Standardization of Noninvasive Blood Pressure Measurement (NBPM).

Observations

It came as a surprise to many that, a century its introduction by N. Kortkoff in 1905, NBPM has still not been standardized. Some time after the workshop, the IMS Medical and Biological Measurements Technical Committee TC-25 established Blood Pressure Measurement Sub-committee, and IEEE-Standards Association established a Working Group chaired by Dr. Groza and developing P1721 Standard for Objective Measurement of Systemic Arterial Blood Pressure in Humans.

<http://ottawa.ieee.ca/ims/BPW2007/>

2008 Workshop — *Adverse Response Monitoring I*

A series of two-day IEEE Ottawa Workshops on Adverse Response Monitoring (WARM) began in 2008, with constant involvement of Dr. Leca and Biosign Technologies in supporting the events on all fronts. Held in Ottawa, the first had sponsors Biosign Technologies, IBM Healthcare, Telus Healthcare, and Emergis Health IT Solutions.

Run under the theme “Patient Safety: Adverse Response to Medication,” the event featured high profile speakers addressing the challenge of quantifying the response to treatment in view of recent advances in measurement, computation, and communication at the interface between life, health, and medical sciences. The focus was medication safety systems that detect and report adverse events objectively, promptly and relevantly.

To increase interaction with the audience, panel discussions with experts were held at the end of each presentation session. Several areas of expertise were brought together to reveal the issues in monitoring and the role of science and engineering.

Observations

The lack of instrumentation to adequately identify and measure adverse response was recognized. An interesting finding of the workshop was a noticeable decline in emphasis given to physical sciences, mathematics, and logic in medical education and training. It was linked to the lack of zeal of applying basic scientific principles in this field.

As medicine continues to lack a unified theoretical framework, a danger of clinical research lapsing into mere statistical empiricism was pointed out. Only after what to look for is defined on the biomedical side, engineering can be meaningfully and successfully applied to instrumentation and measurement. An aggravating factor was seen in complementary problems — more pronounced in areas where several disciplines overlap.

The workshop included a live demonstration of remote patient monitoring using newly developed health monitoring devices and advanced communication technologies. The event attracted media coverage, and it appeared on CTV Ottawa featuring interview with one of the workshop presenters on adverse response to medication.

<http://ottawa.ieee.ca/ims/warm2008/>
<http://www.canhealth.com/News766.html>

2009 Workshop — *Adverse Response Monitoring II*

Expanding the scope from the previous year, WARM 2009 was held at the University of Ottawa and dealt with technologies for self-monitoring, analysis and reporting of adverse response to medication. The workshop had over 80 attendees and 16 speakers from Canada and abroad. Some of the speakers participated via video link. The focus was on collection, integration and analysis of electronic health information, multi-sensor systems for mission critical healthcare applications, as well as on automated detection of adverse responses, emphasizing the value of physical measurement in gathering and analyzing medical evidence for safety and efficacy instead of relying solely on personal experience. Proving causation and assessing health risk in real-time raises issues unique to biomedicine. Smart-healthcare environments provide increasing monitoring capabilities and are changing the conventional thinking about healthcare. Dr. Alessandro Ferrero, IMS President in 2009, gave a video lecture from Politecnico Di Milano, Italy, on a topic essential to metrology and this workshop: “Why Uncertainty in Biomedical Measurements?”

Observations

It should be noted that measured value is only complete if it is accompanied by a statement of the associated uncertainty, i.e. a non-negative parameter characterizing the dispersion of the values attributed to a measured quantity. Medication is often prescribed based on biomedical measurements. It is therefore imperative to have scientifically sound definitions of the quantities to be measured, and then to quantify them and interpret measurement results according to metrological principles.

<http://ottawa.ieee.ca/ims/smarm2009/>

2010 Workshop—Adverse Response Monitoring III

Delving further yet into the same general topic, the 2010 workshop was held in December at the University of Ottawa, with close to 20 speakers, some of whom gave their presentations over video link. The workshop provided insights in the integration of patient safety issues in European projects on e-health, adverse drug reactions from Canadian perspective; essential problems of definition, measurement, and causality in detecting adverse responses to medication; and, real-time tracking of performance and adverse effects of biomedical implants. The advanced sensors for patient monitoring have been continuously explored, and biology inspired robotics is challenging the imagination of engineers and scientists. The subject of metrology of blood pressure monitoring was also dealt with in the workshop. It ended as successfully as the previous workshops.

<http://ottawa.ieee.ca/ims/smartarm2010/>

For all of the aforementioned IMS Ottawa workshops organized to date, credits and thanks for their unwavering support go to Dr. Radu Leca and Biosign Technologies, Dr. Emil Petriu and University of Ottawa, Dr. Rafik Goubran and Carleton University, National Research Council of Canada, and last but not least to the IEEE Ottawa Section and, in particular, to Dr. Voicu Groza, Dr. Hilmi Dajani, Dr. Sreeraman Rajan, Dr. Wahab Almuhtadi, Bogdan Groza, Raed Abdulah, and many other Section officers and volunteers, including students, all of whom, one way or another, contributed with their time, work, and ideas to these events. These workshops provided value not only to IEEE members but to a wider science and engineering community. The author of this article feels privileged to have been a part of that team.

The cooperation between the I&M Society and I&M Chapter in Ottawa has been very good for a number of years. This year, at WARM 2010, the attendees and organizers had a privilege to greet in person Mr. Kim Fowler, the current IMS President, who came to Ottawa to give a talk “A Perspective on the Future of Instrumentation and Measurement.” Although not specifically aimed at drawing a parallel, this talk’s topic provided a nice opportunity for closing a circle with the 2006 IMS Ottawa workshop run under the same theme.

Interview with Kim Fowler, IMS President

This 2010 workshop provided a great opportunity to speak with Mr. Fowler, and he kindly agreed to give an interview for the readership of *IEEE Canada Review* :

Q: This is not your first visit to Ottawa, is this your first visit as Instrumentation and Measurement Society President? How do you find the cooperation between IMS and IMS Chapters as well as other entities in Canada?

A: My visits to Ottawa began back in 1996 when I was part of a small company that was purchased by a Canadian company called DY4. We designed and produced specialized digital processing boards. I was part of the technical marketing team and briefed our Canadian counterparts on the architecture and operations of our computer boards. The combined companies have been absorbed by other companies twice since then and are now part of Curtiss-Wright Embedded Computing.

I next visited Ottawa in May 2005 to attend the Instrumentation and Measurement Technology Conference (IMTC). By then I had been the editor of the IEEE Instrumentation and Measurement Magazine for nearly six years. The weather was beautiful and the tulips were in full bloom—it was lovely. IEEE had some international meetings in the following years, but this visit to speak at WARM 2010 was my first as President of the Instrumentation and Measurement Society (IMS).

The Canadian chapters, like some other chapters around the world, are extremely active and a tremendous source of technical contribution to the IMS. We are grateful for your enthusiasm and hope to use it to infect or invigorate other chapters that are flagging—such as several in the United States. The cooperation, needless to say, is excellent.

Q: How did you get professionally into the field of instrumentation and measurement?

A: Dragged in kicking and screaming. I started my career in 1982 at the Johns Hopkins University Applied Physics Laboratory designing specialized equipment for military, space, and medical applications. Mike Lucas at Kansas State University asked me to give a guest lecture in the fall of 1988 at Kansas State [EH1]. Later Mike asked me to chair a session at the 1989 IMTC in Washington, D.C. Then in

1992 and again in 1993, Steve Dyer asked me to give brief tutorials on how to make an effective technical presentation at the respective IMTCs in San Diego and New Jersey.

Later in the decade I attended the 1998 IMTC in St. Paul, Minnesota, to give a paper and the 1999 IMTC in Venice, Italy, to give a tutorial on instrument design and development. Finally in 1998, I began writing a column in the I&M Magazine; Steve Dyer asked me to take over the editor position in late 1999. I had been captured.

I always thought of myself as a designer or systems engineer for specialized embedded systems. After the fact I realized that much of what I developed in the first 18 years of my career was instrumentation; that effort has continued to the present day (the following 10 years). Furthermore, the IMS is very broad in its field of interest and cuts across many disciplines, which aligns with my own interests and career.

Q: How did you become the IMS President?

A: Becoming the IMS President is a long process. First, you are elected to a four-year term on the Administration Committee (AdCom). Second, you must be committed and involved in various assignments. Third, you are nominated and then voted a Vice President by the AdCom to preside over a specific responsibility (see <http://www.ieee-ims.org> for people and details). Then you may serve as the Executive Vice President for two years to learn the ropes within IMS and IEEE.

All previous presidents have arrived at the position through different avenues. My own path was unusual—I spent eight years as editor-in-chief of the I&M Magazine and two consecutive terms as an AdCom member at large. The editors-in-chief of I&M publications attend all adcom meetings, and this means I have attended almost all of them since 2000. I became Executive Vice President in 2008; my path to President skipped over all the other Vice President positions—a contingency situation in succession had arisen and I had long experience on the AdCom and was available.

Q: In this era of omnipresent and dominating digital technology, especially in communications, does Instrumentation and Measurement really matter?

A: Great question! We are wrestling with it in the IMS.

Many people do not appreciate the challenge and necessity for measurement and instrumentation. Certainly the general public does not know why they are important. Even scientists and engineers seem to be hazy as to the issues surrounding this field. A recent whitepaper by Derek MacLachlan opens with this comment: “Accurate measurements are central to virtually every scientific and engineering discipline, but all too often measurement science gets little attention in the undergraduate curriculum [at least this is true in the United States]. Even those who received a thorough grounding in measurement fundamentals as undergraduates . . . [have] forgotten some of the details.” (*Getting Back to the Basics of Electrical Measurements*, Derek MacLachlan, Staff Applications Engineer, Keithley Instruments, Inc.)

There are some specific factors contributing to ignorance of measurement and instrumentation we need to understand:

1. New technologies, such as the internet, gaming, and the smart grid, can be more exciting than measurement science to the latest generation of students, academics, and practitioners.
2. The science of measurement has been thoroughly investigated over the past two hundred years, which might breed complacency and potentially contempt for measurement science.
3. No series of failures or catastrophes have occurred that can be attributed to issues within measurement science.

I have also heard the following reasons for the general ignorance of this field:

- Workplaces had forced “stove-piped disciplines”, which tended to isolate people and reduce communication.
- Vendors of sensors and instrumentation and process controls have been effective in reducing the concern over the issues of measurement and removing the need to understand them. In essence, they have persuaded buyers to relax.
- Crossing cutting disciplines requires a disinvestment of personal ownership in specifics for the good of the whole. This is a necessary in order to “bring down the stove-pipes.”



Kim Fowler, IMS President, presenting on “A Perspective on the Future of Instrumentation and Measurement,” in Ottawa last December

- We communicate mostly in digital format. Society has forgotten that the world is analog and needs measurement, which requires conversion to digital format.
- Society is transactions-based. Most measurement and instruments want smooth, continuous operations.
- Instrumentation is expensive.

Q: What is the impact of instrumentation and measurement (I&M) on the future of science and engineering (S&E)?

A: I&M is increasingly important to developments in S&E. From nanotechnology to cosmology, new measurements and instruments are needed and developed every day. Unfortunately, the perceptions laid out in the previous question and its answer will continue to blind many people to the necessity of I&M in future S&E efforts.

Q: In Europe, and elsewhere, courses on I&M have been taught at universities for a long time whereas in North America, with rare exceptions, they have not been taught as standalone subjects. Yet, I&M has been important enough to have its own learned societies. What place do you see for I&M in the education of college students?

A: The answer to the previous question says that need for I&M will continue to grow. Consequently, basic education in I&M should be among the fundamentals taught in colleges and universities. Unfortunately (had to use that adverb again), fads and fashions will continue to rule at many universities and I&M will not be thoroughly taught. The only way out of this is for outside influences, such as industry and IEEE, to persuade educational institutions to re-engage the teaching of I&M.

Q: How can IEEE and IMS facilitate and enable innovation?

A: The simple answer is YOU. Each of you, readers and practitioners in engineering and I&M, provide and facilitate the innovation.

Get involved in some of the activities and ventures of your profession and its technical societies—IMS, in particular. The primary activities that facilitate innovation are publishing, technical committees, and conferences. IMS extends these activities to include the International Measurement University (IMU), tutorials, the Distinguished Lecturers Program, website developments, and books on instrumentation fundamentals. We are also looking at developing forums for active networking and technical references.

Become more involved in your chapters and sections to develop local contributions and innovations. Join a technical committee within the IMS and help with standards and technical guidelines.

Finally, you might consider involvement with the IMS AdCom; the necessary qualifications are that you must be an IEEE member in good standing and have demonstrated volunteer effort in society activities. There are many different activities; investing yourself in any one of these activities will raise your visibility and demonstrate your effort. Some of these activities include chapter meetings, conference attendance and volunteer contribution, serving on ad hoc society committees, and serving on technical committees (I&M has 37 different ones) to promote a specific area and standards. Our website at <http://www.ieee-ims.org> is a good starting point for checking out current activities and initiatives of the society and where you might contribute.

Q: What is the future of IMS in the next few years?

A: The IMS is at a tipping point—we can become a significant catalyst for renewal of I&M, or another organization will take over and become prominent in that effort. Alternatively, significant world events could jump-start interest in I&M or completely dismiss it. I&M could bumble along as the forgotten step-child of S&E for years, but at some point we must move forward with promoting its importance or it may lose its significance and utility altogether. My hope is that IMS will be front and center in rebuilding I&M in the near future.

With this we thanked Mr. Fowler for being so kind to come to Ottawa, giving his talk at the workshop, and—in spite of his very short stay—finding the time for this interview. We wished him a safe trip back home to snowy Washington (well into winter by this time in December), with a standing invitation to visit us again in the not-so-distant future.

About the Author

Branislav V. Djokic (M’90–SM’97) is a senior researcher at the Institute for National Measurement Standards, National Research Council (NRC) of Canada in Ottawa. From 1990 to 1994, he was Staff Member with the School of Electrical Engineering, University of Belgrade, Belgrade, Serbia, where in 1993 he received his Ph.D. Joining NRC in 1994, his research interests include high accuracy measurement systems, data acquisition, measurement automation, and digital signal processing. Dr. Djokic is currently the Chair of IEEE PES Emerging Technologies Coordinating Committee, IEEE Canada Industrial Relations Committee, and IEEE Ottawa Section Educational Activities.



Engineering Management: What's New in the Literature?

On: Inventions, Rankings, Water Vs Energy, First Laser, Leaders' Mistakes, Innovation Wars, Employee Networks, Talent Analytics, Wellness, Future Consciousness

by Terrance Malkinson

- ◆ “The 50 Best Inventions of 2010” was featured in the November 11th issue of Time Magazine [www.time.com/time/specials]. The “biggest (and coolest) breakthroughs in science, technology and the arts” are described - and pictured - in nine categories: Technology, Transportation, Health and Medicine, Bioengineering, Green Energy, Clothing, Robots/Software, Military and Miscellaneous; other interesting lists appear in the Specials web tab. Going back several decades, Thomas A. Edison (1847-1931) was the subject of Time Magazine’s history issue published July 5, 2010. The American inventor, scientist and businessman is credited with the creation of the first industrial research laboratory which is seen as setting the stage for today’s technological think tanks. During his lifetime he developed or perfected many devices that changed the world, including the motion picture camera, phonograph, and the incandescent light bulb to name but a few.
- ◆ The Centre for World-Class Universities of Shanghai Jiao Tong University released its latest annual Academic Ranking of World Universities (ARWU) on August 15, 2010 [www.arwu.org]. Initiated in 2003 and based on a set of objective indicators and third-party data, ARWU is recognized as one of the most influential lists of university rankings - although the methodologies for such rankings will always be highly criticized. The United States dominates the 2010 list with eight of the universities in the top 10, and 54 in the top 100. Harvard University leads the ranking followed by Berkeley and Stanford. The University of Toronto, the University of British Columbia, McGill and McMaster rank respectively 27th, 36, 61 and 88.
- ◆ Jason Meyers discusses the Princeton Review’s annual ranking of undergraduate and graduate entrepreneurship programs in “Best in Class” [Entrepreneur; www.entrepreneur.com]. Data from a survey of more than 2,000 institutions formed the ranking of the top 25 undergraduate and 25 graduate programs. Meyers discusses the methodology used to gather and analyze the data. As stated in the articles introduction: “The education of an entrepreneur may begin in the classroom, but it’s often the educational environment that determines how well-rounded a program truly is - and what it can help entrepreneurial-minded students achieve.”
- ◆ “Water vs. Energy” was the topic of a special report in IEEE Spectrum’s June 2010 issue. This in-depth analysis provides valuable insights into the competing global demands for the estimated 1.39 billion cubic kilometres of water on our planet. Our increasing demand for energy, which utilizes large amounts of water, is a major focus of the article suggesting that only radical new ideas will help us resolve the competing demands on this limited natural resource.
- ◆ 2010 marked the 50th anniversary of the demonstration of the first laser by Theodore Maiman at the Hughes Aircraft Company in 1960. An IEEE Milestone was unveiled in December to commemorate this achievement. Laser technology, regarded as one of the most significant technological discoveries of the century, has enabled many devices and processes that have widespread applications we use daily. The development and growth of the technology is described in [American Scientist, September-October 2010; www.americanscientist.org].
- ◆ “Mistakes Leaders Keep Making”: Failing to set proper expectations, Excusing subordinates from the pursuit of overall goals, Colluding with staff experts and consultants, and Waiting while associates prepare. Robert Schaffer describes these behaviour traps and provides strategies for overcoming them in the September 2010 issue of Harvard Business Review [www.hbr.org].
- ◆ Tension often occurs between innovation teams and other business operations and these conflicts have a negative impact on the organization. Innovators are often seen as “undisciplined upstarts” and operations people as “bureaucratic dinosaurs.” Vijay Govindarajan



and Chris Trimble provide strategies that will prevent these tensions from disrupting the organizations growth initiatives in “Stop the Innovation Wars” [Harvard Business Review, July/August 2010]. As suggested by the authors, factors important for success include having an innovation leader who can collaborate well throughout the organization and senior executive who support the innovation enterprise.

- ◆ Rob Cross, et al., believe from their research of twelve large companies that, because of their inflexibility, standardized processes and formal organizational charts do not the support the internal and external collaborations needed to maximize organizational success [“The Collaborative Organization: How to Make Employee Networks Really Work”, MIT Sloan Management Review, Fall 2010; sloanreview.mit.edu]. They suggest instead that innovation emerges through informal and unplanned interactions among employees that encourage different perspectives. Effective organizations make use of these informal employee networks to reduce costs, improve efficiency and spur innovation.
- ◆ Human resource costs are a large part of an organizations budget. Many companies are adopting sophisticated methods of analyzing employee data to increase their competitive advantage. Thomas Davenport, Jeanne Harris and Jeremy Shapiro discuss six ways that leading companies track, analyze and use human resources data to leverage attract, and retain the best talent in “Competing on Talent Analytics” [Harvard Business Review, October 2010]. In the December 2010 issue of this publication, Leonard Berry, Ann Mirabito and William Baun discuss how employee wellness programs provide a significant return on investment—sometimes as high as six to one!—in “What’s the Hard Return on Employee Wellness Programs”. The authors provide six pillars considered essential for the successful implementation and management of a wellness program. These pillars emerged from their analysis of ten organizations that have financially sound workplace wellness programs. An inset provides key employee and organizational metrics for a wellness dashboard.
- ◆ Future consciousness is the ability to have thoughts, feelings, and goals about the future. Tom Lombardo is the director of the Center for Future Consciousness [www.centerforfutureconsciousness.com] and author of the book The Evolution of Future Consciousness, as well as others that explore heightening your awareness and understanding of trends, possibilities, challenges, and opportunities. He posits that through education and self-development practices it is possible to develop our “future consciousness”. In “Wisdom Facing Forward: What It Means to Have Heightened Future Consciousness” [The Futurist, September-October 2010; www.wfs.org] he discusses his belief that “wisdom is the ideal toward which we should aspire as we develop our awareness and understanding of the future.” Thinking futuristically is one pathway toward personal and career success.

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, associate 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 420 publications, and an accomplished triathlete.
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WEST

12th Canadian Workshop on Information Theory (CWIT)

2011-05-17...20, Kelowna, BC

<http://cwit2011.ok.ubc.ca/>

Int'l Conference on Autonomous and Intelligent Systems (AIS)

2011-06-22...24, Burnaby, BC

<http://www.ais.uwaterloo.ca/ais11>

Joint 20th IEEE Int'l Symposia on Applications of Ferroelectrics / Piezoresponse Force Microscopy & Nanoscale Phenomena in Polar Materials

2011-07-25...27, Vancouver, BC

<http://www.sfu.ca/isaf2011/>

IEEE Pacific Rim Conference on Communications, Computers and Signal Processing (PacRim)

2011-08-23...26, Victoria, BC

<http://www.ece.uvic.ca/~pacrim/>

2011 IEEE Electrical Power & Energy Conference (EPEC)

2011-10-03...05, Winnipeg, MB

<http://www.ieee.ca/epec11/>

CENTRE

2nd IEEE Canada Teacher-In-Service Program (TISP)

2011-04-28...29, Toronto, ON

<http://guest.cvent.com/d/mdqtb1/1Q>

IEEE Canada Women in Engineering National Conference (CWIENC) and Symposium on Future Friendly Technologies (SFFT)

2011-04-30, Toronto, ON

<http://www.ieee.ca/wie/wienc11>

10th Int'l Conference for Upcoming Engineers (ICUE)

2011-05-05, Toronto, ON

<http://www.rnet.ryerson.ca/icue2011/>

24th IEEE Canadian Conference on Electrical and Computer Engineering (CCECE 2011)

2011-05-08...11, Niagara Falls, ON

<http://www.ieee.ca/ccece11/>

IEEE Int'l Electric Machines & Drives Conference (IEMDC)

2011-05-15...18, Niagara Falls, ON

<http://www.iemdc2011.info>

RESNA/ICTA Conference - Advancing Rehabilitation Technologies for an Aging Society

2011-06-05...08, Toronto, ON

<http://www.ficcdat.ca>

CENTRE cont'd

21st Int'l Conference on Noise and Fluctuations (ICNF)

2011-06-13...17, Toronto, ON

<http://www.icnf2011.org>

19th IEEE Int'l Conference on Program Comprehension (ICPC)

2011-06-28...30, Kingston, ON

<http://icpc2011.cs.usask.ca>

22nd IEEE Int'l Symposium on Personal, Indoor and Mobile Radio Communications (PIMRC)

2011-09-11...14, Toronto, ON

<http://ieee-pimrc.org/2011>

IEEE Petroleum and Chemical Industry Technical Conference (PCIC)

2011-09-19...21, Toronto, ON

http://www.ieee-pcic.org/Conferences/2011_Toronto

EAST

9th Annual Conference on Communication Networks and Services Research Conference (CNSR)

2011-05-02...05, Ottawa, ON

<http://www.cnsr.info/2011>

21st Optical Fiber Sensors Conference (OFS)

2011-05-15...19, Ottawa, ON

<http://ofs21.org>

ICO Int'l Conference on Information Photonics (IP)

2011-05-18...20, Ottawa, ON

<http://www.ip2011.org>

CANEUS/IEEE Fly by Wireless Workshop (FBW)

2011-06-14...17, Montréal, QC

<http://www.caneus.org/fbw11>

7th Int'l Workshop on Fibre Optics and Passive Components (WFOPC)

2011-07-13...15, Montréal, QC

<http://www.wfopc2011.com/>

IEEE Photonics Society Summer Topical Meeting Series

2011-07-18...20, Montréal, QC

<http://www.i-leos.org>

IEEE Int'l Conference on Virtual Environments, Human-Computer Interfaces and Measurement Systems (VECIMS)

2011-09-19...21, Ottawa, ON

<http://vecims2011.ieee-ims.org>

IEEE Int'l Conference on Computational Intelligence for Measurement Systems and Applications (CIMSA)

2011-09-19...21, Ottawa, ON

<http://cimsa2011.ieee-ims.org>



CCECE 2012 (Silver Anniversary)

25th Annual Canadian Conference on Electrical and Computer Engineering

April 29–May 2, 2012, Montreal, Quebec

Call for Papers and Proposals

The 2012 IEEE Canadian Conference on Electrical and Computer Engineering (CCECE 2012) will be held in Montreal, Quebec, Canada April 29 to May 2. CCECE 2012 provides a forum for the presentation of electrical and computer engineering research and development from Canada and around the world. Papers are invited, in French or English, for the following symposia.

- **Circuits, Devices and Systems**
Chairs: Drs. Karim Karim (University of Waterloo), Shahriar Mirabbasi (University of British Columbia)
- **Control and Robotics**
Chairs: Drs. Stephen Smith (University of Waterloo), Joshua Marshal (Queen's University)
- **Computers, Software & Applications**
Chair: Dr. Jagath Samarabandu (University of Western Ontario)
- **Biomedical and Health Informatics**
Chair: Dr. Carolyn McGregor (University of Ontario Institute of Technology)
- **Communications and Networking**
Chairs: Drs. Anader Benyamin-Seeyar (Concordia University), Shahram Yousefi (Queen's University), Mark Coates (McGill University)
- **Power Electronics and Energy Systems**
Chairs: Drs. Bala Venkatesh (Ryerson University), Olivier Trescases (University of Toronto)
- **Signal and Multimedia Processing**
Chairs: Drs. Fabrice Labeau (McGill University), Xianbin Wang (University of Western Ontario)

Authors wishing to submit papers that do not fit within any of the above topics are encouraged to do so to the "general interest" symposium.

NOTE: Selected papers accepted in this conference would be proposed for publication in IEEE *Systems Journal* and IEEE *Canadian Journal of Electrical and Computer Engineering*, after another round of review.

Regular Paper Submission

Please submit original full length paper(s) to the Technical Program Committee using the on-line submission process on our web site at <http://www.ccece2012.org> before January 7, 2012. Click on "Call For Papers" and follow the instructions provided.

Tutorial and Workshop Proposals Submission

Proposals for half-day tutorials and workshops should be submitted before December 2, 2011 to the Tutorials Chair at tutorials@ccece2012.org.

Important Dates

Tutorial or workshop proposals must be received by:	Friday, December 2, 2011
Full length papers must be received by:	Friday, January 7, 2012
Notification of acceptance will be sent out by:	Friday, February 24, 2012
Author's Registration ends by:	Friday, March 9, 2012
Advance Registration ends by:	Friday, March 30, 2012

Industrial Exhibits and Sponsorships

For industrial exhibits please contact the Industrial Exhibits Chair at exhibits@ccece2012.org. For sponsorships please contact the Sponsorships Chair at sponsorship@ccece2012.org.

Questions or Comments

To volunteer as a reviewer, please contact Tech. Program Co-Chairs: Scott Yam (scott.yam@queensu.ca), Lacro Pavel (pavel@control.toronto.edu) and Gerry Moschopoulos (gmoschopoulos@eng.uwo.ca).

For any questions or comments, please contact the Conference Chair: Amir G. Aghdam. Ph: 514 848-2424 Ext. 4137, Fax: 514 848-2802 Email: aghdam@ece.concordia.ca

<http://www.ccece2012.org>

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Concordia University
- Technical Program Chairs**
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Queen's University
Lacro Pavel
University of Toronto
Gerry Moschopoulos
University of Western Ontario
- Tutorials and Workshops**
TBD
- Finance**
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- Local Arrangements**
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- Publications**
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- Publicity**
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CCGÉI 2012 (25e anniversaire)

25ème Congrès canadien de génie électrique et informatique

29 avril au 2 mai 2012, Montréal, Québec

Appel de communications et propositions

Le Congrès canadien de génie électrique et informatique édition 2012 (CCGÉI 2012) aura lieu à Montréal (Québec), Canada du 29 avril au 2 mai. Le CCGÉI 2012 constitue un forum où les recherches et développements en génie électrique et informatique effectués au Canada et dans le reste du monde sont présentés. Nous vous invitons à présenter des communications, en français ou en anglais, pour les symposiums suivants :

- **Circuits, dispositifs et systèmes**
Prés: Drs. Karim Karim (University of Waterloo), Shahriar Mirabbasi (University of British Columbia)
- **Commande et robotique**
Prés: Drs. Stephen Smith (University of Waterloo), Joshua Marshal (Queen's University)
- **Ordinateurs, logiciels et applications**
Prés: Dr. Jagath Samarabandu (University of Western Ontario)
- **Informatique santé et biomédicale**
Prés: Dr. Carolyn McGregor (University of Ontario Institute of Technology)
- **Communications et réseaux**
Prés: Drs. Anader Benyamin-Seeyar (Université Concordia), Shahram Yousefi (Queen's University), Mark Coates (Université McGill)
- **Électronique de puissance et systèmes énergétiques**
Prés: Drs. Bala Venkatesh (Ryerson University), Olivier Trescases (University of Toronto)
- **Traitement du signal et multimédia**
Prés: Drs. Fabrice Labeau (Université McGill), Xianbin Wang (University of Western Ontario)

Les personnes qui souhaitent soumettre des communications sur un thème autre que ceux indiqués ci-dessus sont encouragés à le faire dans le cadre d'un symposium « général ».

N.B.: Les articles sélectionnés pour cette conférence seront proposés pour publication dans l'IEEE Systems Journal et le Journal canadien de génie électrique et informatique, après un autre cycle de révision.

Soumission d'une communication régulière

Veuillez soumettre votre (vos) communication(s) originale(s) complète(s) au Comité du programme technique en utilisant le processus de soumission en ligne sur notre site web à <http://www.ccece2012.org> avant le 7 janvier 2012. Cliquer sur « Appel de communications » et suivre les instructions fournies.

Soumission d'une proposition de séance didactique et d'atelier

Les propositions de séance didactique et d'atelier d'une demi-journée devraient être soumises avant le 2 décembre 2011 au président en charge des séances didactiques à tutorials@ccece2012.org

Dates importantes

Date limite des propositions de séance didactique ou d'atelier:	vendredi 2 décembre 2011
Date limite d'envoi de communication complète:	vendredi 7 janvier 2012
Date de notification d'acceptation :	vendredi 24 février 2012
Date limite d'inscription des auteurs :	vendredi 9 mars 2012
Date limite d'inscription anticipée :	vendredi 30 mars 2012

Expositions industrielles et parrainages

Pour les expositions industrielles, veuillez contacter le président en charge des expositions industrielles à exhibits@ccece2012.org. Pour les parrainages, veuillez contacter le président en charge de ces dossiers à sponsorship@ccece2012.org.

Appel pour réviseurs, questions ou commentaires

Pour agir bénévolement comme réviseur, svp contactez les co-présidents du programme technique: Scott Yam (scott.yam@queensu.ca), Lacro Pavel (pavel@control.toronto.edu) et Gerry Moschopoulos (gmoschopoulos@eng.uwo.ca).

Pour toutes autres questions ou commentaires, svp contactez le président de la conférence: Amir G. Aghdam. Ph: 514 848-2424 Ext. 4137, Fax: 514 848-2802 Email: aghdam@ece.concordia.ca

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Président du congrès
Dr. Amir G. Aghdam
Université Concordia

Prés. Programme technique
Dr. Scott Yam
Queen's University
Lacro Pavel
University of Toronto
Gerry Moschopoulos
University of Western Ontario

Séances didactiques et ateliers
Détails à venir

Finances
Détails à venir

Arrangements locaux
Dr. Anader Benyamin-Seeyar
Université Concordia

Publications
Détails à venir

Publicité
Détails à venir

Inscriptions
Détails à venir

Exposition Industrielle
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Traduction
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à Trois-Rivières

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