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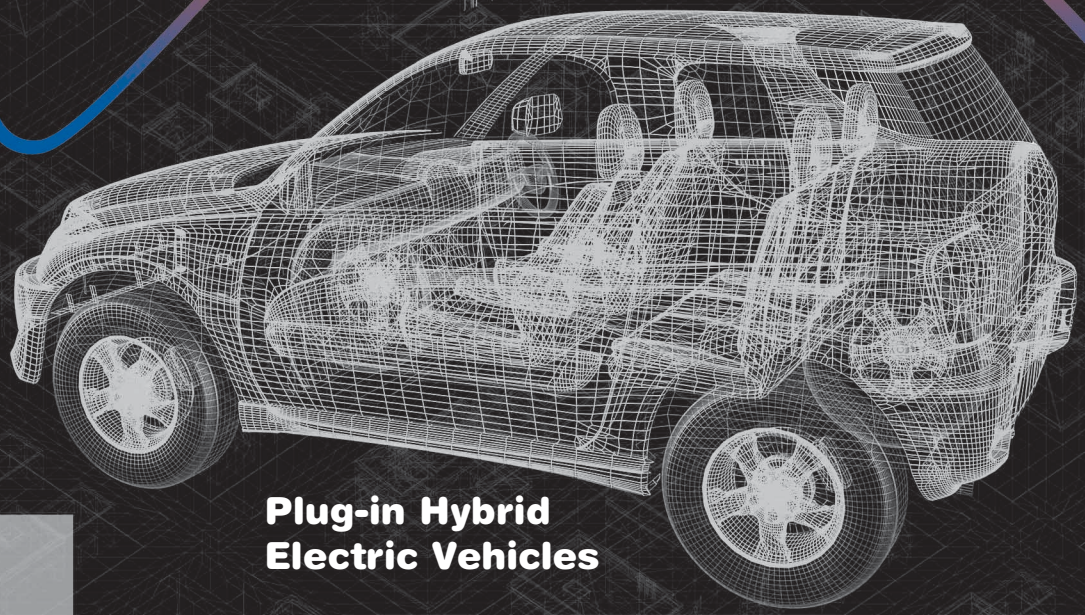
IEEE Canadian Review

La revue canadienne de l'IEEE

Applications of Engineering to Bicycling

Power-Line Anomaly Sensor System

Extraterritoriality in Patent Law



Plug-in Hybrid Electric Vehicles

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IEEE Canada

IEEE Canadian Review General Information

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(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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2- International Affairs	5- Power	8 - Electronics
3- Industry	6- Communications	

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Editorial / *Éditorial*

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

Malgré un léger glissement dans notre calendrier, et le fait que nous dépendons surtout des efforts de nos bénévoles, nous avons réussi (j'espère) à produire une autre *Revue* de qualité. Celle-ci est un peu éclectique avec des articles principaux sur les véhicules électriques hybrides, les senseurs de lignes de courant, la protection par brevets, et le génie appliqué au cyclisme - ou vice-versa.

Dans ce numéro de *la Revue canadienne de l'IEEE*, notre chroniqueur Terrance Malkinson illustre comment l'Application du génie au cyclisme a contribué à améliorer ce domaine. Ainsi, comme Terry se préoccuper de la santé de nos Membres, il s'appuie sur son expérience pour vous rappeler comment le cyclisme peut s'appliquer utilement aux ingénieurs.

Restant sur le sujet des véhicules: un article présente un survol de quelques défis techniques auxquels font face les Véhicules hybrides rechargeables (VHR). Il ne prétend pas être un article technique pointu; en général nous publions ceux-ci dans notre publication soeur *le Journal canadien de génie électrique et informatique* (http://www.ieee.ca/journal/, soumettez vos articles!) Comme la plupart de nos articles principaux, il est destiné à être lu par des ingénieurs qui ne sont pas experts dans le sujet de l'article mais peuvent quand même apprécier ses aspects techniques.

Les VHR et d'autres applications émergentes peuvent affecter la qualité de l'onde électrique. Une solution est proposée pour la surveillance et le contrôle des anomalies de lignes électriques, utilisant l'analyse d'harmoniques et la transmission de données sans fils. Cet assemblage de méthodes éprouvées et de nouveaux outils pourrait être un élément utile du système d'assurance qualité de votre compagnie d'électricité.

Maintenant, planifiez-vous protéger ces inventions issues de votre dur labeur: analyse de données GPS améliorée, groupe motopropulseur hybride innovateur, méthodes d'analyse d'anomalies ? Planifiez un peu plus: les ingénieurs au Canada peuvent être affectés par l'extraterritorialité des brevets américains (parmi d'autres). De jure, et selon des juges américains, les frontières ne sont plus ce qu'elles étaient. Demandez à Research in Motion; même si vous croyez être dans votre bon droit, dans les cas limites des poursuites peuvent survenir.

Des accidents peuvent aussi survenir. John Grefford, bénévole du IEEE Canada, et les employés des Services aux membres de l'IEEE ont fait un travail formidable pour vous donner accès à des tarifs de groupe pour de nouveaux produits d'assurance. Consultez la publicité de la compagnie d'assurance La Personnelle à la dernière page de ce numéro. Allez voir http://thepersonal.com/ieee, demandez une soumission.

Despite a bit of schedule slippage, and relying mostly on volunteer efforts, we have managed (I hope) to produce yet another quality *Review*. This one is a bit eclectic with feature articles on hybrid electric vehicles, power line sensors, patent protection, and engineering applied to cycling - or vice-versa.

In this issue of the *IEEE Canadian Review*, our columnist Terrance Malkinson illustrates in Applications of Engineering to Bicycling how our profession has helped to improve the field. As well, since Terry is mindful of IEEE members' health, he refers to his own experience to remind you how cycling can be usefully applied to engineers.

While we are on the subject of vehicles: One article presents an overview of some of the technical challenges facing Plug-in Hybrid Electrical Vehicles. It is not intended to be technically in-depth; we generally publish those in our sister publication *The Canadian Journal of Electrical and Computer Engineering* (http://www.ieee.ca/journal/, submit your papers!) Like most of our feature articles, it is intended to be read by engineers who are not experts in the article's subject but can still appreciate its technical dimensions.

PHEVs and other emerging applications can impact electrical power quality. A solution is proposed for Power Line Anomaly Monitoring and Control using Harmonics Analysis and Wireless Data Transmission. This combination of old methods and new tools could be a useful part of your power utility's quality assurance system.

Now, do you plan to protect those inventions stemming from your hard work: improved GPS data analysis, hybrid power train innovations, fault analysis methods? Plan a bit more: Engineers in Canada can be affected by US Patents Extraterritoriality (amongst others). *De jure*, and according to US judges, borders are not what they used to be. Ask Research in Motion; even if you believe you are in the clear, in border(line) cases patent lawsuits do happen.

Accidents do happen as well. IEEE Canada volunteer John Grefford has done a marvelous job working with IEEE's Membership Services staff to provide you access at group rates to new insurance products. See the back page of this magazine for advertisement from The Personal insurance company. Go check it out at http://thepersonal.com/ieee, get a quote.

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Cover Page: IEEE Canadian Review *is grateful to Cervélo for original photos upon which the wire-frame bicycle image is based.*

Ferial El-Hawary, FIEEE, FEIC, FMTS, President of IEEE Canada: 2008-2009 / Présidente de l'IEEE Canada: 2008-2009

As the year 2009 is beginning, and despite difficult economic news, we should remember and be proud of the many accomplishments reached during this past year.

2008 was a year of Celebrations. We have commemorated a number of our Sections' Anniversaries at the occasion of IEEE Section Congress 2008 (SC'08). This excellent event held in Quebec City was remarkable for attracting the largest number of attendees – at close to 1,500 participants – in SC History. We received overwhelming positive feedback and are still getting congratulatory comments.

We shared the celebration with many IEEE Awards recipients: seventeen IEEE members were elevated to the distinguished Fellow Grade, we counted eleven Medalists at the National level, as well as IEEE MGA Award Winners. Canadian Industry was recognized at the IEEE Honors Ceremony when Research in Motion (Waterloo, Ontario) received the IEEE-sponsored Corporate Innovation Recognition, for developing and promoting the Blackberry™ and helping to transform the mobile work environment. Congratulations to all Awards recipients.

Also, I would like to salute the supportive team of IEEE Canada Board, acknowledge the fine work of our Committees and devoted individuals who completed their terms.

We are ever moving to accomplish our mission of service to the Membership. New insurance products are being introduced as a Member Benefit, thanks to diligent efforts by John Grefford. We are very pleased with our Publications team who have done a wonderful job *getting the news and contents out there*.

Our National Conferences, CCECE'08 and EPEC'08, were fabulous this year with a record number of high quality papers and a large quantity of registrations; our thanks go to the teams of volunteers whose work fostered the success of these conferences.

Work is in progress to integrate and record IEEE Canada History – this special effort by our History team to be completed by the Spring of 2009 for the IEEE 125th Anniversary.

I would like to take this opportunity to wish you All the Best, and a Happy, Healthy and Prosperous New Year to you and your families.

Research in Motion's Mark Pecen, VP, Advanced Technology, is congratulated by then IEEE President Lewis M. Terman upon receipt of the IEEE Corporate Innovation Recognition, presented at the 2008 Sections Congress.

Mark Pecen, VP Technologies Avancées, Research in Motion, est félicité par Lewis M. Terman, Président de l'IEEE, alors que la firme reçoit la Reconnaissance d'innovation corporative de l'IEEE présentée au Congrès des Sections 2008.

Alors que l'année 2009 se termine, et malgré les nouvelles économiques difficiles, nous devrions nous souvenir et être fiers des nombreuses réalisations atteintes au cours de l'an dernier.

2008 a été une année de célébrations. Nous avons commémoré les anniversaires de plusieurs Sections à l'occasion du Congrès de sections de l'IEEE (SC'08). Ce formidable événement tenu à Québec a été remarquable pour avoir attiré le plus grand nombre de participants –près de 1 500 – dans l'histoire du SC. Nous avons obtenu un nombre considérable de félicitations et recevons encore des commentaires positifs.

Nous avons partagé ces célébrations avec plusieurs récipiendaires de distinctions du IEEE : dix-sept membres ont obtenu le prestigieux grade de Fellow, nous comptons onze médaillés au niveau national, ainsi que des gagnants de prix IEEE MGA (Member and Geographic Activities Board). L'industrie canadienne a été reconnue à la Cérémonie d'honneur du IEEE alors que Research in Motion (Waterloo, Ontario) a reçu la Reconnaissance d'innovation corporative –sponsorisée par le IEEE–pour avoir développé et promu le Blackberry™ et aidé à transformer l'environnement de travail mobile. Félicitations à tous les lauréats.

De plus, je désire saluer les membres du Conseil d'administration du IEEE Canada, reconnaître l'excellent travail de nos comités et les personnes dévouées qui ont complété leurs termes.

Nous sommes toujours actifs pour accomplir notre mission de service aux membres. De nouveaux produits d'assurance sont en cours d'introduction comme Bénéfice aux membres, grâce aux efforts diligents de John Grefford. Nous sommes très satisfaits de notre équipe de Publications qui *a fait un excellent travail pour diffuser les nouvelles et le contenu*.

Nos conférences nationales, CCGEI'08 et EPEC'08, ont été fabuleuses cette année avec un nombre record d'articles de haute qualité et une large quantité d'inscriptions; merci aux équipes de bénévoles dont le travail a étayé le succès de ces conférences.

Un travail est en cours pour intégrer et enregistrer l'histoire du IEEE Canada – cet effort spécial par notre équipe d'Histoire devant être complété au printemps 2009 pour le 125e anniversaire de l'IEEE.

Je désire profiter de cette opportunité pour souhaiter à vous et votre famille que l'Année 2009 se passe de la Joie, Santé et Prospérité.

Ferial El-Hawary, P.Eng., FIEEE, FEIC, FMTS
http://www.ferial.ca

Congrès des Sections 2008 de l'IEEE, Québec

Québec City Section's Paul Fortier (far left), André Morin and Xavier Maldagu (far right and next-to, respectively) share some well-deserved recognition on stage with Ferial El-Hawary and Mo El-Hawary.

Dr. Wally Read and Dr. Ray Findlay (from L. to R.) share a lighter moment with their colleagues at the Presidents' panel. Region 7 tallied two of the eight Past Presidents present—a point of pride for us all.

Closing ceremonies over, it's time for fond farewells. From L to R: Mo El-Hawary, Paul Fortier, Barbara & President Lewis Terman, Denis Poussart (Keynote Speaker), Ferial El-Hawary, Xavier Maldagu.

Newslog Editor

Rédacteur des Coupures de presse

Alexandre Abecassis is a patent agent and Partner at Fasken Martineau DuMoulin LLP, Lawyers and Patent and Trade-mark Agents.

Alexandre Abecassis est agent de brevets associé chez Fasken Martineau DuMoulin S.E.N.C.R.L., s.r.l., Avocats et agent de brevets et de marques de commerce.

Send any news clippings you would like to contribute via e-mail to alexandre.abecassis@ieee.org

Veuillez faire parvenir les coupures de presse proposées par e-mail à alexandre.abecassis@ieee.org

MONTREAL, QC. Aug. 12, 2008. At National Instruments' annual conference, Etienne Berthiaume and Steeve Allard from Averna and Luc Boisclair from the St. Lawrence Seaway Management Corporation won the inaugural Graphical System Design Achievement Award in the category Industrial Measurements/ Control for an innovative Vessel Positioning System. Averna, a test engineering software, solutions, and services company, has also been recently been ranked in the Deloitte Technology Fast 50.

TORONTO, ON. Oct. 31, 2008. A partnership was announced between Zerofootprint and Skymeter to measure vehicular greenhouse gas emissions. The purpose is to provide accurate measurement of both corporate and individual CO2 emissions. Skymeter will bring global positioning system (GPS) technology while Zerofootprint – which also sells carbon offsets – will provide carbon footprint measuring technology.

QUEBEC CITY, QC. Oct. 23, 2008. Lyrtech obtained a contract from Defense Research and Development Canada (DRDC) in Valcartier, Quebec that will span over a year and have an initial nominal value of about one million dollars. Its purpose is to provide a large-area surveillance system aiming to identify and geolocate possible hazardous optical systems in urban and/or maritime environments, and therefore increase the safety of operating troops abroad. DRDC is an agency of the Canadian Department of National Defense.

TORONTO, ON. Sep. 23, 2008. Brain Center International announced the introduction of a patent-pending brain training software. The software is used to exercise the brain and sharpen it to optimal performance, as well as to increase memory and other cognitive functions by a claimed 20 per cent.

MARKHAM, ON. Sep. 17, 2008. Nightingale Informatix Corporation, an application service provider of electronic medical record software and related services, announced the launch of a web-based information and communication portal. It will enable a secure link between patients and doctors across Canada and will enable patients to schedule appointments as well as review and download medical history – including prescriptions, allergy and medical assessments – via the Internet.

TORONTO, ON. Jul. 10, 2008. Planeteye announced the launch of an online travel planning service powered by Microsoft World Wide Media eXchange technology. One of PlanetEye's key features that should facilitate bookings is an interactive and dynamic map whereby travelers can identify destinations and discover corresponding information such as geotagged photographs, hotels, attractions and restaurants.

QUÉBEC, QC. Sept. 23, 2008. Medical Intelligence Technologies announced that Tunstall Healthcare is working with a GPS bracelet made by them. Medical Intelligence Technologies designs, inter alia, portable GPS monitoring and locating devices used for assisting individuals having health or safety concerns. Tunstall Healthcare is a provider of telehealthcare solutions and has over 2.5 million users.

MONTREAL, QC. Sep. 17, 2008. Mechtronix Systems, one of the leading designers of flight training equipment, announced that F AIR Ltd, the largest private training school in the Czech Republic, has received one of its flight trainers. The delivered flight trainer is configured as a multi-engine turboprop. Mechtronix Systems is ranked amongst the top three in the global flight simulator business.

MONTREAL, QC. Aug. 8, 2008. Newmerical Technologies International announced obtaining Chinese contracts for in-flight icing simulation software system, for a value of around a quarter of a million dollars.

TORONTO, ON. Jul. 29, 2008. Baudry Cybernomics Corporation launched the Think Green Alliance to promote environmentally-friendly and sustainable operations, technologies, services and products. The Think Green Alliance will look for leaders in the industry in terms of their adoption and integration of environmental strategies into their business plan. Currently, the Alliance comprises over twenty members.

MONTREAL, QC. Jun. 2, 2008. One of the largest community hospitals in Canada, the Scarborough Hospital (TSH), announced that it has selected Chyma, a web-based tool that enables physicians and healthcare administrators to manage on-call schedules, to help improve on-call scheduling and communications between physicians. This hospital has over 700 physicians. The tool is already implemented at various places such as at the Children's Hospital and at St. Justine's in Montreal.

MONTRÉAL, QC. 28 Oct. 2008. Ultra Electronique-Systèmes de Communication Tactiques, une filiale de Ultra Electronics (UK) spécialisée dans les relais radio, annonce la livraison à la US Army de son 1000e système de ce type. Ces produits sont utilisés en Afghanistan et en Irak pour la transmission de données sensibles vidéo et voix entre les postes de commandement et les unités. ■

Marc Rosen new President of the EIC

Dr. Marc A. Rosen, founding dean of Engineering and Applied Science at the University of Ontario Institute of Technology (UOIT) became President of the Engineering Institute of Canada (EIC, http://www.eic-ici.ca) at its national meeting on September 22, 2008. The EIC is an umbrella organization for 12 Canadian engineering societies, including IEEE Canada, that provides Canadian engineers with opportunities for intersociety cooperation in areas such as advocacy, interaction with other organizations and the mounting of multidisciplinary events.

You will have the occasion to meet Dr. Rosen at the upcoming EIC 2nd Canadian Conference on Climate Change Technology, May 12-15, 2009 in Hamilton (http://www.cctc2009.ca/) where he will be a guest speaker, and the National Engineering Summit in Montreal (http://www.engineeringsummit.ca/) the same month.

Montréal selected for 2012 American Control Conference

The American Automatic Control Council (AACC) is an association of the control systems divisions of eight member societies, including the IEEE, and is the US National Member Organization of the International Federation of Automatic Control (IFAC). It holds an annual gathering: The American Control Conference (ACC), usually in June, which attracts between 1,000 and 1,200 participants from various fields of control theory and its applications. The location normally rotates between the US West Coast, Central (Midwest) and East Coast regions.

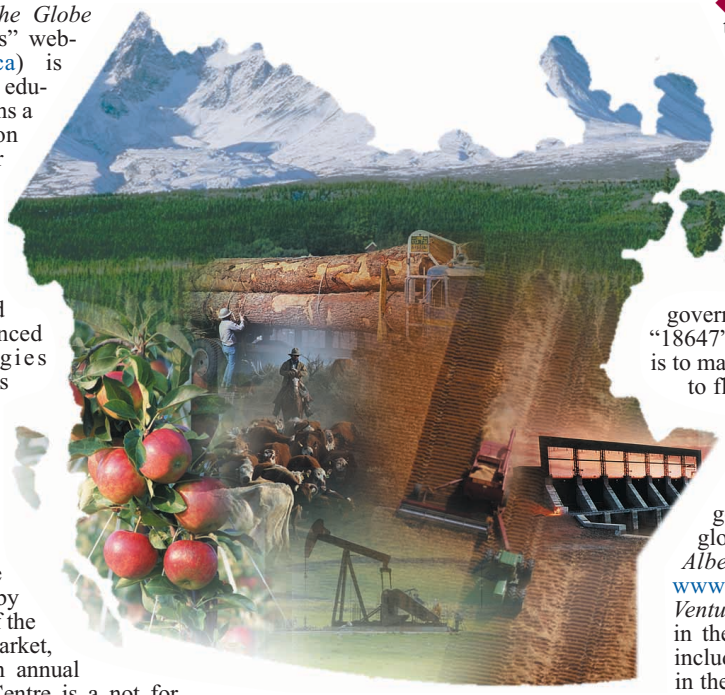
In 2012, for the first time in its history, the prestigious American Control Conference will be held outside the United States - and it will be in the lovely city of Montréal (Québec). Tariq Samad, the 2012 ACC General Chair, surveyed a number of sites and recommended Montréal "for the beauty and culture exhibited by this truly European-style city"; the AACC Board of Directors unanimously approved this location at its June 2008 meeting. The 2012 conference will be held in cooperation with the Canadian National Member Organization of IFAC and a number of co-sponsors, which usually includes the IEEE. The AACC leadership see it a strong possibility that Canada cities would host some future ACCs.

A View from the West

On: Rating Universities; Commercialising Nanotech; Penticton; Online Groceries; Alberta's Green Business, Forestry, and Venture 100; Saskatchewan's and Manitoba's Best.

By Terrance Malkinson
School of Health and Public Safety
SAIT Polytechnic

- In *The Globe and Mail*'s seventh annual Canadian University report, more than 43,000 students rated 55 Canadian Universities on many distinct elements of university life. In general undergraduates are relatively satisfied with their university experience with 83% of Canadian undergraduates recommending their own university to a friend or family member. Interestingly, students at the smaller universities (enrollment under 4,000) generally give higher ratings for overall satisfaction and quality of education with their university than do students from larger institutions. *The Globe and Mail's* "GlobeCampus" website (www.globecampus.ca) is dedicated to undergraduate education in Canada and contains a plethora of information on universities and colleges for parents and student as well as an archive of *The Globe and Mail's* education content.



- The Edmonton based Alberta Centre for Advanced Micro-Nano-Technologies Products (www.acamp.ca) is hailed as a nanotechnology first in North America as a new way to commercialize research. The center is seen as a good fit with Alberta's $130 million nanotech strategy announced in May of 2007. The province aims to capture by the year 2020 two percent of the world's nanotechnology market, estimated at $20 Billion in annual commercial activity. The Centre is a not for profit organizations that provides infrastructure, product development, consulting, training, marketing and commercialization services to researchers, start-ups, and established firms on a fee basis.

- The City of Penticton (www.penticton.ca) located in south-central British Columbia presents itself as one of Canada's best environments for business, investment and lifestyle. The city was recently ranked by KPMG in their 2008 *Competitive Alternatives* analysis (www.competitivealternatives.com) as the lowest-cost place to carry out a manufacturing business in the Pacific North American Region. Particularly striking are its climate and warm water lakes; the Okanagan area with its desert temperature landscapes is famous for its orchards. Due to economic reasons many of the fruit orchards are being converted to vineyards and a new prosperity is being driven by the burgeoning wine industry (search "sour grapes" at www.bcbusinessonline.ca).

- Small Potatoes Urban Delivery (SPUD), a web based Vancouver grocer that recently doubled in size due to expansions into three American cities, now has annual revenues exceeding $24 million and an annualized growth rate of 20%. Over 16,000 customers order from its selection of natural, mostly organic groceries (www.bcbusinessonline.ca/node/3174). Web-based grocery delivery is a high-volume, high-overhead business with perishable products and low margins.

- "Welcome to the Green Economy" in *Alberta Venture* provides insights into a number of green business activities in Alberta. (www.albertaventure.com/?p=1576). Initiatives discussed include; emissions trader, sustainable furniture makers, electric bike converter, hydro turbine developer, carbon captor, environmental lawyer, wind farm planner, and the door-to-door organic grower. The Alberta government is moving ahead on its climate change action plan with two new funds totaling $4 billion to reduce greenhouse gas emissions equal to taking more than a million cars off the road each year. The province will create a $2 billion fund to advance carbon capture and storage (CCS) projects while a second $2 billion fund will propel energy-saving public transit in Alberta (www.environment.gov.ab.ca/info/library/7894.pdf).

- The Forestry sector is being told not to expect any government bailouts but to prepare for major changes in the way it does business. Globalization, increasing competition, trade agreements and increasing operating costs are having a significant impact on the sustainability of the forest industry ("Recommendations" at www.srd.alberta.ca/forests/managing/business/). A new business model for the forestry industry in Alberta is being created by a joint government-forest industry committee (Search "18647" at www.businessedge.ca). The objective is to make the industry sustainable and position it to flourish in the future.

- The Alberta economy is dominated by the energy industry and continues to face a shortage of skilled and general labour despite the downturn in the global economy. ("The Boom's Long Tail". *Alberta Venture.* September 25, 2008. www.albertaventure.com/?p=2587). *Alberta Venture's* annual Venture's listing organizations in the province has been published: rankings include: biggest grossing public organizations in the province, private organizations, top performers based on revue growth, declining companies, largest employers, and not-for-profits.(Alberta Venture, September 25, 2008. www.albertaventure.com/?page_id=1755). In 2007 the combined total revenues for the Venture 100 companies was $301.9 Billion

- *Saskatchewan Business Magazine* published in September a ranking of the province's top 100 companies of 2008; leading the list is Federated Co-operatives Ltd, a perennial top-ranking organization, followed by PotashCorp and Viterra Inc. This Magazine also profiles the province's most influential men and wome. (Search respectively for "Saskatchewan 100", "Saskatchewan Men" and "Saskatchewan Women" in Titles at www.thefreelibrary.com).

- Manitoba's top 100 companies are profiled in *Manitoba Business* (www.manitobabusinessmagazine.com. Pp. 7-38. August, 2008) Leading the list is Great West Lifeco Inc. with 18,937 employees, followed by The Canadian Wheat Board and Cargill Limited. Concise profiles of each of the 100 companies are provided.

Terrance Malkinson is a communications specialist, business analyst and futurist; for full biography, see page 19. Opinions expressed are the author's; he can be reached at malkinst@telus.net. The author is grateful to the professional support of the Haskayne School of Business Library at the University of Calgary.

On-Line Wireless Power-Line Sensor System for Anomaly Classification and Control

By *Bradford Stimpson[1,2] and Alagan Anpalagan[3]*
[1]McGill University, [2]OmniGlobe Networks Inc.
[3]Ryerson University

Abstract

This article outlines the design and implementation of a software module that can monitor a power line by analyzing low frequency harmonics from a large data stream. It can then respond in real time to detected faults, using wireless transmission to improve portability and remove the risk that the system could conduct high voltages into a consumer based phone system. Steps include sampling the signal and using a low-pass filter, applying Harmonic Inversion to estimate the frequency and amplitude of each harmonic, and isolating each one in the DCT domain via a triangular-like windowing function. Fault detection is done via correlation and simple comparison between isolated values and corresponding expected values. Data is communicated wirelessly (using 802.11b) to the host system for remote monitoring and control.

Sommaire

Cet article présente la conception et l'implantation d'un module logiciel qui peut surveiller une ligne de courant en analysant les harmoniques à basses fréquences d'un large flux de données. Il peut ainsi répondre en temps réel aux fautes détectées, utilisant la transmission sans fil pour améliorer la portabilité et annuler le risque que le système amène des voltages élevés dans un système téléphonique commercial.Les étapes incluent l'échantillonage du signal et l'utilisation d'un filtre passe-bas, l'application d'inversion harmonique pour estimer la fréquence et l'amplitude de chaque harmonique, et leur isolation en domaine TCD via une fonction de fenêtrage proto-triangulaire. La détection d'incidents est faite par corrélation et simple comparaison entre les valeurs isolées et les valeurs attendues correspondantes. Les données sont communiquées sans fil (via 802.11b) à l'ordinateur hôte pour suivi et contrôle à distance.

1.0 Introduction

Power line disturbances and quality of power are issues of increasing importance, as the share of sensitive electronic circuits increases steadily in modern power systems. Ideally, the voltage supplied by the utility system should be a perfect sinusoidal wave without any harmonics at its nominal frequency of 60 Hz and at its nominal magnitude. Unfortunately, this is not always the case as various harmonics are also present on the power lines. These harmonics are caused by a variety of sources, including magnetic saturation of power system transformers and harmonic currents injected by power electronic loads.The objective of the work presented in this article was to construct a portable module that has the capability of monitoring a power line and then responding in real time to the detected faults. In order to improve system portability, and remove the risks that the system could conduct high voltages into a consumer based phone system, the sensor system was designed to transmit the data via a wireless communication and sensor system. The wireless communication and sensor system was comprised of several modules with a standard digital signal processing apparatus and embedded computer at its core. The digital signal processing apparatus was used to process the given input data and to filter out the high frequency noise. Data was then communicated via a parallel port to an embedded computer where fault detection occurred. Information describing the status of the power line was then transmitted wirelessly using the onboard 802.11b functionality configured in an ad hoc manner. The purpose of this configuration is to move towards a wireless mesh topology as in Figure 1. Implementing a wireless mesh topology for relaying power-line data is advantageous for two key reasons, a) it is highly adaptive and portable (i.e., can be easily reconfigured depending on immediate needs) and b) can react immediately to power-line disturbances while keeping mobile field crews constantly aware of the network's state.

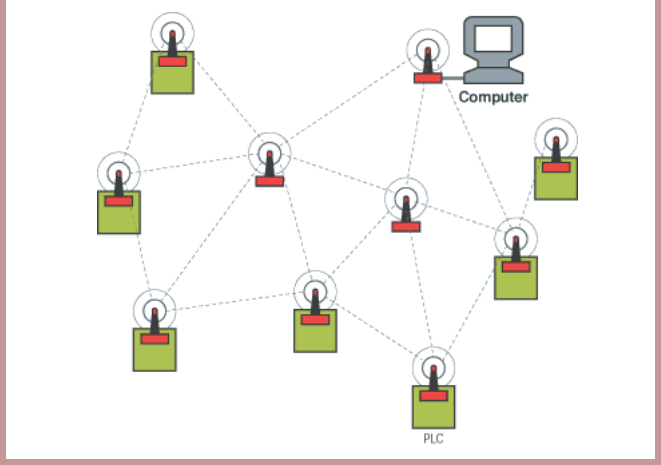


Figure 1: The proposed wireless mesh topology for on-line power-line anomaly classification and control.

2.0 Power-Line Monitoring and Control

There has been extensive research conducted in recent years in the areas of on-line real-time power-line fault detection and correction. These works have produced a variety of fault detection and classification algorithms but have seldom considered the underlying communication medium in great detail. For example, in the work of *Bacciagulupi et al.* [1], they propose a novel on-line fault detection system based on a master/slave DSP architecture but adopt an isolated electronic device view. That is, they consider mostly the optimization of their system in light of the DSP architecture but do not consider the deployment of their approach to monitor a large power network. Furthermore, in the work of *Moore et al.* [2], they also only focus on their numeric technique for frequency measurement and measurement apparatus implementation again avoiding a 'system' view of implementing their apparatus.
The work that bares closest resemblance to ours is that of *Han et al.* [3] and *Raza et al.* [11]. In [11], the authors designed a small-scale control and monitoring system which employs a flexible and efficient communication over power-line protocol. In their work, they focus on the communication protocol and less on the fault detection algorithm or design of schemes for large-scale deployment of their measurement apparatus. Finally, in the work of [3], the authors implemented a high voltage power-line fault detection and analysis scheme that is very similar to our proposed scheme. They use a similar correlation scheme based on a reference signal; however, our work differs as we use harmonic inversion to detect and identify harmonics within the input signal.

3.0 Algorithm design & implementation

The design and implementation of the enhanced fault-detection system consists of the following three components:

- Isolation of relevant harmonics
- Comparison with pre-determined templates
- Fault detection and response

3.1 Embedded System Software

TopologyThe software system was designed with modularity and code portability in mind. Therefore, it was only natural to design the application in C++ where the different fault checking algorithms could inherit a general structure from a base class. To take advantage of the powerful sockets inherent in C programming, it was decided that using an iterative server would be best. This approach could potentially create sever-

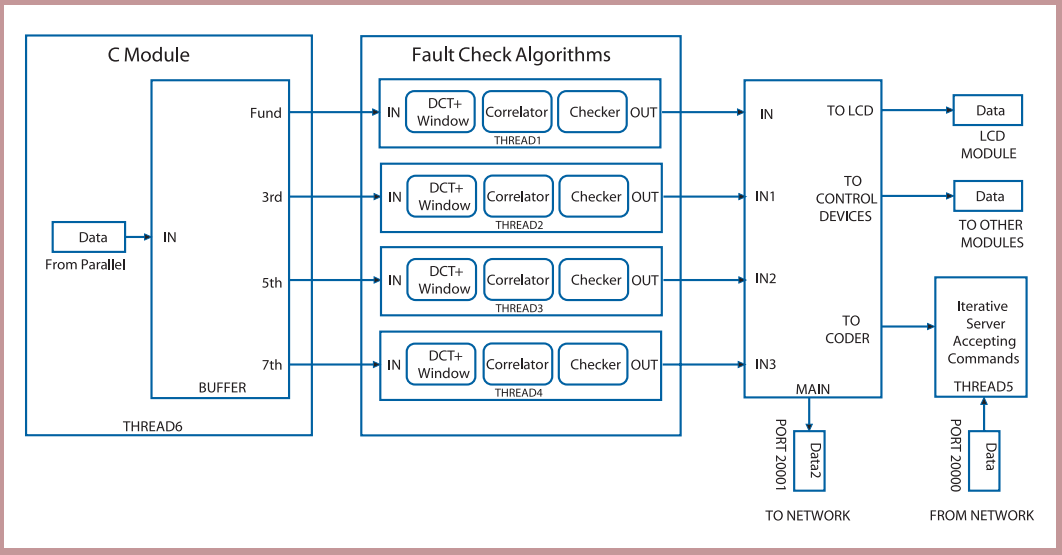


Figure 2: Software topology for the embedded Linux system.

al sockets all transferring data simultaneously; therefore, speeding up the overall real-time abilities of the unit. Finally, all important functions were encapsulated in threads which allowed for many processes to occur concurrently. Figure 2 shows the software topology for the embedded Linux system.

3.2 Harmonic Detection & Isolation

In order to detect and isolate harmonic content of interest, two processes were required. The first being harmonic inversion which can accurately detect the frequency and amplitude of harmonics within a signal composed of a large number of sinusoids. Although, the process of harmonic inversion will not be discussed in detail, further information can be found in [10]. The second required process, Discrete Cosine Transform (DCT), was used to not only compress several periods of the input signal, but to give a fast and accurate picture of the real frequency content of the signal.With the 256-point DCT of the input signal and a quantification of the harmonics in the signal, a skewed flattop windowing function was used to eliminate the unwanted information. From the definition of discrete Fourier transform, the coefficient corresponding to each harmonic can be found as follows:

$$X(k\partial\omega) = X\left(\frac{2\pi k}{N}\right) \qquad (1)$$

$$\omega_k = k\partial\omega = k\frac{\omega_s}{4 \cdot D \cdot N}$$

where N is the total number of coefficients equal to 256, k is the coefficient we want to determine, k is the frequency of the harmonic in rad/s, D is the amount of down-sampling and (in radians) is the spacing between successive samples of X() [10]. The following is the equation and plot of the skewed flattop windowing function used to isolate the fundamental harmonic:

$$w(n) = \begin{cases} 1.22 - \dfrac{2\left|n - \dfrac{M-1}{2}\right|}{M-1}, & if \quad n < M-1 \\ 1.22 - \dfrac{2.1\left|n - \dfrac{M-1}{2}\right|}{M-1}, & if \quad n > M-1 \\ 1, & if \quad n > 1 \end{cases} \qquad (2)$$

By shifting the windowing function to overlap the desired harmonic, it can be used to eliminate unwanted contents. Below is the DCT of the simulated signal, before and after windowing:

3.3 Fault Detection through Cross-Correlation

The fault checking algorithm below performs the following tasks: First, the windowed version of the DCT is cross-correlated with a pre-determined maximum allowable DCT. Secondly, a template cross-correlation function determined by several iterations of the maximum allowable waveforms is then subtracted from the absolute value of the cross-correlated input waveform to produce an error signal. This error signal is then passed through a comparing algorithm that determines the type of fault and its magnitude. Figure 3 shows the signal flow diagram of the fault detection algorithm implemented in C++.

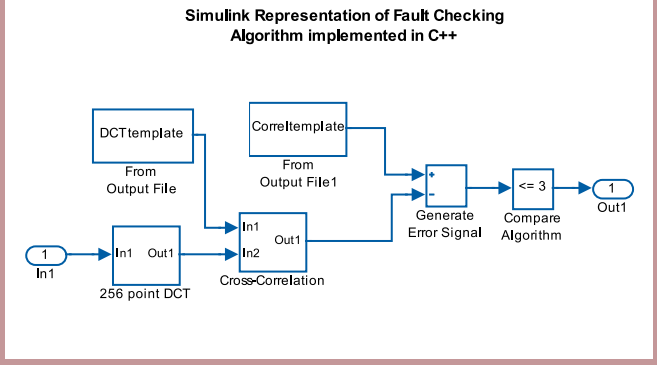


Figure 3: SIMULINK representation of the fault-detection algorithm.

The cross-correlation is used to determine the match degree of two signals. The formula is shown in (3):

where x(n) is the input signal and y(n) is the reference signal. When the DCT output was correlated with the input data, the following correlation was observed:After running the simulation data over several periods, the absolute value of the correlation above was used as a template. Slight differences in the phase of the input signal resulted in unwanted effects

$$r_{xy}(l) = \sum_{n=-\infty}^{\infty} x(n)y(n-l) \qquad (3)$$

on the DCT and can be seen quite evidently in Figure 4 on the opposite page. To overcome this, the cross-correlation templates at those specific instances were averaged over 100 iterations. An input signal that produced a value greater than zero once subtracted from the cross-correlation evidently indicates that a fault is occurring.

4.0 WIRELESS MEASUREMENT APPARATUS DESIGN

As the design of the wireless power-line monitoring system evolved, we chose to use commercial off-the-shelf wireless devices. First, it seemed redundant to construct and build an 802.11 device from scratch, when most personal computers come with them as standard equipment.

Figure 4: DCT of input signal before and after windowing.

Secondly, 802.11b is easier to implement than any other 802.11 transmission method. Thirdly, due to the inherent time and cost constraints, a single board computer on the module side was naturally a better approach. This afforded us the luxury to concentrate on writing the algorithms needed to implement an 802.11 network and not the hardware.

To further emphasize why 802.11b was selected as the transmission method, it is important to note that IEEE's 802.11b protocol operates in the 2.4 GHz unlicensed band making it an appropriate solution for easy validation. Also, with its main modulation technique being direct sequence spread spectrum (DSSS), the system is basically anti-interference and resistant to frequency select fading which makes it a robust system selection.

Finally, it was decided that the entire wireless system would be based on mesh (ad hoc) networking protocols with secondary access point protocols. This was chosen as a straightforward method to improve the inherent range limitations of 802.11b devices and to simultaneously create interconnected intelligent devices. If a fault is detected on one device, it could take the appropriate actions without the need of direct user control, effectively isolating a portion of the grid instantaneously. The final revision of the system consisted of a single sensor node and one remote monitoring station shown in Figure 5 and Figure 6, respectively.

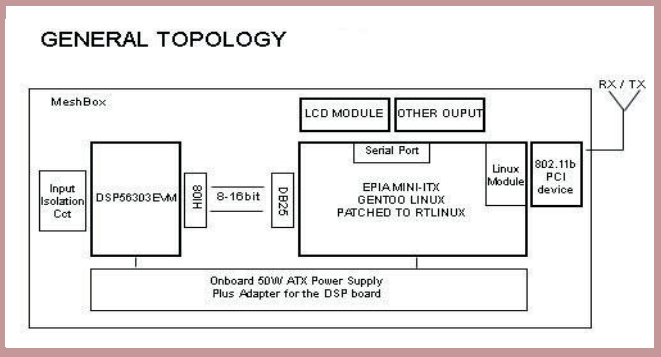


Figure 5: General hardware layout for the mesh networked sensor node.

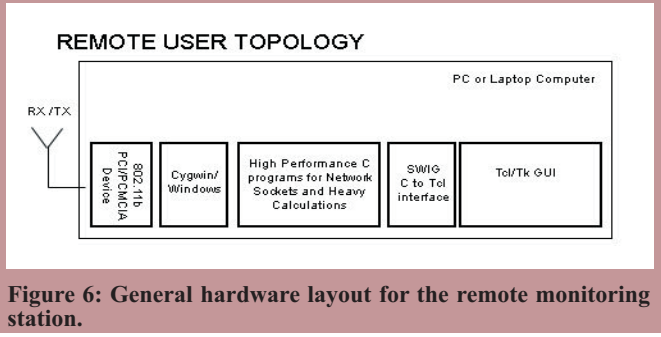


Figure 6: General hardware layout for the remote monitoring station.

5.0 SIMULATION RESULTS

Cross-correlation was used to determine if a fault is present or not. A template data file was constructed using the data from a MATLAB simulation of the maximum allowable worst case power-line signal. Therefore, if any signal falls outside that maximum allowable range, an error signal would be generated and the system would respond accordingly. The following plots in Figure 7 are the simulated data sent into the fault checking algorithm, the corresponding error values it returned and the discussion of its returned value.

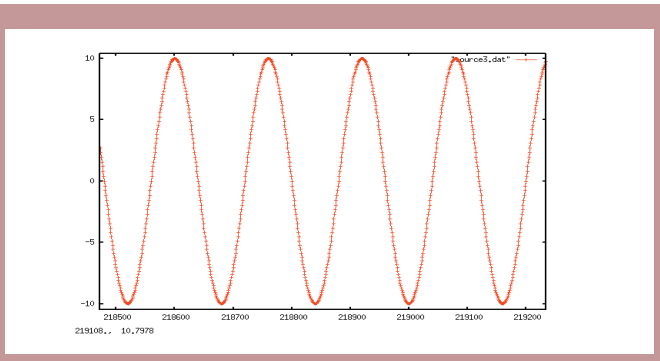


Figure 7(a): Optimal power line waveform simulation.

The **returned error of 0%** is properly justified by the input data sequence, as this is the optimal power line signal and any signal in this range is desired.

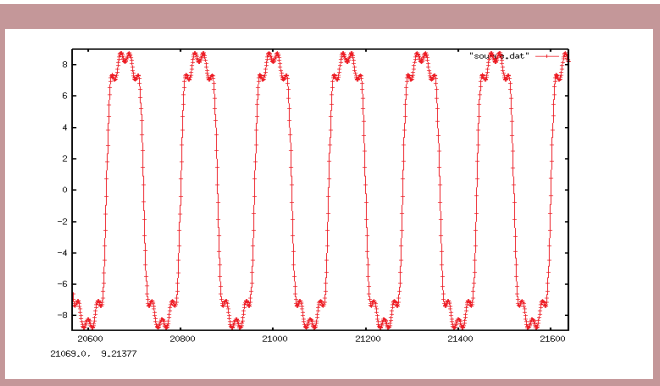


Figure 7(b): Power line waveform with maximum allowable low-order harmonics.

The **returned error of 0.3%** is properly justified by the input data sequence, as this is the maximum allowable low order harmonic power line signal and any signal in this range is allowable according to the IEC 1000-3-2 Canadian standard [5].

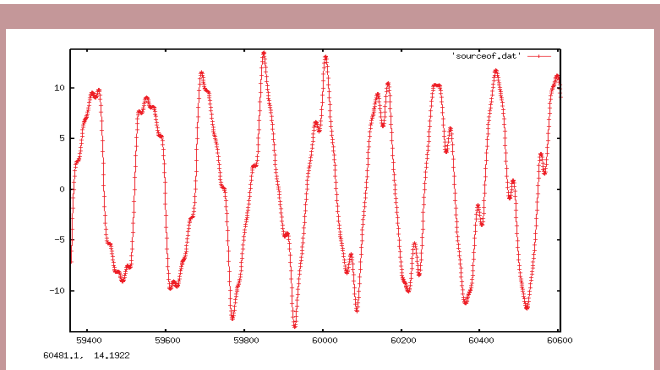


Figure 7(c): Power line waveform with 5 Hz over-frequency in the fundamental harmonic and maximum allowable low-order harmonics.

The **returned error of 52%** is properly justified by the input data sequence, as an over frequency in the fundamental could potentially cause much damage and should be dealt with quickly.

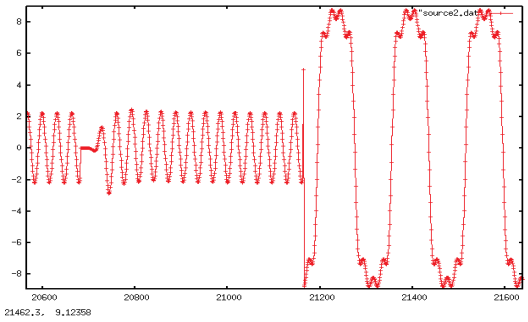


Figure 7(d): Power line waveform with momentary interruption and extreme voltage sag.

The **returned error of 100%** is properly justified by the input data sequence, as it consisted of low-order harmonics, an under-voltage and a temporary complete power outage.

Each one of the above input data sequences produced the desired results with the fault checking algorithm. Any extreme power line disturbances consistently returned a 100% error. All midrange disturbances produced a moderate error and little-to-no disturbances produced zero error. It is important to note that error signal generated is proportional to the type of-disturbance which allows for the ability for the system to react differently for different types of disturbances, a characteristic that could be extremely useful in today's power utility system. Also, it should be noted that voltage spikes were not tested with this fault detection algorithm and that it may need to be modified to properly detect an anomaly of that scale. In summary, we designed and tested via simulation an on-line wireless power-line sensor system that can be used for monitoring and control.

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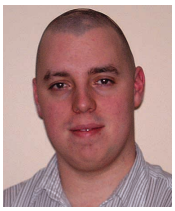
About the Authors



Bradford Stimpson received his B.Eng degree in Electrical Engineering from Ryerson University, Toronto, Canada in 2005 and began working on his M.Eng degree in Electrical Engineering from McGill University, Montreal, Canada in 2006 with expected completion in 2008. His graduate work is in the telecommunications field specializing in predictive dynamic bandwidth allocation schemes for wireless networks. Starting in 2005, he began work with OmniGlobe Networks Inc. as a Research Engineer and has been engaged in several projects funded by the Canadian government including bandwidth optimization schemes, overlay traffic identification schemes and intelligent network management for satellite and wireless networks. Currently, he is the lead System Engineer for all of OmniGlobe's wireless networks in the province of Ontario.

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Congratulations to our 17 newly elevated Fellows for their distinguished work

Plug-in Hybrid Electric Vehicles: Challenges and Opportunities

By *Shaahin Filizadeh, Ehsan Tara*
University of Manitoba

Abstract

Plug-in hybrid electric vehicles (PHEVs) use the electricity drawn from an electric utility system for charging their on-board batteries. Proliferation of this emerging vehicular technology poses several challenges and opportunities for both the users and the utility networks. The paper presents some of such challenges and opportunities in the context of the design and operation of future vehicles.

Sommaire

Les véhicules hybrides rechargeables (VHR) utilisent l'électricité obtenue du réseau public pour charger leurs batteries. La prolifération de ce type émergent de véhicules suscite plusieurs défis et opportunités pour les usagers et les réseaux publics. Cet article présente certains de ces défis et opportunités dans le contexte du design et de l'opération des futurs véhicules.

1.0 Introduction

Global warming, air pollution and vulnerability of oil resources are major concerns of today's transportation industry. Greenhouse gases, which are the main reason of global warming, are mostly emitted in transportation sector. In the transportation sector itself, road transportation is the most polluting part. Fig. 1 shows the amount of greenhouse gas emissions from the transportation sector in British Columbia, Canada, in 2005. It shows that among various means of transportation, more than half of greenhouse gases are produced by the road transportation sector [1].

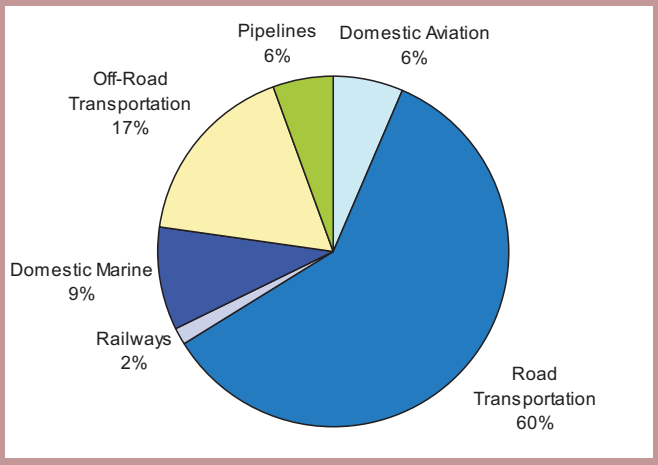

Fig. 1. Greenhouse gas emission from the transportation sector in B.C. in 2005 [1].

The ultimate goal of the vehicle industry is to develop zero emission vehicles (ZEVs), which are pure electric vehicles. Several obstacles however should be overcome before this goal could be realized. Energy storage units (batteries) and battery chargers are the main points of concern in ZEV development. Solving these problems is the mainstream activity of several research studies in the automotive industry.

In the meantime, Hybrid Electric Vehicles (HEV) have gained much interest in transportation industry. The HEV is a bridge between conventional vehicles and future's all-electric vehicles. The number of hybrid vehicles on the roads has significantly increased in recent years.

Hybrid electric drive-trains combine an electric drive system with a conventional gas or diesel engine to provide propulsion for a vehicle [2]. Improved fuel economy is obtained by eliminating wasteful engine idling, recuperating the kinetic energy of the moving vehicle through regenerative breaking, and using the conventional gas engine in operating areas where it is more efficient [3]. This leads to less fuel consumption and less reliance on non-renewable sources of energy for transportation.

A major, new driving force behind development of emerging hybrid electric vehicles is to promote the use of renewable sources of energy in the transportation sector. Existing HEVs do not directly allow such undertakings. Therefore, plug-in hybrid electric vehicles (PHEVs) are being pursued as a viable solution. The next generation of HEVs, which offers the option of plugging the vehicle into a utility network for charging, is believed to be the most promising vehicle for the transportation fleet [4].

A PHEV is essentially a hybrid electric vehicle with extra energy storage that can be charged through direct connection to a utility network [5]. It complements the improved efficiency and fuel economy of an HEV with the possibility of re-charging the vehicle's on-board electric energy storage, and extends the electric-drive range of the vehicle.

In an ideal situation where re-charging can be done entirely using electricity produced from renewable sources (e.g., wind) a PHEV is a strong solution for further penetration of renewable energies. Under ordinary circumstances, where charging uses electricity from a combination of renewable and non-renewable sources, a PHEV's extended electric-range offers superior emission and fuel-consumption indices to an HEV.

Although key benefits are realizable through widespread use of PHEVs, there are several challenges (such as PHEV design consideration, charging schemes, power quality, network stability, etc.) that need to be addressed.

2.0 PHEV Design Considerations

The first consideration in designing an HEV or a PHEV is to design the power train, which is the backbone of the vehicle. Drivetrain design includes sizing combustion engine and electric motor and deciding about the path of energy flow in the vehicle. Typical drivetrains for HEVs are the series and parallel drivetrains [6].

In series drivetrain topology all the propelling force is provided by electric motors in the vehicle. The energy to run these electric motors and charging the batteries is provided by a combustion engine that is used to run a generator. Fig. 2 shows the series drivetrain topology.

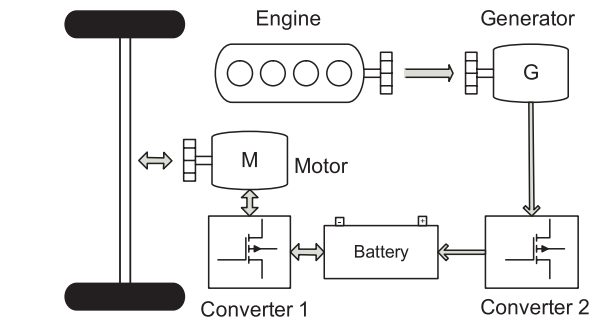

Fig. 2. Series drivetrain topology

The generator is coupled to the engine and provides electrical energy for power rectifier. Power rectifier makes this energy suitable for electric motor and energy storage. Using this topology the combustion engine can be operated at a high efficiency point, which in turn improves the vehicle efficiency. The electric motor is the source of propulsion force. Electric motors are easy to control and their characteristics better fit vehicular needs. This results in a less complicated mechanical transmission system. On the other hand, converting energy from mechanical to electrical form and back again to mechanical would introduce higher losses in converter stage, which can result in some loss of efficiency.

Parallel hybrid vehicles use a different way of power management. The ICE output energy is partly converted to electrical form and the rest is directly used to propel the vehicle. Fig. 3 depicts a conventional parallel hybrid drivetrain topology. As shown in this figure, energy flows in a mechanical path as well as an electrical path from ICE to wheels. The final drive is driven by a torque coupler that adds up the engine and motor torques together.

Less power conversion from one form to another results in a higher efficiency in a parallel drive-train compared to a series one. But this is achieved at the cost of loosing freedom in choosing the ICE's operating point freely, which may result in a lower efficiency. Moreover, introducing the torque coupler makes the mechanical design of system more complicated.

Series and parallel templates are basic drive-trains that have been modified by different manufactures to best fit a particular vehicle. Toyota Prius for example is using a different drive-train called Toyota Hybrid System (THS) [7], which is neither series nor parallel but can offer benefits of both using a planetary gear system (PGS).

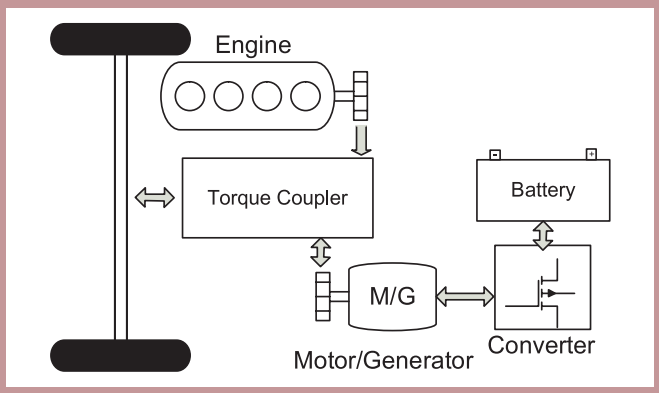

Fig. 3. Parallel drivetrain topology

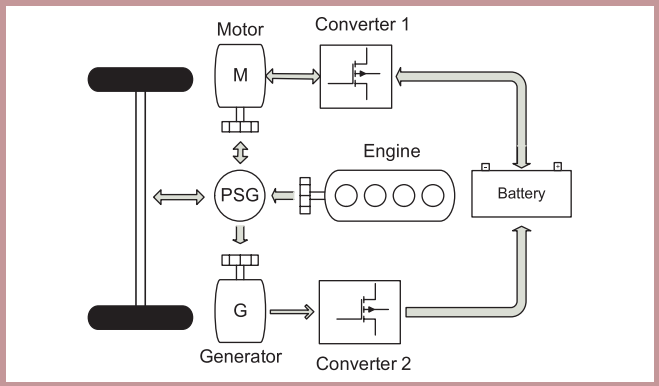

Fig. 4. THS drivetrain topology

Using a power split device, the engine power can go to the wheels through a purely mechanical path, a purely electrical path or a combination of both, which results in high efficiency and also a high degree of freedom.

Drive train design is the most challenging part of HEV design, but designing the electric part of the vehicle, i.e., batteries and chargers are perhaps as crucial as drive train design. The electrical system is more complicated and plays an important role in a PHEV. The key benefit of a PHEV is that it has an extend electric-drive range. When the on-board electric-energy storage is depleted, the vehicle engages its gas engine to provide propulsion and to re-charge the batteries. An important consideration in the design of a plug-in hybrid vehicle is to size the batteries so that a typical commuter can travel with minimum (or ideally no) use of the gas engine. Given the wide variations in the vehicle use among users and the small number of power-train configurations that can be mass-produced, this consideration should be tackled as an optimization problem, in which the objective will be to determine the optimum size of the batteries for which the largest number of commutes can be completed entirely on the electric mode before the user finds an opportunity to re-charge the batteries by plugging the vehicle into the gird. Differences in the performance of various battery technologies, and the category and intended use of vehicles are other factors that should be considered in the design of a PHEV. The size of battery pack is also an important issue from a power system point of view. High capacity batteries are larger loads for the network. In other words, under same charging condition, it takes longer to charge a high capacity battery pack. Table 1 compares three different battery packs for a Toyota Prius in terms of the all-electric range and charging time using a 120VAC/15A charger circuit with a power factor of 0.9 and an average efficiency of 85%. This range has been calculated assuming a steady 50 km/h speed.

Package size	EV range (miles)	Charging time (SOC 0%-100%)
1.3 kWh	1.50	0.95 h
4.5 kWh	5.15	3.3 h
9.0 kWh	10.30	6.5 h

Table 1-charging requirements for a toyota prius with different battery packs

Another important aspect of PHEV energy management system is selecting a proper charging power. The voltage and the current at which the batteries are charged are important from the power system point of view. High charging power means a high power demand for a short period of time while low power means a lower power demand for a longer period of time. Therefore, high power is preferred by drivers, because they do not need to wait for a long time to have their vehicles fully charged. On the other hand, low power is preferred by the power utility because such a kind of load is less likely to cause difficulty for a power system. Table 2 compares different chargers in terms of required time for a full charge.

Package size	Charger power	Charging time
9.0 kWh	120V, 15A	6.5 hrs
9.0 kWh	120V, 20A	4.9 hrs
9.0 kWh	120V, 30A	3.3 hrs
4.5 kWh	120V, 15A	3.3 hrs
4.5 kWh	120V, 20A	2.5 hrs
4.5 kWh	120V, 30A	1.6 hrs

Table 2-charging strategies

A slow charging strategy has a lower power but it will be connected to the network for a longer period of time while a fast charging strategy draws a large amount of current over a short period of time. Slow charging is preferred for charging vehicles at home overnight or at parking lots in office hours, as it does not need any special infrastructure to be installed. Fast charging strategies, on the other hand, need some high power infrastructures to be installed but they can be used in charging stations to provide drivers with a fast charge-up utility.

3.0 PHEV Charging Schemes

Charging batteries using a plug is the main difference between a PHEV and an HEV. When the vehicle is plugged in, different methods (charging regimes) can be used to charge the on-board batteries. The simplest way is to charge the batteries whenever the vehicle is plugged in. This method is the least expensive way and it does not need any special infrastructure. Drivers can use plugs at their home, office or any public parking. On the other hand, this means that a large number of loads are going to be connected randomly to the power network, which may result in instability problems [8].

We often assume that all PHEVs are going to be plugged in over night and tend to forget that most people would like to plug their cars in whenever it is convenient for them, which is not necessarily late at nights. The worst case scenario is that a large number of vehicles would be plugged in late in the afternoon, which is a peak load time of the day. This scenario is also likely to happen because most people would plug their cars in when they get home. This potentially large load demand may result in network instability. In [9] a study on the effect of introducing PHEV to the power network for four power subregions (Entergy, TVA, Southern and VCAR) has been done. This research shows that extra power plants would be necessary in some scenarios of PHEV charging.

In order to mitigate stability problems and also to operate the power system in the most economic way, some new charging methods like smart charge [10] and V2G [10], [11] have been introduced. In the smart charge method for charging PHEVs, a communication link between the power system and loads is used. By means of this link, the power utility has control on the charging time of the plugged PHEVs. It is then possible to charge batteries at a suitable time, e.g., the off-peak hours.

Although smart charging of PHEVs can mitigate many network problems, the situation can be improved using V2G charging method. In V2G method, a bidirectional power flow is used. This means that PHEVs are not only loads for the network but they can also serve as a source of power when need be. This method has two advantages. Firstly it improves the power system stability by preventing PHEVs to charge up simultaneously at peak load periods and also using their batteries as a source of power at critical unstable situation. Secondly it leads to a more economic way of battery charging. Each PHEV charges its batteries when the power price is low and feeds the power system at expensive power times.

4.0 Introduction of Vehicular Loads to Power Grids

4.1 Benefits of Large Vehicular Loads

As indicated earlier, proliferation of the PHEV technology can result in significant reduction in the use of fossil fuels, and thereby harmful emissions, in the transportation sector. Moreover, it is expected that under normal situations most PHEVs will charge their batteries during overnight hours when load levels of power networks are typically low. This results in a more even load distribution between day and night hours, which is a desired situation.

Apart from long-term load leveling, during the time when the batteries are connected to be charged through the network it becomes possible to treat the pool of the energy storage of the PHEVs as either a source or a sink of power during network disturbances to provide stability support. This feature becomes particularly useful when a large number of PHEVs are available for a prolonged period of time, e.g., in the parking lot of a large office building during the time the owners are at work. Under such cases, the prolonged parked time of the vehicle allows the batteries to be fully re-charged, should the stored energy in them be taken momentarily back to the grid for network support during a disturbance.

4.2 Challenges for the Integration of PHEVs

Despite their anticipated benefits, several issues need to be addressed before PHEVs can be successfully introduced into power networks. Such issues are present both in the design [12] and operation of PHEVs. Some of the challenges that are of particular importance to power systems are presented in the following sections.

4.2.1 Additional infrastructure required

Vehicular loads may need charging stations available in parking places, both in residential and public scales. Design of large charging stations fed through the grid, safety considerations, performance under variable climates, and financial aspects need to be carefully tackled.

4.2.2 Charging regimes

Charging regimes for future vehicular loads is a major consideration for PHEVs. Ideally the on-board batteries will be charged overnight or over long periods of time when the owners are at work. However, to enable gas-free driving to a larger extent, it is necessary to be able to top-up the batteries in a short period of time, also referred to as 'opportunity charging'. These highly variable and relatively stochastic charging regimes could have unforeseen impacts on the network that need to be investigated.

4.2.3 Network stability and security, and power quality

Given the nonlinear and relatively unpredictable nature of vehicular loads, it is imperative that potentially adverse impacts of an extensive PHEV load on power grids be studied. It is also worth noting that introduction of numerous power-electronic chargers into the network will give rise to large harmonic currents and voltages, thus raising concerns about the quality of power. Beside harmonics, voltage profile, power factor and reactive power distribution through the network will all be affected by massive PHEV loads [13]. The power quality problem has both local and widespread effects. While large local PHEV loads are expected in large public or office building parking lots, the loads get widely spread when units are individually plugged in at home through night time hours. PHEV chargers would generate harmonic currents in the system which affects transformers, cables and breakers [14].

4.2.4 Electricity transactions and charging patterns

If PHEVs are equipped with advanced chargers and proper charging algorithms it becomes possible to conduct smart electricity transactions. For example, the charging algorithm may decide to charge the batteries only when the price of electricity communicated to it is low and avoid charging when the price is high (for example during peak load hours). This should be combined with the requirements of the battery's state-of-charge and would involve sophisticated optimization procedures. Since proper implementation of this scheme requires updated electricity prices to be available, it may be seen as a future possibility that may be economically justified if a sufficiently large vehicular load emerges.

5.0 Conclusions

In light of the rising energy prices and environmental concerns over emissions form vehicles, the automotive industry is undergoing a transformation towards development of vehicles with better fuel economy and less emission. The plug-in hybrid electric technology is deemed to be a viable solution for further extension of gas-free operation of hybrid vehicles. It is expected that the technology will continue to grow and as a result, future power systems will have to deal with an escalating vehicular load. Benefits can accrue from this situation: Widespread PHEV load can contribute to load leveling capability, help promote renewable sources of energy, and improve network stability by acting as a momentary energy source/sink.

N.Ed.

- *IEEE USA published in 2007 a position paper on plug-in electrical vehicles: See http://www.ieeeusa.org/policy/positions/.*
- *A small non-profit association, Electric Mobility Canada, is organizing a conference "Plugin Highway 2009" to be held in November 2009 in Montreal. See http://www.pluginhighway.ca/.*
- *The Government of Canada is developing a technology roadmap for electric vehicles: http://www.evtrm.gc.ca/. The goal is to identify critical energy technology requirements, gaps and milestones needed to advance electric vehicles in Canada.*

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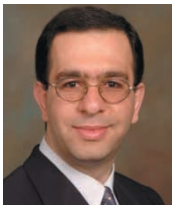

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2008 TELUS Innovation Contest Winners

The 2008 Awards were presented at the IEEE Canada Student Conference, September 12, at the Toronto Delta Airport Hotel. Congratulations to the winning teams and to all participants. The top three entries are awarded $10,000, $5,000 and $2,000, respectively. Many thanks to TELUS for its continued support of the Contest; 2008 marked the fourth time the Awards have been presented.

Certificates in hand and proud smiles on their faces, 1st place went to Queen's University students (left to right): Arjun Phull, Jordan Heuser and Mark Storus. They are joined (to the left) by TELUS judge Alex Rootham and IEEE Canada President Ferial El-Hawary and (to right) TELUS judge Dave Keegstra. Their winning entry was *Speech Synthesis through Gesture Recognition*.

UBC students (L to R) Yuanyuan Yin, A. J. Moss and Andrew Wong placed 2nd for *The dScrybe Digital Receipt System*.

University of Alberta's Mike Ball, Ahmed Elnahas, Chris van Slyke and Andrew Steadman (L to R) placed 3rd for *Foresight - Distributed Monitoring for a Forestry Environment*.

Extraterritoriality in Patent Law:
How engineers in Canada can be affected by US Patents

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Abstract

A patent provides a right to exclude to a patentee. The boundaries of the monopoly in the space dimension are defined by the limits of the jurisdiction in which the patent is granted. In electrical or software engineering, the idea of limiting a design to a jurisdiction it is too limiting. Contention may occur between A- the patentee who has the patent for the innovation in a first jurisdiction and B- a second party who claims that his application is not entirely located in the first jurisdiction since some part of the application is located in the second jurisdiction, and that therefore he should not be held liable for infringement. An extraterritoriality dimension may occur and, to a certain degree, the geographic dimension of the monopoly granted may be extended to other jurisdictions. An engineer developping an application in Canada may become affected by the existence of a patent in the US.

Sommaire

Un brevet fournit un droit d'exclusion à un demandeur. Les frontières du monopole dans sa composante spatiale sont les limites de la juridiction dans laquelle le brevet est octroyé. Dans les domaines du génie électrique ou logiciel, l'idée de limiter une application à une juridiction est trop restrictive. Une tension peut avoir lieu entre A- le demandeur qui a obtenu le brevet pour une innovation dans une première juridiction et B- une autre partie qui revendique que son application n'est pas entièrement située dans la première juridiction car une partie de l'application se situe dans une second juridiction, et par conséquent elle ne devrait pas être reconnue coupable de contrefaçon du brevet. Une notion d'extraterritorialité peut alors apparaître et, jusqu'à un certain degré, la dimension géographique du monopole octroyé peut alors se retrouver étendue à d'autres juridictions. Un ingénieur qui développe une application au Canada peut alors se retrouver affecté par l'existence d'un brevet aux États-Unis.

1. Introduction

Patent rights provide exclusive rights to a patentee. Those exclusive rights are key to fueling innovation since they provide a reward, i.e. a monopoly limited in time and space, for disclosing an innovation. The monopoly is intended to discourage an unauthorized practice of the protected innovation by a second party.

It is however important that the public does not become a collateral victim of the monopoly granted. The scope of the monopoly conferred to the patent holder has therefore to be defined clearly in order to enable other parties to avoid infringement – since infringement actions may end up with serious repercussions for a defendant even if the infringement committed is not a willful one.

As previously mentioned, the boundaries of the monopoly are limited in the time dimension and in the space dimension. The limit of the monopoly in the time dimension is usually 20 years, while in the space dimension the limits of the monopoly are defined by the limits of the jurisdiction in which the patent is granted. For a given jurisdiction, the public is therefore able to assess whether a given product or apparatus falls within the scope of protection of the patent, and therefore whether infringement would be occuring.

In electrical or software engineering, the idea of limiting a design to a jurisdiction often does not make any sense since it is too limiting. This is particularly the case in telecommunication applications which by essence transcend borders, e.g. a server may be located in one jurisdiction and a client may be connected to the server from another jurisdiction. In such cases, contention may occur between the patent rights holder who has the patent for the innovation in the first jurisdiction (and who is looking to enforce it) and the second party who claims that his application is not entirely located in the first jurisdiction since some part of the application is located in the second jurisdiction, and that therefore he should not be held liable for infringement.

In fact an extraterritoriality dimension may occur and, to a certain degree, the geographic dimension of the monopoly granted may be extended to other jurisdictions. A possible definition for extraterritoriality in patent infringement is a situation in which an infringement action occurs for acts performed outside the jurisdiction in which the patent has been granted.

Since the United States is one of the largest trade partners of Canada, it is of great interest to monitor the situation there and outline some issues for engineers in Canada. Moreover, the US is also one of the most sought after jurisdictions for obtaining patent rights for innovations. It will be appreciated that this study is intended to be brief, and that to give an idea of some potentials issues a US lawyer should be consulted for an opinion or for advice.

2. How everything started

The seminal court case in Extraterritoriality in United States patent law is a US Supreme Court decision, Deepsouth Packing Co v. Laitram[1] (1972). This decision is of interest for mechanical engineers. In this case, Laitram had a patent in the United States for a machine for deveining shrimps. The patent was for a combination of old known elements. Deepsouth manufactured and shipped all elements of the invention outside United States and the customer was then combining them to build the machine for deveining the shrimps. Laitram argued infringement under Section 271(a), which is the section dealing with patent infringement in United States law. The decision of the court was that the "*word "make" as used in Section 271(a) does not extend to the manufacture of the constituent parts of a combination machine, and that the unassembled export of the elements of an invention does not infringe the patent*". This decision opened a Pandora's box since it was then possible to export from the United States unassembled components of a patented invention and escape infringement for a patented combination. Understanding that this was a great flaw in the system, the US Congress patched the loophole in 1982 by introducing Section 271(f), which reads as follows:

> (1) Whoever without authority supplies or causes to be supplied in or from the United States all or a substantial portion of the components of a patented invention, where such components are uncombined in whole or in part, in such manner as to actively induce the combination of such components outside of the United States in a manner that would infringe the patent if such combination occurred within the United States, shall be liable as an infringer.
>
> (2) Whoever without authority supplies or causes to be supplied in or from the United States any component of a patented invention that is especially made or especially adapted for use in the invention and not a staple article or commodity of commerce suitable for substantial non-infringing use, where such component is uncombined in whole or in part, knowing that such component is so made or adapted and intending that such component will be combined outside of the United States in a manner that would infringe the patent if such combination occurred within the United States, shall be liable as an infringer.

Exporting from the US unassembled components of a patented invention became an infringement if the exporter actively induces the assembly of the device outside US under Section 271(f)(1). Exportation of a single component that is neither a staple article of commerce nor which has a substantial non-infringing use is also infringing the patent if the exporter knows that the component's only use is in the patented device and also knows that it will be combined outside US into a completed device (Under §271(f(2))).

[1] Deepsouth Packing Co. v. Laitram Corp., 406 U.S. 518 (1972)

3. Eolas Technologies Inc. v. Microsoft Corp

A couple of decades later, extraterritoriality again appeared in court with Eolas Technologies Inc. v. Microsoft Corp[2]. This case is of interest for software engineers. Eolas sued Microsoft for infringement of US Patent No5,838,906 alleging that certain aspects of Internet Explorer were infringing their patent granted in November 17, 1998 for a "*Distributed hypermedia method for automatically invoking external application providing interaction and display of embedded objects within a hypermedia document*".

Moreover, Eolas claimed royalty damages for both foreign and domestic sales of Windows with Internet Explorer. Microsoft moved to prevent Eolas from seeking damages based on foreign sales under Section 271(f). In fact, Microsoft exported a limited number of golden master disks containing the software code for the Windows operating system to original equipment manufacturers (OEM) abroad that were using those golden master disks to replicate the code onto hard drives for sale outside of the United States. One of the issue was whether "*software code made in the US and exported abroad is a component of a patented invention*" under Section 271(f). The court explained that Section 101 states that "*an invention includes "any new and useful process, machine, manufacture or composition of matter*" *and that without question, software code alone qualifies as an invention eligible for patenting under these categories, at least as processes*". The court further stated that "*every form of invention eligible for patenting falls within the protection of 271(f)*" and that further "*every form of invention deserves the protection of 271(f)*". In particular, the court stated that "*software code on the golden master disk is not only a component, it is probably the key part of this patented invention*". The Federal Court of Appeal stated that for the purpose of Section 271(f)(1) components includes "*software codes on golden master disks*" and Eolas royalties for Microsoft infringement should include foreign sales of the code.

This case therefore pointed out that there is no physicality requirement for a "*component*" of a patented invention to fall within the statute. This case was not heard by the Supreme Court.

For software engineers, this case was a serious warning since it meant that "*component*" could be given a broad interpretation and cover golden disks.

4. NTP Inc. v. Research in Motion

In this famous case[3], the technology at issue is related to the Blackberry(TM) devices which are capable to transmitting data over wireless networks.

According to this technology, once an email is received at a user computer, the new message is transmitted encrypted to a relay of the system, located in Canada, and forwarded to an appropriate wireless network that conveys it to the recipient user's handheld device.

Research in Motion argued that there was no infringement since some part of the system (i.e. the relay) was not located in the United States and that therefore the system as a whole was not located in the United States where the patent was granted. On the other hand, NTP argued that there was infringement.

The court held that "*the use of an invention occurs in the place at which the system as a whole is put into service (i.e. where control is exercised and beneficial use of the system is obtained)*".

The claims of the patent intended to protect the system were therefore considered to be infringed by Research in Motion.

However, the court held that "*A process cannot be used "within" the US as required by §271(a) unless each step is performed within this country*". Accordingly the court considered that the claims of the patent intended to protect the method were therefore not considered to be infringed by Research in Motion.

This case never went to Supreme Court since a settlement was reached between the two parties, but it raised again a lot of fears amongst engineers in Canada since a US patent holder had been able to successfully sue a Canadian company for patent infringement even if some part of the infringing system was located outside United States - provided that "*control is exercised and beneficial use of the system*" was obtained in the United States.

Again, for software engineers, this case is of big concern since the condition of "*control is exercised and beneficial use (of the system)*" is obtained in the United States is not a very difficult condition to meet when the system is intended to accommodate US customers.

5. Restricting extraterritoriality, the Supreme Court clarifies the situation in Microsoft v. AT&T[4]

In that case, AT&T had a patent[5] for a speech compression technology that was infringed by a product of Microsoft. Microsoft exported the code which, once abroad, was copied and installed in computers that were then sold abroad. Because of the way the invention is claimed, the code alone was not infringing the patent. The infringement would only occur once the code was combined with the computer hardware. Microsoft sent each manufacturer a master version of Windows, either on a golden disk, or via an encrypted electronic transmission, which the manufacturer used to generate copies. Those copies, not the master version sent by Microsoft, were then installed on the foreign manufacturer's computers. Finally, the foreign-made computers were then sold to users abroad.

The Supreme Court held that there was no infringement since Microsoft did not export from the United States the copies of Windows installed on the foreign-made computers in question, Microsoft does not "*supply from the United States "components" of those computers, and therefore is not liable under 271(f)*". The court pointed out that "*a copy of Windows, not Windows in the abstract, qualifies as a "component" under Section 271(f). Section 271(f) attaches liability to the supply abroad of the "components of a patented invention, where such components are uncombined in whole or in part, in such manner as to actively induce the combination of such components*". The court stated that "*Abstract software code is an idea without physical embodiment, and as such, it does not match 271(f)'s categorization component amenable to "combination"*".

For the court, "*the master disk or electronic transmission Microsoft sends from the United States is never installed on any of the foreign-made computers in question. Instead, copies made abroad are used for the installation. Because Microsoft does not export from the US the copies actually installed, it does not supply from the US components of the relevant computers, and is therefore not liable under Section 271(f)*".

It is however interesting to note that the court did not close the possibility that software could qualify as a "*component*" under Section 271(f) under other circumstances.

6. Conclusion

Some of the cases mentioned above show that checking that there is no infringement of a US patent is not a bad idea when a software innovation is developed. This is called obtaining a "*freedom to operate opinion (FTO)*" or "*right to manufacture opinion*". Even though it might take a while to be "*on the radar*" of a potential patent holder, designing around the patent may be cumbersome after a while and anticipating issues often cost less than dealing with them later.

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[2] Eolas Technologies Inc. v. Microsoft Corp., 399 F.3d 1325 (Fed. Cir. 2005)

[3] NTP, Inc. v. Research In Motion, Ltd., 418 F.3d 1282 (Fed. Cir. 2005)

[4] Microsoft v. AT&T, 550 U.S.___ (2007)

[5] RE 32,580

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Applications of Engineering to Bicycling

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Abstract

The importance of adopting a healthy lifestyle is driven by a number of factors including the increasing cost of healthcare, a longer lifespan, an increased time for leisure, and personal satisfaction. Today, engineering and technology plays an important role in the design of athletic equipment, in training practices and in monitoring athletic performance. The objective of this article is to provide the reader with an understanding of some facets of engineering as it is applied to the sport of cycling. Cycling encompasses key elements of fitness common to most athletic activities: strength, endurance, tenacity, and flexibility.

Sommaire

L'importance d'adopter un style de vie sain est motivé par un certain nombre de facteurs incluant l'accroissement du coût des soins médicaux, une durée de vie accrue, plus de temps pour les loisirs, et la satisfaction personnelle. De nos jours, le génie et la technologie occupent un rôle important dans la conception d'équipement sportif, les pratiques d'entrainement et le suivi de la performance athlétique. L'objectif de cet article est de fournir au lecteur une compréhension de certaines facettes du génie appliqué au cyclisme. Ce dernier procure des éléments clés de condition physique partagés par la plupart des activités athlétiques : force, endurance, ténacité, et flexibilité.

1.0 Introduction

Because of the growing understanding of the benefits of wellness, lengthening life spans, and the increasing cost of healthcare, the importance of adopting a healthy lifestyle is transforming the lives of many citizens from athletic observers to athletic participants. This is evidenced by key recreational trends and sports participation rates from 1987 to present, found in the annual tracking study conducted by American Sports Data Inc. (www.americansportsdata.com) a specialist in consumer sports survey research. The National Sporting Goods Association (www.nsga.org) further confirms this trend. On the other hand, a study published by Statistics Canada (Clark, 2008) reveals an alarming drop in sports participation by children aged 5-14. For those children who did participate, parental example and influence were found to be extremely important.

The research is unequivocal; exercise is beneficial. It enhances and protects brain function and can serve to moderate undesirable age-related changes in cognition, brain function, brain structure and overall body functions (Cotman and Engesser-Cesar, 2002; Kramer et al, 2006; Weinert and Timiras, 2003; Duncker and Bache, 2008). Employee wellness programs provide a positive return on investment (Shephard, 1999; Wattles and Harris, 2003; Wells, 2008; Mitchell, Goetzel, and Gzminkowski, 2008). Employer financial incentives tend to increase participation in worksite health management programs (Anderson et al, 2008).

Enthusiasts at all levels are interested in becoming more knowledgeable about their chosen athletic activities and learn about developments in engineering and sports medicine that will assist them in their quest. Creative and innovative engineering developments are revolutionizing the athletic experience. In the cycling sector, engineering is being used to design lighter, faster, and safer bicycles and associated equipment; to monitor performance facilitating effective and safe training practices, and by the athlete during competitive events as an important component of self management of a healthy level of exertion.

2. Brief History of the Bicycle

The bicycle is a remarkably efficient machine both structurally and mechanically and has enjoyed a long history as an energy efficient means of personal transportation in both developed and undeveloped countries (Wilson, 1993) and as a means of maintaining health and fitness. In 1490 Leonardo DaVinci sketched a facsimile of the modern bicycle which never left the drawing board. In 1817 German Baron von Drais invented a walking machine that became known as the Draisienne. It was made entirely of wood and consisted of two same-size in-line wheels, the front one steerable, mounted in a frame which you straddled and propelled by pushing your feet against the ground, rolling you and the device forward. In 1865, pedals were applied directly to the front wheel in a machine known as the bone shaker. Made entirely of wood, then later with metal tires, it made for an extremely uncomfortable ride. In 1871 British engineer James Starley designed the 'High' bicycle. This was the first somewhat efficient bicycle consisting of a small rear wheel and large front wheel pivoting on a simple tubular frame with tires of rubber.

In 1870 the first all metal machine appeared. Solid rubber tires and the long spokes of the large front wheel provided a smoother ride. This machine was the first one to be called a "bicycle". In 1879 Englishman Harry John Lawson produced the first bicycle driven by a chain to the rear wheel. Subsequently John Kemp Starley built a bicycle with equal-sized wheels. The saddle, handlebars, and crank axle were well balanced and logically placed. This established the shape of the bicycle as we know it today. Further improvement of metallurgy sparked the next innovations, particularly chain and sprockets. Instead of just one wheel circumference for every pedal turn, you could advance through the gear ratios. Thereafter, improvements in bicycle components such as the frame, tires, variable speed gears, brakes, saddle, and chains emerged.

Bicycling became so popular in the 1880s and 1890s that cyclists formed the League of American Wheelman now called the League of American Bicyclists http://www.bikeleague.org/. The league's mission is to promote bicycling for fun, fitness and transportation and work through advocacy and education for a bicycle-friendly America. This is done by representing the interests of the US's 57 million cyclists and advocating on their behalf. The National Bike Bill sponsored by Representative Earl Blumenauer passed the US House of Representatives on May 21, 2008. The Safe and Complete Streets Act of 2008 was introduced into the U.S. House (HR 5951) on May 1. This bill would make sure that roads built and improved with federal funds safely serve everyone using the roadway, including pedestrians, bicyclists, bus riders, as well as those with disabilities. The Bicycle Commuter Act would extend the transportation fringe benefit, currently available to transit users and car drivers, to bicycle commuters. The legislation would provide a tax benefit to employers who offer cash reimbursements to an employee who commutes by bicycle, while helping defray the costs of commuting for the bicyclist.

3. Canada is a Leader in High-Performance Bicycle Design

Cervélo Cycles (www.cervelo.com) is a manufacturer of racing bicycle framesets based in Toronto. Their story began at McGill University in Montreal in 1995 when two mechanical engineers embarked on a bike building project. What followed was a classic success story filled with blood, sweat, and tears and their belief in themselves as they pursued their goal of designing a new kind of bike—leading edge and high performance. The partnership between co-founders Phil White and Gérard Vroomen continues today with a company that is considered the world's leader in high-performance bicycle design and manufacture. Today

Cervélo has two production facilities in Asia and employs sixty people, including twelve engineers who apply their talents of cutting-edge technology and innovation.

Ergonomics, biomechanics, and aerodynamics are imperative along with comfort, efficiency and speed in their pursuit of the best frame geometry. Their philosophy of frame size is —"Pros ride exactly the same frames as customers—no custom frames, no custom sizes" (Lefebvre, 2008). Cervélo only has six sizes of frames whose dimensions fit the rider's optimal position. Critical to the success of the company is their sponsorship of elite level athletes; this has led to global recognition of the brand. Cervélo's were the first Canadian bicycles to be used — and to win! — at the Tour de France. At the 2008 Ironman Triathlon World Championships in Kona, Hawaii, Cervélo was once again at the top of the list as the bike of choice for 415 athletes. Its nearest competitor was used by a distant 117 athletes (Culp, 2008). Cervélo bikes are used in the prestigious 3000 mile Race Across America (www.raceacrossamerica.org), and in the Ultraman Triathlon (www.ultramancanada.com).

4. Bicycle Design Today

Today's bicycles are marvels of engineering design and engineered materials; safe, lightweight and aerodynamic, they maximize the physiological abilities of the rider. Carbon fiber composite is a cyclist's dream come true and today is used in an increasing number of bicycle components. Carbon fibers can be oriented for superior vibration damping qualities, torsional and lateral stiffness, along with superior vertical compliance compared to aluminum, steel or titanium. This material is lighter than aluminum and stronger than steel, and can be molded into complex shapes and sizes. Importantly, the anisotropic (directional-specific) nature of advanced composite materials allows bicycle engineers to use weaves and ply designs to create components that are stiffer in one or more axes, while remaining compliant in other directions. The resulting patterns of directional layers of composite fibers optimize the bicycles stiffness and strength performance characteristics. This is particularly important in the frame tube as orienting the fibers at different angles within the shaft allows the designer to take advantage of the materials strength and stiffness properties to withstand multiple vectors of flex, torque, compression and tension forces. The skill applied during the engineering, manufacturing and assembly of the frame, in combination with the quality of the carbon fiber used are critical to the quality of the final product.

5. Ergometry

Cycle ergometry is the basis for stationary training and for testing of endurance capacity (Lear et al, 1999; Basset and Boulay, 2000; Paton and Hopkins, 2001). Engineering developments have resulted in innovative computer-controlled precision electronic bicycle ergometers that provide accurate and repeatable electronic resistance over a variety of load ranges, virtual gearing, and a road feel that closely simulates riding outdoors.

Training and testing protocols can be purchased or created by the athlete themselves. Cycling protocols can be designed using a variety of parameters such as watts, time, distance and grade. Data is displayed instantaneously as well as averages and minimum/maximum values for each performance variable. Variables displayed and recorded include watts, heart rate, speed, cadence, distance, left/right leg power splits, to name but a few. Data is displayed numerically and/or graphically.

Ergometer resistance is controlled by system software which runs on laptop or desktop computers. Features include programmable workload protocols, motivational 3-D bike courses, two-person races, recordable performances, course creation either manually or with optional software course creating software. Many race routes have been filmed and then displayed on a monitor while real-time software adjusts the ergometer in a manner that simulates the challenges on the real course. Further information can be found at (www.racermateinc.com), (www.cycleops.com), or (www.monarkexercise.se)

Advanced systems utilize integrated metabolic measurement system for cardiopulmonary stress testing, indirect calorimetry, and maximal O2 consumption measurement that are accurate, reliable and easy to use. A few of the parameters measured include: metabolic equivalents (METS) ; maximal oxygen uptake (V02); minute ventilation (VE); ventilatory equivalents (VE/V02 VE/VC02); respiratory gas exchange ratio (RER); carbon dioxide production (VC02); and ergometer or treadmill work in watts. Further information on metabolic testing is available at: www.parvo.com

6. Transponder Technology

The technology is based on is a radio-frequency-identification (RFID) miniature transponder which is encased in a waterproof plastic housing. For swimming, cycling or running the device is generally attached to an ankle bracelet. The battery-less device contains a silicon chip and an energizing coil. As the athlete passes over a timing mat the coil is energized and the transponder transmits a unique identification number to a receiving antenna in the mat. This number and corresponding time accurate to hundredths of a second in are transferred to a central computer for further processing.

The system allows for accurate time measurement from a large number of athletic participants regardless of which then passed over the start line. For example the start of the New York City Marathon timed with ChampionChip® (www.championchip.com) equipment handles approximately 5000 athletes per minute. Transponder technology also reduces athlete fraudulence as intermediate mats can be placed in strategic locations on the course. Timing is accurate to the hundredths of a second which can become extremely important to determine the order of finishing. Applications of the transponder technology are boundary-less with instantaneous real-time tracking of individual athletes emerging in the near future.

7. Global Positioning Sensor (GPS) Technology

Global Positioning Sensor (GPS) technology is increasingly being incorporated into personal monitors and other athletic training technology. New applications have revolutionized training and information feedback to moving athletes.

A number of manufacturers have devices for athletes that utilize GPS technology. Primary applications are for cycling and running. The system the author uses for cycling is the Garmin Edge 705 (www.garmin.com) and illustrated in Figure 1. This small (5.1x10.9x2.5 cm) low weight (104.9 g.) wireless device features a 176x220-pixel color display and a rechargeable 15 hr. battery. Memory is expandable to 2.5 GB of data storage. Important features of this device include self-calibrating wireless speed/cadence sensor, wireless heart rate monitor, wireless data sharing, barometric altitude and vertical profile, turn-by-turn directions, mapping detail, and the device will display power data from compatible third-party bicycle power meters. A total of forty-seven data fields are available for continuous display. Data is downloadable to your computer for detailed analysis.

Figure 1: Performance bicycle with GPS

An example of information obtained from the bicycle GPS system obtained during the author's participation in the 180 km segment 2008 Ironman Canada Triathlon Championships (www.ironman.ca) is provided as Figure 2.

8. Power Meter Technology

One very exciting technology that is emerging involves the measurement of power while cycling. A cycling power meter is a device on a stationary or mobile bicycle that measures power output of the rider. Power meters provide instant feedback to the rider about their performance and measures their actual work output. An athlete performing "interval" training while using a power meter can instantly see what they are producing. This is different and more effective than waiting for the heart rate to climb to a certain point.

Power meters measure the force that moves the bike forward. This has two significant advantages over heart rate monitors: 1) an athlete's heart rate may remain constant over the training period, yet their power output is declining. This cannot be detected with a heart rate monitor; 2) an athlete who is not rested or not feeling well may train at their normal heart rate yet they are unlikely to be producing their normal power; and 3) power meters enable riders to experiment with cadence and evaluate its effect relative to speed and heart rate.

Most cycling power meters use strain gauges to measure torque applied, and when combined with angular velocity, calculate power. Power meters using strain gauges can be mounted in the bottom bracket, rear freehub, chain, or crankset. The wireless display is mounted on the handlebar.

On the bicycle, power is a product of speed and all of the forces that resist forward motion like aerodynamic resistance or wind, gravitational resistance, grade of a hill, rolling resistance, quality and pressure in your tires, and the resistance in bicycle components. By knowing your average power output and the duration of a given ride, you can calculate the amount of energy you use on that ride. Power output is an absolute and objective measure of the training stimulus or intensity. Advent of this technology makes it possible to accurately quantify an individual's training load during training and competition.

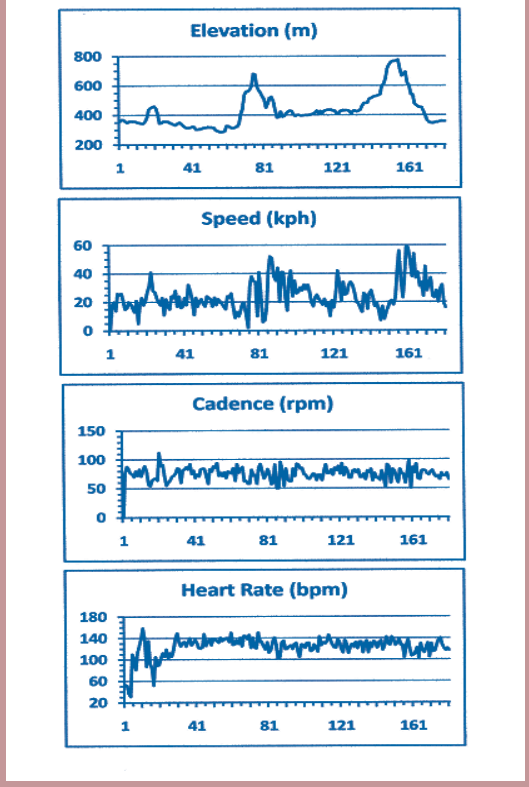

Figure 2: Typical data from bicycle GPS system

9. Conclusion

The bicycle has played an important role in the history of man and will do so for many years in the future as an energy efficient, non-polluting mode of transportation and for maintaining health and wellness.

Engineering as well as other disciplines are playing an important role in maximizing the efficiency of the cyclist. Technology itself is only a facilitator of athletic participation efficiency. It is important to note that hard physical training, motivation and adherence will always be critical factors for the success of any athletic enthusiast.

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About the Author

Terrance Malkinson is a communications specialist, business analyst and futurist. He is Vice-Chair of the IEEE-USA Communications Committee, an international correspondent for IEEE-USA Today's Engineer Online, editor-in-chief of IEEE-USA Today's Engineer Digest, and an associate editor for IEEE Canadian Review. He was an elected Senator of the University of Calgary and an elected Governor of the IEEE Engineering Management Society as well as an elected Administrative Committee member of the IEEE Professional Communication Society. He has been the editor of several IEEE conference proceedings, and past editor of IEEE Engineering Management. He is the author of more than 360 publications, and is an accomplished triathlete. His career path includes being an accomplished technical supervisor and medical researcher at the University of Calgary, a business proposal manager for the General Electric Company, and an associate for Sears Canada Inc. Currently, he is with the School of Health and Public Safety/Applied Research and Innovation Services at SAIT Polytechnic in Calgary.

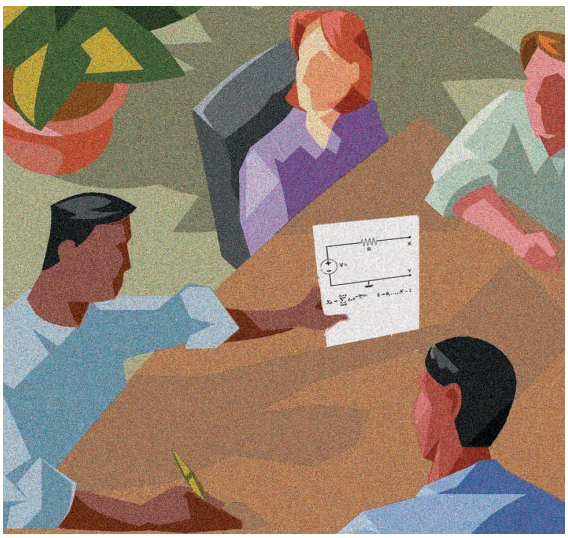
Engineering Management: What's New in the Literature?

On: Career Satisfaction, Boss Skills, How the Best Get Better, Executing Strategy, Team Motivation, Creativity, and Elder Care at Work.

By Terrance Malkinson
School of Health and Public Safety
SAIT Polytechnic

◆ Many high achieving people feel dissatisfied and unfulfilled. Some even feel trapped by their jobs and wished that they had chosen a different career. Robert Kaplan in "Reaching Your Potential" [Harvard Business Review, 86(7/8): 45-49, July-August 2008, www.hbr.com] examines why this is the case. Often we play out our life cautiously, focusing on safety and security. The goal is not necessarily about advancing to the top of the organization, but rather finding your own path to satisfaction and fulfillment by determining how you define success. Steps towards achieving real success include: understanding yourself, seeking honest feedback from others about your strengths and weaknesses, and determining what you truly enjoy.

To achieve real success you need to take ownership and control of your life and your career. It is your responsibility; do not go along with other people's definition of success; set your own path. As Robert Kaplan concludes: "those that courageously identify their dreams and develop the skills to realize them will find fulfillment — even if they hit bumps along the way." What does success mean to you?



◆ Advice from experienced business leaders are summarized by Malwina Gudowska in "20 Skills Every Boss Should Know" [Alberta Venture. 12(4):49-58. April, 2008. www.albertaventure.com]. Business people share skills they consider to be essential for any leader, and which will not be learned from other sources. You may find their advice valuable, not just as a leader at any level but in your everyday interactions in the workplace.

◆ Graham Jones, a sports psychologist and executive coach, shares his experiences in "How the Best of the Best Get Better and Better" [Harvard Business Review. (86(6):123-127. June, 2008. www.hbr.org]. The key to elite performance according to the author is mental toughness. Champions are "not necessarily more gifted than others; they're just masters at managing pressure, meticulously tackling goals, and driving themselves to stay ahead of the competition." Competition and pressure spurs them to achieve. They rebound from defeat by carefully planning short-term goals while keeping focused on the long-term goals and aspirations. They do not get distracted by the success or failures of others. They focus on the task by compartmentalization and value immediate feedback. And they recognize the importance of celebrating their success.

◆ From data collected from more than 125,000 employees from 1,000 organizations in more than 50 countries emerged the top 17 traits exhibited by organizations that are most effective at executing strategy. ["The Secrets to Successful Strategy Execution". Harvard Business Review. 86(6); 61-70. June, 2008. www.hbr.org]. Gary Neilson, Karla Martin and Elizabeth Powers believe that the best way to execute strategy is to clarify decision rights and improve the flow of information throughout the organization, not redrawing the organization chart or tinkering with incentives. By doing so the right structures and motivators will emerge. The most common attribute is that employees must be clear about what decisions and actions they are responsible for.

◆ It is in the project manager's best interest to create and maintain a motivating environment for all members of the team. In "Motivation: How to Increase Project Team Performance" [Project Management Journal, 38[4]: 60-69, December, 2007, www.interscience.wiley.com], Tanya Peterson discusses how the project manager must harness many different interpersonal skills and be personally enthusiastic. Motivation inspires, encourages, and stimulates individuals to achieve common goals through teamwork. The author discusses common motivational theories, motivational mistakes, applying motivation to the team environment, and developing a team culture.

◆ Creativity requires a large number of people from different disciplines working effectively together to solve unforeseeable problems. Pixar has a unique track record for producing technological and artistic breakthroughs. In "How Pixar Fosters Creativity" [Harvard Business Review, 86(9), pp. 64-72, September 2008, www.hbr.com], Ed Catmull discusses how the film studio fosters collective creativity. Operating principles include: "1) everyone must have the freedom to communicate with anyone; 2) it must be safe for everyone to offer ideas; and 3) staying close to innovations happening in the academic community."

Strategies discussed include: placing the creative authority for product development firmly in the hands of the project leaders rather than corporate executives; building a culture and processes that encourage people to share their work-in-progress and support one another as peers; and dismantling the natural barriers that divide disciplines.

◆ According to the National Alliance for Care Giving [www.caregiving.org/], more than 44 million Americans provide elder care for adult family members, and more than half of these caregivers are also employed. The situation is likely similar for Canada. It is challenging for the caregiver to help elderly dependents while carrying out responsibilities as an employee. In "Elder Care at Work" [HR Magazine, 53(9), pp. 111-118, September 2008, www.shrm.org/hrmagazine], Pamela Babcock discusses how some employers are helping employees with providing elder care. This employee benefit is also seen to be beneficial to the employer by reducing productivity losses, keeping employees' careers on track and bolstering loyalty and retention. Babcock provides examples of where such programs have been implemented and further sources of information.

Terrance Malkinson is a communications specialist, business analyst and futurist; for full biography, see page 19. Opinions expressed are the author's; he can be reached at malkinst@telus.net. The author is grateful to the professional support of the Haskayne School of Business Library at the University of Calgary.

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http://sysconf09.ieeesystemscouncil.org/

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6th IEEE Int'l Working Conference on Mining Software Repositories (MSR)
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http://www.msrconf.org

IEEE 31st International Conference on Software Engineering (ICSE)
2009-05-16...23, Vancouver, BC
http://www.cs.uoregon.edu/events/icse2009/

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http://www.eit-conference.org/eit2009

IEEE Toronto Int'l Conference - Science and Technology for Humanity (TIC-STH)
2009-09-27...29, Toronto, ON
http://www.toronto.ieee.ca/TIC2009

IEEE Symposium on Product Compliance Engineering (PSES)
2009-10-26...28, Toronto, ON
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22nd Canadian Conference on Electrical and Computer Engineering (CCECE - CCGEI)
2009-05-03-06, St. John's, NL
http://www.ccece09.org *(See Page 22)*

Communication Networks & Services Research (CNSR2009)
2009-05-11...13, Moncton, New Brunswick
http://www.cnsr.info/Events/CNSR2009/

11th Canadian Workshop on Information Theory (CWIT)
2009-05-13...15, Ottawa, ON
http://www.site.uottawa.ca/CWIT09/

IEEE Electrical Insulation Conference (EIC)
2009-05-31...06-04, Montréal, QC
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Dates importantes

Date limite d'inscription des auteurs, le :	Vendredi 6 mars 2009
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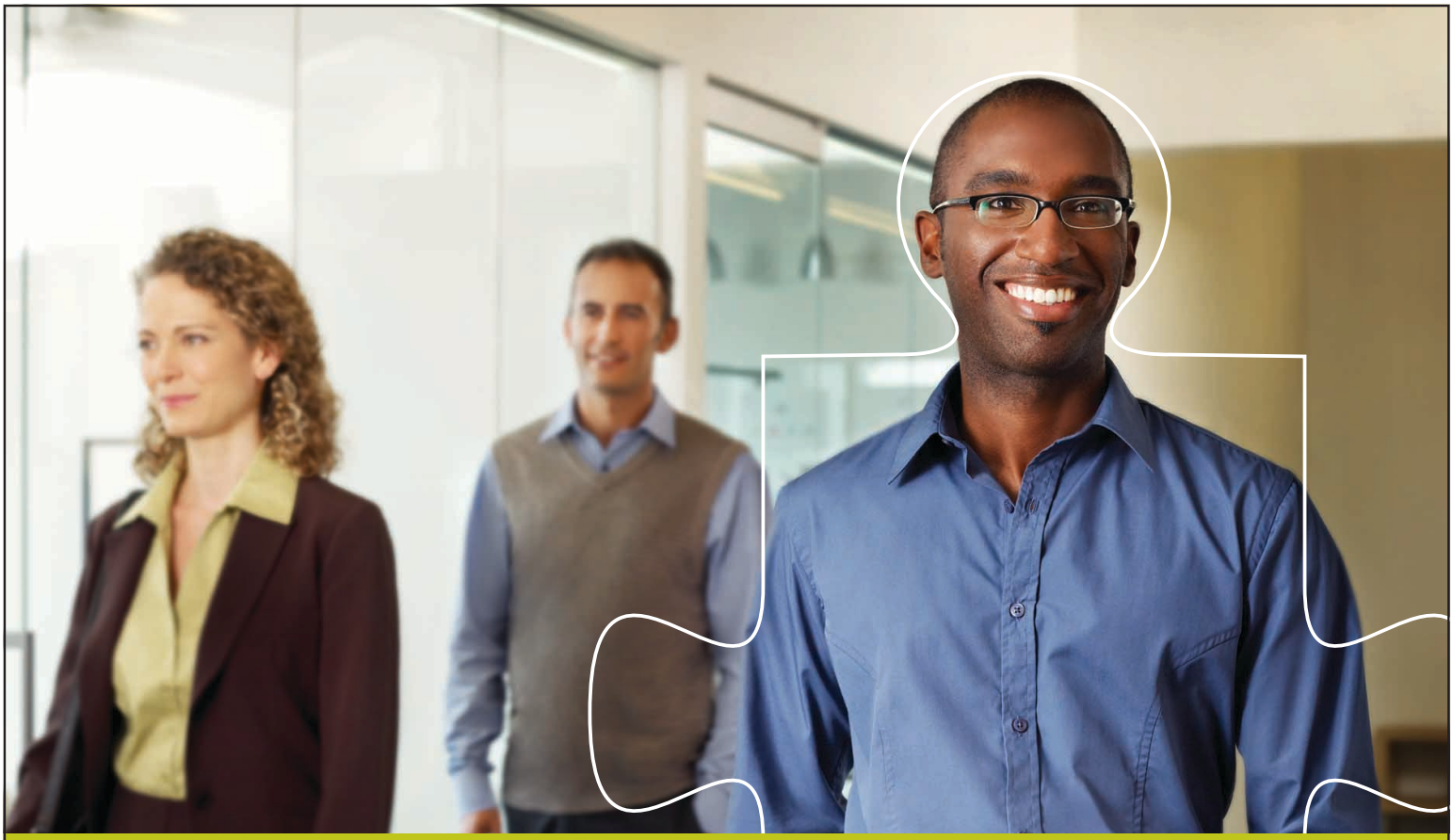

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