Winter / Hiver
2005

No. 49

http://www.ieee.ca

IEEE Canadian Review

La revue canadienne de l'IEEE

Canada Post—Canadian Publications Mail Sales Product Agreement # 40592512

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The ***IEEE Canadian Review*** is published 3 times/year as follows: Winter (to appear in April); Spring/Summer (to appear in August); Fall (to appear in December). Its principal objective is to project an image of the Canadian electrical, electronics, communications and computer engineering professions and their associated academic and business communities to:

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

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

1- National Affairs	4- Education	7- Computers
2- International Affairs	5- Power	8 - Electronics
3- Industry	6- Communications	

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Free of charge to all IEEE members in Canada. For IEEE members outside Canada: $20.00/year. Price for non-members: $35.00/year. Corporations and libraries: $37.50/year. Additional copies may be ordered at a cost of $7.50 each from the Managing Editor.

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"http://www.ieee.org.reg/7"

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

Quelques mots du rédacteur en chef

Vijay K. Sood, Hydro-Québec

Avec la venue de la nouvelle année, il est temps de réfléchir sur les événements passés et aussi de regarder vers l'avant. J'ai été à la tête de ce magazine en tant que rédacteur en chef depuis plus de neuf ans et deux ans précédemment comme rédacteur adjoint.

Ce fut une expérience extrêmement enrichissante pour moi. J'ai appris énormément sur la rédaction, l'éditique, les relations interpersonnelles et les heures de tombé à respecter. Produire un magazine tel quel la revue canadienne de l'IEEE n'est pas une mince affaire. Cela demande dévouement, engagement, des connaissances techniques, des qualités en rédaction, des habiletés pour le réseautage, de la patience et un sens de persuasion plus que j'avais cru. La Figure 1 illustre quelques-unes des tâches du rédacteur en chef. Il était très important d'avoir une méthode d'opération très organisée et un sens de l'humour quand les choses ne tournaient pas rond. Et il y a eut plusieurs journées comme ça. Maintenant, il est temps de passer à autre chose. Je transmets donc le flambeau à une nouvelle équipe. Cette édition est ma dernière. Je serai rédacteur à titre honorifique pour le prochain numéro CR50. Ce cinquantième numéro de la revue canadienne constitue un événement marquant. Il rendra hommage à tous ceux qui m'ont précédé et ont eu pour vision de démarrer ce magazine. Nous rendrons hommage aux contributions de ces pionniers.

La rédaction de la revue canadienne n'est pas l'affaire d'un seul homme. J'aimerais remercier plusieurs personnes et j'espère seulement que vous allez me pardonner si j'oublie qui que ce soit par manque de concentration (mieux connu sous le nom de maladie d'Alzheimer). Je remercie premièrement Paul Freedman, ancien rédacteur en chef de la revue canadienne, qui m'a confié cette tâche. Ensuite, Dave Kemp (ancien président de IEEE Canada) et Marc Hung (ancien directeur de recherche à l'IREQ, Hydro-Québec) qui m'a permis d'effectuer cette tâche eta octroyé un soutien en secrétariat en la personne d'Eileen Dornier (ancienne secrétaire du groupe de simulation de systèmes de puissance à l'IREQ) durant mes débuts en tant que rédacteur en chef.

Durant 9 ans, j'ai servi sous la gouverne des présidents de IEEE Canada: Dave Kemp, Linda Weaver, Celia Desmond, Mo El-Hawary et Bill Kennedy. Je les remercie tous pour m'avoir permis de publier ce magazine porte étendard de IEEE Canada. Ils m'ont donné tout le soutien nécessaire, le financement et m'ont permis d'accomplir pleinement le travail. Je remercie aussi les Publication Chairs avec qui j'ai eu le plaisir de travailler: Bruno Di Stefano et Om Malik.

Au cours des années, j'ai reçu le soutien de plusieurs bénévoles qui ont agi en tant que rédacteurs adjoints et auxiliaires. Ils ont apporté leur contribution dans la sélection des articles et ont attiré les auteurs possibles et les autres personnes qui ont contribué au magazine. Parmi eux (énumération sans ordre précis): Paul Freedman, Brunilde Sanso, Chela Vaidyanathan, Slawo Wesolkowski, Alexandre Abecassis, Isabelle Chabot, Shaowen Song, Terrance J. Malkinson, Samuel Pierre, Camille Alain Rabbath, Alain Zarka et Habib Hamam. Une brève mention pour remercier Cathie Lowell, administratrice de IEEE Canada, qui a mis à jour la liste des membres et a aidé à obtenir d'autres informations utiles. Aussi, merci à Marc Provencher pour son aide et assistance, entre

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Cover picture / *Photo de couverture*

The cover picture depicts the new thyristor-based valves used at Dorsey Converter Station in Manitoba, at the southern end of the HVDC Nelson River scheme. The previous mercury arc-based valves (shown in Figure 5 on page 25) were replaced as they were inefficient and manufacturers had stopped building and supporting them. Manitoba began use of HVDC lines in the early 1970s, first with connections to the Kettle Plant, and then in the mid 1970s with Long Spruce.

A few words from the Managing Editor

As another new year begins, it is time to reflect on past events and take stock of the future to come. I have been at the helm of this journal as Managing Editor for more than 9 years now and a couple of years as Associate Editor before that.

This has been a most enthralling experience for me as I learned a tremendous amount about editing, desktop publishing, interacting with people and delivering on-time and on-schedule. Producing a journal like the IEEE Canadian Review is not a trivial job, and requires dedication, commitment, technical knowledge, publication skills, networking, patience and arm-twisting skills far beyond I imagined. Figure 1 on the next page illustrates some of the duties of the Managing Editor. Above all else, it was most important to keep an organized method of operating and a sense of humour when things did not work. And there were many days like that. It is now time for me to move on and hand over this task to a new team. This is my pen-ultimate issue and I will serve as Honorary Editor for the next issue CR50; it will be the fiftieth issue of the CR and will mark a milestone. This issue will honour all those who preceded me and had the vision to launch this journal in the first place. We will pay homage to the contributions of some of those pioneers.

Publishing the CR is not a job that I performed alone. There are many people to thank, and I only hope that you will forgive me if I forget anyone for lack of concentration (normally known as a bout of Alzheimer's). I thank first Paul Freedman, former Managing Editor of the CR, who entrusted me with this task. Next in line are Dave Kemp (former President of IEEE Canada) and Marc Hung (formerly Director of Research at IREQ, Hydro-Quebec) who permitted me to take on this

Contents / *Sommaire*

Mission Accomplished? Maybe.

In 1996, when I first took over the helm of the CR, I undertook an overhaul of the journal focusing on four aspects. How well I fared is left upon the readers to judge. Below, I provide some comments and statistics on a post-mortem on my tenureship.

1.0 Improving the quality, content and profile of the journal

In 1996, it was a magazine with, on average, some 20-24 pages of printed content. The magazine was published on glossy paper, in 2-color format to reduce costs; occasionally, 4 pages in full 4-color format would be added where the graphics demanded better presentation. Since then, the number of articles has gone up by almost 50%, thanks to the use of a smaller font size and closer control of content presentation. The quality has been considerably improved, I hope. And the number of pages has increased from 24 to 32 pages. As in any catch-22 condition, an improved quality of production has resulted in more authors willing to submit articles which, in turn, improves the content. In turn, this provides better articles for our readers. A measure of success in this aspect is that I have not had a shortage of submitted articles, and I have not had to solicit articles. Advertising revenues progressed as well, as advertisors saw the value of reaching our highly educated membership.

2.0 Increasing the French content of the journal

In 1996 in general, the French content of the magazine was limitted to translation of the Abstracts of the technical articles, and the editorial column. Full articles in French were hardly ever presented. Today, a full article (two in issue CR48) is almost always included in the hardcopy version; furthermore, the English articles are translated and are available online - not always on-time, but the intent is there. We are limited in terms of funds and volunteers who are able to do this job. Today, we follow a policy of "**Publish in the language selected by the author**". However, space in the printed copy is often at a premium, and we must be cognizant of this fact that full translation of articles is prohibitively expensive.

3.0 Providing an on-line version of the journal in English and French (see www.ieee.ca)

In the late 1990's, the increasing presence of the Internet and its reducing costs made it feasible to consider an online version of the journal, along with other News letters etc. See www.ieee.ca/can-rev. The assistance of our webmaster, Bob Alden, in this venture is noteworthy.

4.0 Reducing production costs and improving the commercial viability of the journal

The total operating budget increased from some 60 K$ p.a. in 1996 to about 75 K$ p.a. in 2004. These increased costs resulted from:

- Increased number of printed pages per issue from 24 to 32 i.e. a 33% increase,
- Augmenting from 2-color to full 4-color production, and
- Increased mailing costs (due to increased Canada Post charges and a 33% increase in posted weight).

In reality, due to improved advertising revenues, these costs were reduced by about 10 K$ p.a. on average. So a very tight handle on costs was maintained over the 9 years, and a high value-for-money production criteria was achieved.

In closing, of the 50 issues of the CR over its lifespan, I will have edited exactly 25 issues i.e 50% of the issues. On my retirement, I will have been the longest serving Managing Editor of the CR. It was a task that was very meaningful to me and **I thoroughly enjoyed the experience .... in its entirety**. I can only hope that you, our members/readers, gained something from this effort. Till the next time when I get the opportunity to serve you, I wish you all Au revoir.

Vijay K. Sood

task and provided secretarial support in the form of Eileen Dornier (former Secretary of the Power System Simulation Group at IREQ) in my early years as Managing Editor.

Over the 9 years, I served the following 5 Presidents of IEEE Canada: Dave Kemp, Linda Weaver, Celia Desmond, Mo El-Hawary and Bill Kennedy. I thank them all for allowing me to continue in this task of publishing this the flagship magazine of IEEE Canada. They provided all the necessary support, funding and allowed me to get on with the job at hand. I thank also some of the Publication Chairs with whom I had the pleasure to work with, namely Bruno Di Stefano and Om Malik.

Over the years, I have had the voluntary support of many Associate and Assistant Editors who provided the article leads and sought out potential authors and other contributors to the journal. Amongst them are (in no particular order) Paul Freedman, Brunilde Sanso, Chela Vaidyanathan, Slawo Wesolkowski, Alexandre Abecassis, Isabelle Chabot, Shaowen Song, Terrance J. Malkinson, Samuel Pierre, Camille-Alain Rabbath, Alain Zarka, and Habib Hamam. A short note to thank Cathie Lowell, administrator of IEEE Canada, who helped in providing the updated rosters, membership lists and other information. Also, to Marc Provencher for aiding and assisting, and his contributions towards the French translation of articles. Thanks to Bob Alden for setting up the CR website and doing such a great job with it. And thanks to Bruce Van Lane and his team for their support with the publication side.

Finally, a huge Thank You to **Vina** for spending long hours on doing the desktop publishing, typing and re-typing, proofing, mailing and generally organizing of the CR. It certainly would not have been possible without her support and skills. Also, for putting up with me during those long hours when I was away from home and neglecting my other duties. **She was the backbone of this whole endeavor.**

It has been a privilege and an honour for me to serve as the Managing Editor of this prestigious magazine. I thank all the readers and IEEE Canada members who emailed or wrote to me with messages of encouragement and suggestions for improvement.

To the new Editors of the CR (see their profiles on page 14 in this issue), I wish them luck and success on undertaking this endeavor. To all you readers/members, I wish you a very Happy New Year.

Vijay K. Sood

Managing Editor of the IEEE Canadian Review

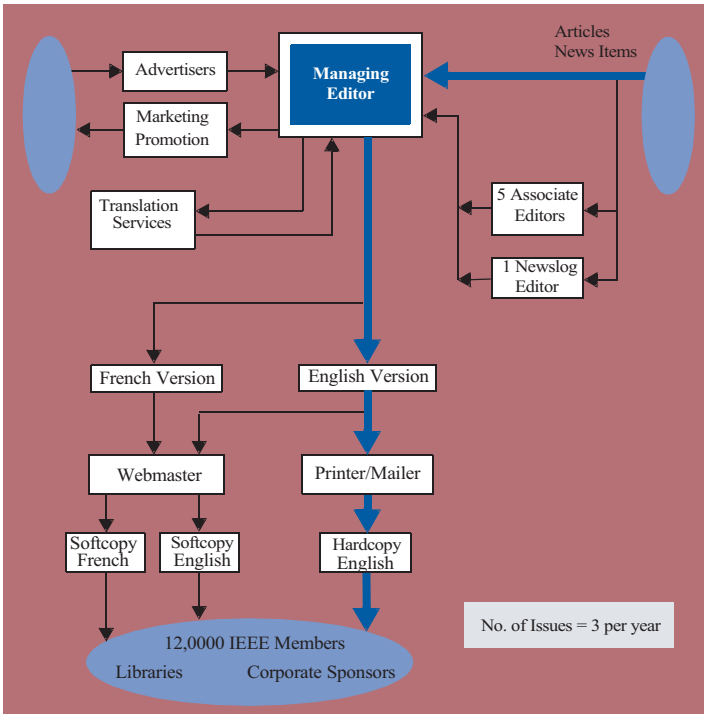


Figure 1: This flow chart depicts the role of the Managing Editor of the IEEE Canadian Review.

Canadian Newslog / Coupures de presse Canadienne

Newslog Editor

Rédacteur des Coupures de presse

Alexandre Abecassis is a patent agent trainee in Montreal at Ogilvy Renault, Lawyers and Patent and Trade-mark Agents.

Alexandre Abecassis travaille à Montréal chez Ogilvy Renault, Avocats et agents de brevets et de marques de commerce, comme agent de brevets en formation.

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

LONGUEUIL, QC, Dec. 7, 2004. D-Box Technology has won the Home Theater category Innovation Award offered by the US Consumer Electronic Association as part of their CES Innovation Award 2005 for a new motion simulator seating. The motion simulator seating provides movements which are synchronized to image and sound. The distinction is conferred on products that stand apart through the originality of their design and their innovative technology.

TORONTO, ON, Dec. 1, 2004. An order valued at more than 150k$has been received by Cometix Inc, a provider of biometric identification and authentication solutions for its Civil Applicant Processing System. The system is used to fingerprint potential employees of an investment bank in order to run criminal history and periodic status check. The system will facilitate electronic data submission to the FBI automatic fingerprint identification system via channeling agents.

MONTREAL, QC, Oct. 20, 2004. Mediagrif Interactive Technologies Inc. has been ranked among 500 North American companies on the Deloitte Technology Fast 500. The award is based on percentage revenue growth over a five-year period. Winners of this award are from all technology industry segments including software, hardware, Internet, communications, wireless and life science. Mediagrif is an operator of e-business networks and provider of complete e-business solutions.

MONTREAL, QC, Sep. 29, 2004. Nexxlink Technologies which is a provider of integrated information technology solutions announces the launch of an ASP ("Application Service Provider") offering at the Municipal Affairs show of the Quebec Federation of Municipalities being held this week in Quebec. The offering will enable cities to access various municipal market solutions.

OTTAWA, ON, Sep. 21, 2004. Spotwave Wireless took top prize for the Most Innovative In-Building Wireless Solution category at the annual Excellence in Business Awards. The company has provided a solution to enhance the wireless coverage of an hospital so that staff and patients had access to the latest mobile technology. Mobile access to important patient information can be performed from virtually anywhere within the hospital using the solution.

CALGARY, AB, Aug, 2004. PsiNaptic Inc. has entered into an agreement to license one part of its technology to Modius Inc. The technology licensed comprises a discovery protocol that enables very small embedded processors to offer java-based services. Such technology therefore enables devices to spontaneously offer or consume services on a network. The java-based services can be anything from a simple driver to a full-blown application with a graphical user interface.

QUEBEC CITY, QC, Dec 3, 2004. Lyrtech Inc. has announced that Dolby Laboratories is referring pro-audio developers to Lyrtech who created the reference design for Dolby's new Dolby(R) Digital Professional Encoder Technology. The platform offers up to three times the channel density of existing fixed solutions for equipment for the creation of professional digital audio for DVDs, HDTV broadcasts and cable/satellite transmissions.

TORONTO, ON, Nov. 30, 2004. Mint Inc. announced today that the Toronto Parking Authority launched its new corporate parking card on its parking locations throughout the Greater Toronto Area. The card is used instead of cash or credit card and therefore offers flexibility and cost management.

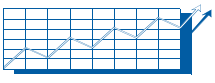
TORONTO, ON, Nov. 8, 2004. Workbrain Corporation announced that its founder has received Ernst & Young's special citation for Technology Innovation. The company develops and deploys software solutions that optimize workforce processes such as employee scheduling, time and attendance and business intelligence.

MONTREAL, QC, Oct. 29, 2004. Nstein Technology has announced the sale of its solutions to a leading player in the printing industry. The US based company has purchased a translation platform from Nstein. Nstein provides large organizations with global intelligent information management platform for structured and unstructured multilingual data sources. The platform assimilates, organizes, analyzes, translates, shares and disseminates information essential to operational and decision-making processes.

VANCOUVER, BC, Sep. 14, 2004. Ngrain and Quantapoint Inc. have announced a multi-year licensing and OEM agreement that will enable Quantapoint to use Ngrain's patented interactive 3D technology to build advanced visualization capabilities into Quantapoint data management and design solution. The agreement provides Ngrain with recurring licensing revenues and ongoing royalty income from sales generated by Quantapoint services that use the Ngrain functionality.

TORONTO, ON, Dec. 9, 2004. Bioscrypt Inc., a provider of identity verification technology, has announced that its biometric access control fingerprint readers are being deployed at Dubai international airport in order to strengthen physical access control.

BURLINGTOM, ON, Nov. 1, 2004. Gennum Corporation has announced that its wholly owned subsidiary, Gennum Japan Kabushiki Kaisha was selected by the Canadian Chamber of Commerce in Japan as the recipient of the Entrepreneurship/SME. Gennum has played a role in the evolution of high-definition television in Japan by developing transport and image processing products that enable routing, transfer and display of high-definition video with the broadcast studio and post-production houses.



La corrélation optique, un outil de décision

par *Ayman AlFalou,*
Institut Supérieur d'Electronique de Bretagne,
Brest Cedex, France

Abstract

Indisputably, pattern recognition is an expanding field due to the incessant need for recognizing forms (fingerprints, eyes, machine elements, …). Correlation presents a very powerful tool of decision mainly due to its global behavior and to its robustness to noise. The present article gives an overview on the method of correlation which turns out to be appropriate to the optical approach. While covering the various techniques of optical correlations, the article will distinguish between mono- and multi-decision approaches.

Sommaire

La reconnaissance des formes est incontestablement un domaine en expansion du fait que le besoin de reconnaître des formes (empreintes digitales, yeux, pièces mécaniques…) est incessant. La corrélation présente un outil de décision très puissant principalement du fait de son caractère global et de sa robustesse au bruit. Cet article donne un aperçu sur la méthode de corrélation qui s'avère appropriée à l'approche optique. En passant à travers les différentes techniques de corrélations optiques, l'article distinguera entre les approches monodécision (prise par simple détection d'une corrélation) et multidécision (la réalisation en parallèle de plusieurs corrélations).

1.0 Introduction

A l'origine de ce domaine, on trouve un certain nombre de travaux en traitement du signal (*signal unidimensionnel*) centrés essentiellement sur la détection et dont les applications (radar, sonar, …) remontent aux années quarante. En particulier, la reconnaissance des formes connaît depuis quelques décennies un regain d'intérêt, tant dans ses aspects fondamentaux qu'appliqués. Cela est dû au moins à trois causes. Premièrement, le champ d'application de la reconnaissance est en croissance constante étant donné les nouveaux besoins qui se manifestent continuellement. On peut citer des domaines tels que la robotique, la sécurité bancaire, la sécurité routière, la vision artificielle, la détection de défauts, le suivi du regard (eye tracking), la métrologie, l'astronomie, … À titre d'exemple, en reconnaissant les positions de la pupille de l'œil, on peut traiter l'information telle qu'une personne à mobilité réduite puisse contrôler son ordinateur et par exemple naviguer sur Internet. Deuxièmement, les progrès en mathématiques appliquées et en informatique et surtout en ce qui concerne l'algorithmique ont ouvert les perspectives de la reconnaissance des formes. Troisièmement bien entendu, les progrès technologiques au niveau des capteurs (caméra CCD, ...) et surtout au niveau des calculateurs numériques de plus en plus puissants ont contribué au progrès de la reconnaissance des formes.

On distingue deux familles d'approches pour la reconnaissance des formes : (1) Les approches par segmentation et (2) les approches globales. Pour la première famille, un certain nombre de caractéristiques propres à l'objet sont extraites et la classification se fait à partir de ces données. À cette famille appartiennent surtout les méthodes numériques. Les approches de la deuxième famille utilisent plutôt la comparaison à un ensemble de références. L'objet brut vu par le capteur d'entrée du système de reconnaissance est comparé à une bibliothèque d'images de référence. Aucune information n'est extraite de l'image et c'est sur la globalité de forme que se fonde la décision. La corrélation est une technique très efficace de la famille des approches globales. Elle a l'avantage d'offrir une grande robustesse au bruit.

2.0 L'optique, pourquoi?

L'outil puissant qu'est la corrélation est particulièrement approprié à l'optique essentiellement du fait que la transformée de Fourier, le noyau de la corrélation, est naturelle en optique. De plus, la nature bidimensionnelle de l'image se prête bien au traitement optique. En effet, le traitement parallèle de l'information contenue dans une image par des faisceaux lasers est un des atouts de l'optique cohérente. Outre les progrès inhérents aux qualités des lasers (faisceaux quasi-parallèles, haute puissance, cohérence et monochromatisme), le traitement de l'information par voie optique a fait des progrès énormes surtout grâce à l'introduction des interfaces opto-électroniques à base de cristal liquide (Spatial Light Modulator : SLM) et des matrices CCD.

3.0 La corrélation en signal un outil de décision

La corrélation, une technique de reconnaissance de formes, est bien appropriée aux signaux bidimensionnels et notamment aux images [1]. Comme précisé ci-haut, en plus de l'avantage de la robustesse par rapport au bruit, elle offre la possibilité de traiter l'image dans sa globalité [2]. Son principe est très simple (Figure 1-a) et consiste à comparer l'objet à reconnaître (***La cible***), en général figurant dans une scène limitée en espace, et des objets prédéterminés (***Les références : r_i*).**

Pour réaliser cette comparaison, le spectre de la cible (S), obtenu après un passage du domaine spatial à celui des fréquences par une Transformée de Fourier, est multiplié par le complexe conjugué du spectre de la référence, que nous notons $\boldsymbol{h = R^*}$. Ainsi, une deuxième Transformée de Fourier fournit le produit de corrélation (***le plan de Corrélation :* cible/référence**).

Chacune de ces comparaisons conduit à une décision binaire, et la comparaison à toute une banque de références permet de réaliser une classification de la cible parmi ces références. Il s'agit donc d'une simple opération de filtrage, désignée en littérature par filtrage adapté. Cela étant dit, les performances de la corrélation sont limitées pour les raisons suivantes :

- En raison du caractère global du traitement, la corrélation est très sensible aux effets (rotation, variation d'échelle, bruits intenses,…) des cibles par rapport aux références. Cette insuffisance a fait l'objet de travaux intensifs qui ont débouché sur plusieurs sortes de filtres pour assurer l'invariance par rotation ou par facteur d'échelle, etc.[3],
- Le processus de décision utilisé dans un corrélateur, la présence ou non d'un pic de corrélation localisé en un seul pixel, conduisent à l'utilisation d'une très faible partie du produit espace-bande passante dans le plan de sortie. Il en résulte une faible fiabilité (robustesse, pouvoir de discrimination). Cette structure de décision fondée sur une seule corrélation Figure 1 : est appelée **monocorrélation**.

4.0 Les corrélateurs optiques monovoies

Comme nous venons de le voir, l'objectif du processus de reconnaissance est d'identifier un objet (cible) en le comparant avec d'autres objets (références). Cela suppose que l'on dispose d'une base d'apprentissage (base des références) constituée des modèles représentatifs de cet objet (cible). Pour mieux illustrer ce processus nous avons choisi l'exemple de la reconnaissance de caractères d'imprimerie en utilisant la méthode de reconnaissance dite : « Vander-Lugt ». Toutes les méthodes développées ont été testées dans un premiers temps sur ce type d'application (caractères). Or ces images ont à peu près les mêmes énergies et leur comportement vis–à-vis de la corrélation est bien connu. Nous avons ensuite étendu le méthode à d'autres types d'applications et à d'autres types d'images, en particulier celles des visages afin d'évaluer les performances de notre processus de reconnaissance.

Le montage classique d'un corrélateur Vander Lugt [4] est donné par la Figure 1-b. La scène (S) (le mot « IEEE » écrit en Times New Roman), placée dans le plan d'entrée, est éclairée par une onde plane monochro-

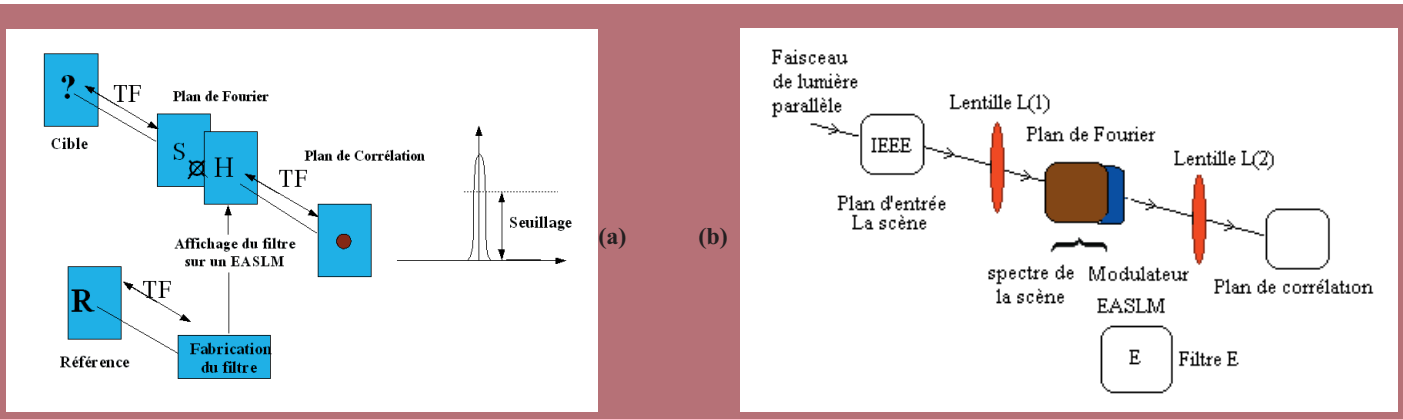


Figure 1: a) Schéma synoptique de l'algorithme de monocorrélation en signal, b) Schéma principe du corrélateur Vander Lugt (ou BPOF).

matique. Une lentille convergente implémente optiquement la transformée de Fourier (TF) de cette scène « S » et fournit le spectre dans son plan focal image (plan de Fourier ou plan du spectre). Dans ce plan, on place un filtre «H» appartenant à la base d'apprentissage choisie et calculée en fonction du traitement désiré. Donc la première étape de fabrication de ce filtre de corrélation consiste en construction d'une base d'apprentissage adéquate à notre application. Dans notre cas de reconnaissance des caractères d'imprimerie nous avons choisi une base constituée de deux classes de lettres, à savoir la classe (I) et la classe (E). Chacune de ces deux classes contient plusieurs représentations de police de chacune de ces deux lettres, afin de pouvoir reconnaître la lettre quelle que soit sa police.

Enfin une deuxième lentille effectue une seconde TF dans le plan de sortie (plan de corrélation). En effet, ce type de corrélateur consiste à agir sur le spectre de l'objet, donc sur le plan de Fourier, de façon à modifier la répartition spectrale de l'amplitude lumineuse. Le résultat est observé dans le plan de sortie ou plan de corrélation (Figure 2). Ce plan montre bien la présence de trois pics avec l'introduction du filtre « E » dans le montage via un modulateur EASLM. Ce qui est dû à la corrélation entre les trois lettres « E » existantes dans la scène d'entrée (le mot :IEEE) et le filtre « E » placé dans le plan de Fourrier. Toutefois, nous observons un faux pic non négligeable. Il s'agit du pic correspondant à la lettre "I". L'apparition d'un tel pic peut être expliqué par le fait que les lettres "I" et "E" ont des segments et des parties de segments en commun et notamment le segment vertical qui est dominant de point de vue énergétique.

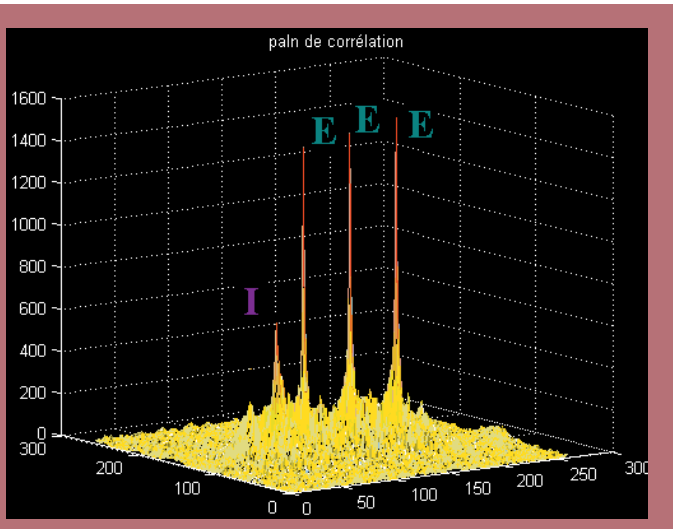


Figure 2: Plan de corrélation (réponse d'une corrélation du mot IEEE avec le filtre " E ")

Cependant, plusieurs travaux [5,6] ont montré que la phase de la transformée de Fourier contient la majeure partie de l'information. De plus, cette méthode conduit à un rendement optique optimal car un tel élément n'est pas absorbant. Ces raisons nous ont amenés à adopter le filtre de phase dans nos travaux. Un tel corrélateur utilisant ce type de filtre de phase pure est appelé corrélateur « POF » (Phase Only Filtre). Le filtre POF peut être ensuite binarisé suivant différents codages [6] pour obtenir le filtre binaire de phase pure BPOF (selon que sa partie réelle est positive ou négative). Ce filtre binaire de phase s'est imposé en corrélation optique pour plusieurs raisons, dont:

- Tout comme les POFs, il présente un bon rendement optique [5]. Ce qui le rend attractif lors de la réalisation pratique de systèmes optiques de corrélation (permet de réduire la puissance des sources utilisées) surtout pour le compositage (c.à.d combinaison de transmittances),
- L'existence des modulateurs spatiaux binaires fonctionnant en phase,
- Les données sont binaires d'où la réduction du volume de la base des données.

5.0 Processus de décision et multicorrélation

Pour améliorer la fiabilité de la décision lors d'une reconnaissance d'une forme complexe (décision prise sur un seul point dans le plan de sortie : **monocorrélation**), nous proposons de faire de la **multicorrélation** [7]. En effet, cette alternative consister à prendre en considération une part plus importante du plan de corrélation au prix d'un alourdissement algorithmique [7] pour couvrir toutes les situations possibles et limiter les ambiguïtés (bon pouvoir discriminant). Ainsi, on décide au vu de plusieurs corrélations, réalisées à l'aide de plusieurs références. En d'autres termes, il est utile de s'intéresser à des structures de décision fondées sur l'utilisation de plusieurs corrélations pour palier les insuffisances précédemment citées. D'un point de vue pratique, la prise en compte de plusieurs références peut s'envisager simplement, et dans un premier cas, en multiplexant temporellement ces références (Figure 3-a). Cette solution consiste à considérer successivement, plusieurs corrélations (au nombre des références) utilisées en un seul point pour prendre la décision. Ceci est évidement au prix d'un temps de calcul important.

Une autre solution consiste à multiplexer spatiale- ment ces références [3] en combinant leurs filtres respectifs tel que le montre la Figure 3-b. La solution, qui a été choisie dans nos travaux, consiste à réaliser simultanément et indépendamment un certain nombre de corrélations puis à prendre une décision au vu de cet ensemble de résultats : ***c'est l'approche de la multicorrélation*** [3].

6.0 La multicorrélation au moyen d'une approche monovoie

Dans cette approche, nous proposons de revenir à l'architecture la plus simple, la monovoie (Figure 4-a), et de transférer toute l'intelligence de la reconnaissance dans la détermination de la base de filtres utilisés. Le filtre que nous cherchons à construire est donc un filtre permettant de

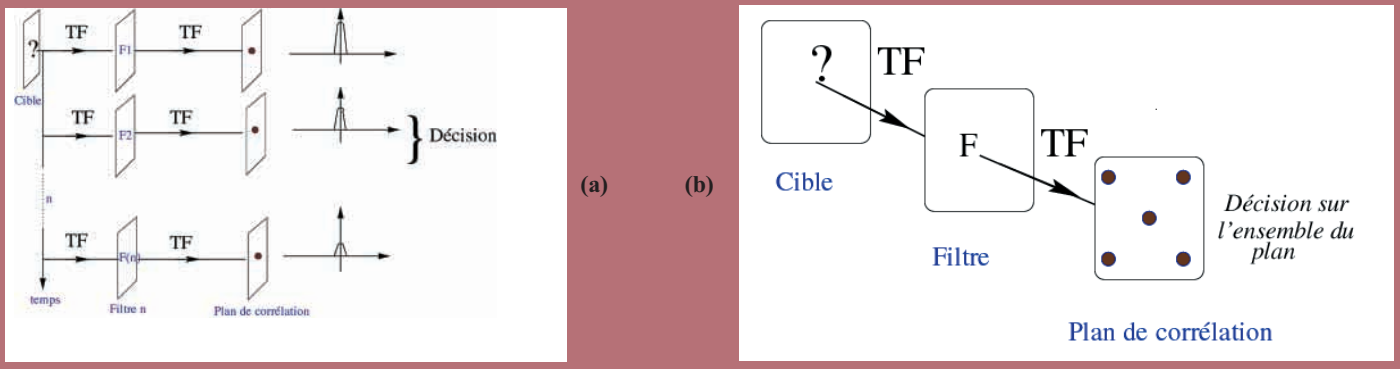


Figure 3: a) Multiplexage temporel, b) Multiplexage spatial

reconnaître un ou plusieurs objets dans une scène. Afin de construire un tel filtre nous avons adopté dans l'un de nos travaux une démarche qui est celle des filtres composites [3] pour la multicorrélation. Dans l'approche filtre composite chaque point du plan de Fourier participe à la corrélation d'une classe donnée à concurrence de l'intensité de son spectre en ce point. Ceci est évidemment gênant si plusieurs classes différentes sollicitent un même point. La démarche proposée dans cet article consiste à attribuer à chacun des points du plan de Fourier (Figure 4-b), une classe gagnante (segmentation spectrale) ce qui permet éventuellement de neutraliser les zones de forte ambiguïté. Cette segmentation doit viser à neutraliser les zones de forte ambiguïté, la diaphonie (chevauchement de références qui induit à des fausses décisions), introduite par la superposition des spectres des différentes classes, sans toutefois trop affaiblir la représentation d'une classe (conserver pour une classe un pic suffisant). Il y a un compromis à obtenir entre les deux cas suivants : premièrement tout affecter à une classe pour obtenir le meilleur pic, deuxièmement supprimer toute zone d'ambiguïté de façon à supprimer toute diaphonie.

Pour une segmentation optimale, il convient de choisir un bon critère de segmentation conduisant à des corrélations optimales. Après avoir testé plusieurs critères, le critère qui nous a semblé le mieux adapté à notre étude est un critère d'énergie. Physiquement, ce critère compare, pour chaque pixel, l'énergie d'une classe donnée à l'énergie totale de cette classe sur tout le plan de Fourier avec celle des autres classes. La décision d'affecter ce pixel à une classe ou à une autre, est prise sur l'ensemble de ces comparaisons, en affectant ce pixel à la classe gagnante.

7.0 Erreur de reconnaissance du filtre composite segmenté de phase vis-à-vis de l'invariance par rotation

D'un point de vue pratique, le filtre de phase demeure un filtre à fort pourvoir de discrimination mais à une faible robustesse [3,5,6]. Pour constater cette faible robustesse, nous allons prendre un visage au quel nous allons appliquer une rotation comprise entre 0° et 90°, par pas de 10°. Cette base de rotation est alors comparée par corrélation au filtre composite fabriqué à partir deux positions pour le visage initial : aucune rotation (0°) et une rotation de (90°). La Figure 5-a confirme la faible robustesse de notre filtre de phase à la rotation. En effet, le PCE est divisé par un rapport de quatre. Pour palier cette insuffisance nous allons rajouter une référence qui est un visage mais tourné de 45°. Les résultats obtenus, en reprenant les mêmes conditions qu'auparavant, sont présentés (Figure 5-b). Ces résultats montrent la possibilité d'améliorer la robustesse du filtre de phase en utilisant une base d'apprentissage constituée de trois références dans chaque classe (une à 0°, la deuxième à 45° et enfin une troisième à 90°).

8.0 Effet de la binarisation sur le filtre composite segmenté de phase pure

Pour des raisons technologiques, mais aussi pour économiser de la mémoire et diminuer le temps de transfert de l'information entre le filtre et la base des filtres, il est intéressant d'étudier l'impact de la binarisation du filtre composite sur ses différentes réponses dans le plan de corrélation. En effet les modulateurs spatiaux de lumière (SLMs) rapides (3 kHz et plus) permettant l'implantation optique de ces filtres dans un corrélateur. Les filtres rapides actuellement commercialisés sont encore binaires (de phase ou d'amplitude à cristaux liquide ferroélectrique).

On substitue au filtre précédemment calculé, des filtres binaires de phase pure segmenté (SBPOF) obtenus en donnant à ces filtres la valeur ± 1 suivant que la partie réelle des filtres calculés est positive ou négative.

Afin d'évaluer la détérioration introduite par cette opération de binarisation sur les performances de notre filtre segmenté, nous allons observer le comportement de ce filtre vis-à-vis du nombre de corrélations réalisées, dans les deux cas : binaire et non binaire. Les résultats obtenus sont présentés sur la Figure 6. Cette comparaison montre très clairement la détérioration du niveau de discrimination obtenue avec le filtre com-

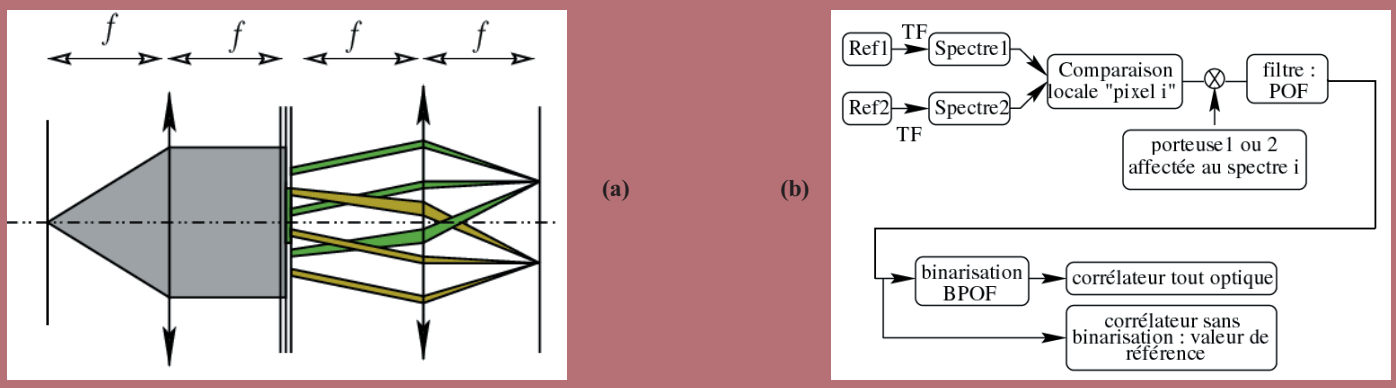
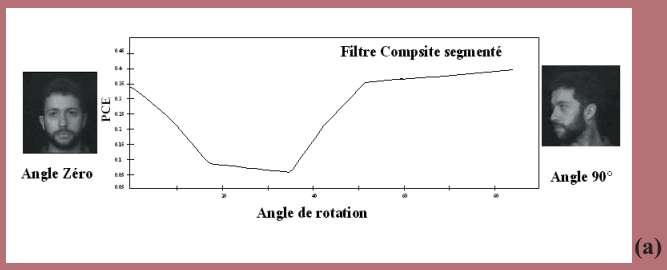


Figure 4: a) Schéma de base d'un corrélateur monovoie utilisant un filtre composite segmenté pour la multicorrélation, (b) schéma synoptique d'un corrélateur utilisant un filtre composite segmenté pour la multicorrélation



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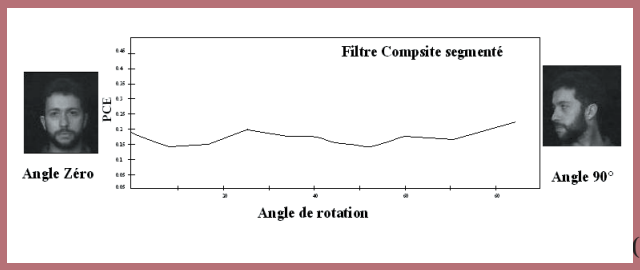


(b)

Figure 5: Robustesse du filtre composite segmenté à l'invariance par rotation: (a) Réponses obtenues avec un filtre segmenté à deux références 0° et 90°. (b) Réponses obtenues avec un filtre segmenté à trois références 0°, 45° et 90°

posite segmenté binarisé. Cependant pour maintenir les bonnes performances de notre corrélateur, nous devons lutter contre ces types de pertes d'informations et essayer de corriger ces erreurs en les diffusant sur l'ensemble du spectre de chaque référence avec la technique de diffusion d'erreur [8].

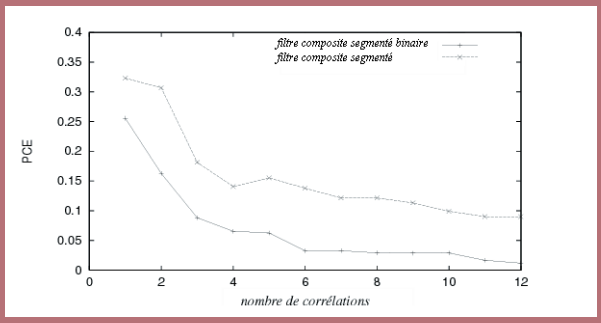


Figure 6: Comparaison entre le filtre composite segmenté et le filtre composite segmenté binarisé

9.0 Méthode de diffusion d'erreur

Le principe de la méthode de diffusion d'erreur (Figure 7-a) consiste à diffuser l'erreur commise lors de la binarisation d'un pixel sur le ou les pixels voisins. En effet la binarisation se fait de la manière suivante : après la comparaison de la valeur du pixel choisi *f(i)* à un seuil *T* (seuil de binarisation), si *f(i)<T* nous codons cette valeur par *zéro : h(i)=0,* dans le cas contraire si *f(i)>T* nous attribuons à sa valeur une unité : *h(i)=1*. Dans les deux cas de figure nous commettons une erreur égale à *S(i)=f(i)-h(i)*. Cependant pour conserver l'énergie dans le plan de filtrage, l'énergie perdue ou ajoutée (erreur commise) lors de la binarisation d'un pixel est rajoutée ou retranchée des autres pixels avec des portions (poids) propres à chacun de ces pixels (Figure 7-b).

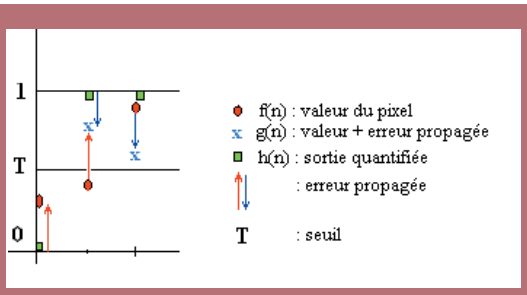
Pour sélectionner les pixels et leurs poids qui seront utilisés pour diffuser cette erreur, plusieurs techniques ont été proposées [8]. De notre côté, nous avons proposé une nouvelle méthode de génération de la matrice des poids. Au lieu d'utiliser une matrice de coefficients connus, nous proposons de générer notre propre matrice en posant la contrainte suivante : **Les erreurs commises lors de la binarisation du filtre (dans le domaine de Fourier) ne doivent pas affecter le pic de corrélation et ainsi leurs effets doivent être placés ou répartis à l'extérieur de l'entourage du pic de corrélation.** Pour se faire nous imposons une zone sans bruit autour du pic de corrélation tel que montré dans la Figure 7-c. Pour mettre en évidence le bon comportement de notre méthode d'optimisation, nous l'avons comparé avec la méthode classique de binarisation. Le tableau 1 présente en première ligne le rapport signal sur bruit (*S/B)* obtenu en utilisant la binarisation classique. Les résultats obtenus par la nouvelle méthode de binarisation sont reportés par la dixième ligne. Cette comparaison montre clairement l'amélioration significative de rapport *S/B* ce qui augmentera la fiabilité de décision de la multicorrélation avec une approche monovoie.

Tableau 1: Résultats de la corrélation en utilisant un filtre composite segmenté

	Amplitude du pic de corrélation	S/B
Méthode de binarisation classique	307.401	0.433
Nouvelle Méthode de binarisation	301.70	2.581

10.0 Conclusion

Nous avons fait un tour d'horizon de la reconnaissance de forme en focalisant sur la corrélation. Cette dernière s'avère bien adaptée à l'approche optique offrant ainsi le parallélisme du traitement de l'information. Étant donnée que la corrélation est un outil de reconnaissance à caractère global, la tâche essentielle dans la mise en oeuvre du corréla-



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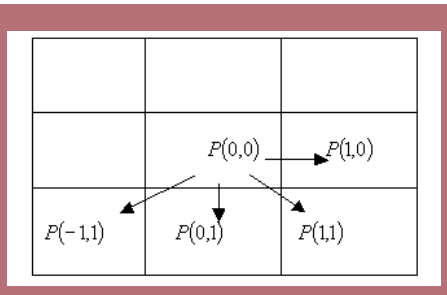

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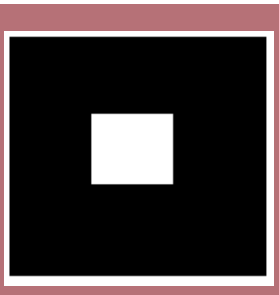

(c)

Figure 7: (a) Méthode de diffusion d'erreur en une dimension, (b) Méthode de diffusion d'erreur en deux dimensions, (c) fenêtre d'optimisation.

teur est la conception du filtre approprié. Les filtres binaires ont montré des avantages incontestables tant au niveau technologique qu'au niveau performance. Cependant, la neutralisation ou du moins la minimisation des effets cumulatifs de la binarisation des pixels du filtre sur la qualité du plan de corrélation demeure souhaitable. C'est dans cet objectif que la méthode de diffusion d'erreur a été élaborée.

Finalement, les performances de la corrélation comme outil de décision ont été améliorées par l'utilisation de l'approche multivoies. En effet, dans cette logique multivoies, nous utilisons l'ensemble du plan de sortie pour prendre une décision, et nous avons augmenté le nombre de corrélations effectuées par seconde.

11.0 Remerciements

Le Groupe optique de traitement du signal et de l'image « GOSI » de l'ISEN-Brest remercie le laboratoire d'optique et d'électromagnétisme de l'université de Moncton- Faculté d'ingénierie, en particulier son responsable le Prof. Hamam Habib, pour leurs conseils techniques et la mise à disposition d'un stagiaire, ce qui non seulement a été une aide pour la réalisation de ce travail, mais également permet d'amorcer une collaboration dans le domaine du Traitement optique d'information entre nos deux établissements.

12.0 Références

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Ayman AlFalou a obtenu un B.Ing. en électronique, électrotechnique et auto-matique à l'université Al-Fanar - Liban en 1994. Il a obtenu une M.Sc. en traitement de l'information de l'Université de Bretagne Occidentale, France 1995, et un Ph.D en traitement du signal et télécommunications de l'Université de Rennes I conjointement avec l'École Nationale Supérieure de Bretagne, France 1999. Actuellement, il occupe le poste de maître de conférence et responsable du laboratoire GOSI à l'Institut Supérieur d'Électronique et du Numérique – Brest, France. Dans ses recherches scientifiques, il s'intéresse au traitement optique du signal et de l'image, aux télécommunications optiques, aux problèmes d'optimisation et aux systèmes opto-électroniques.

IEEE Canada

Carleton University Student and IEEE Volunteer Wins Prestigious Award

Maimuna (Mona) Chawla is an IEEE student volunteer who was awarded a $4,000 Excellence scholarship from the Canadian Millennium Scholarship Foundation. This 22 year-old scholar is a student at Carleton University.

The Canadian Millennium scholarship foundation was established in 1998 with an endowment of $2.5 billion to help Canadian students pursue their post-secondary goals. The Excellence awards are a part of this foundation's regular endowments, given out as in-course scholarships, specifically created for students who have not received other major awards and have demonstrated qualities that inspire others, on their campuses and in their communities. This is the second year the Excellence awards have been given out.

Just one of 15 Carleton students who were hand picked across Canada for the Excellence award, Chawla has been an executive member of the IEEE student branch for the past two years. This year, she acts as the Vice-Chairperson. "I am sure my involvement in the IEEE helped me win the scholarship," she says.

The IEEE club at Carleton is very active in student life and has 300 members, making it the second largest student chapter in all of Canada. They provide student services like computing and printing. They also take their club members to industrial site visits. The club is currently working with Microsoft's web design competition and have held pop and pizza nights for students to meet with Microsoft representatives and gain more information on the competition. Members of the club used the opportunity to give out their résumé's. In January, the IEEE club will host the Student Professional Awareness Conference The theme of this year's conference is Career Choices. At the event, students will meet people who already have jobs in the industry and use it as an opportunity to do more networking. Chawla has been very active in promoting these events. She also organized a design competition, where students improved on a classroom project, to be judged by professors. As well, she helped organize the 4th year info session, that is a job-fair, which over 200 students attended.

"I have developed a great sense of accomplishment during my time at Carleton," she says. One of her accomplishments has been to maintain her entrance scholarship valued at $8,000 with an A average all through her career in Carleton's Engineering Faculty, the fifth largest of its kind in the country.

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An optical-telecommunications-based technique to disrupt stroke using the artery as an acoustic Biological fiber

by Zoubeir Hajri[1], Habib Hamam[2], Mounir Boukadoum[3] and Réjean Fontaine[1]

[1] Université de Sherbrooke, QC

[2] Université de Moncton, NB

[3] UQAM, QC

1.0 Introduction

Thrombosis is the presence of a coagulated blood clot inside a blood vessel causing a deceleration of the blood flow (Figure 1). When the clot is located in the brain, it may cause a stroke, also called a brain attack (Figure 2). It is well known that this cardiovascular disease represents an important cause of death in the world. The main treatment of stroke is medicines and drug therapy which will thin the blood and make it flow more easily. Furthermore, surgery can be employed to treat acute stroke or to repair vascular damage in the brain [1]. Meanwhile, therapeutic methods based on the application of ultrasound waves have also been used to disrupt strokes in vivo and in vitro. However, there is currently an additional interest in this problem due to progress in bioacoustics.

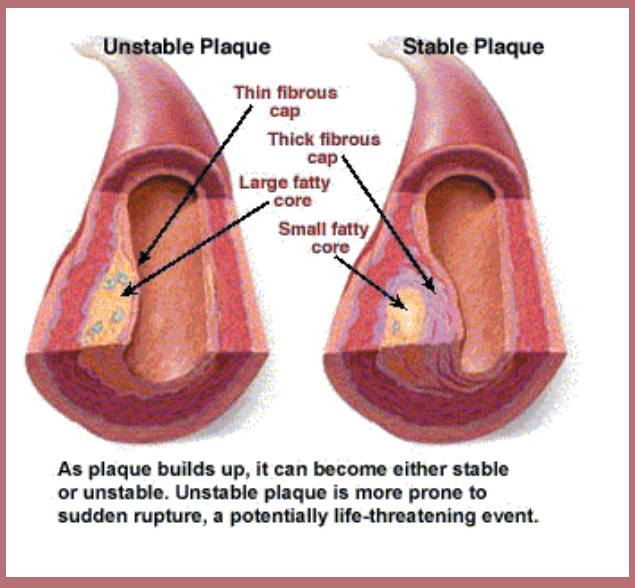

Figure 1: Plaque blocking the artery

It is well known that the ultrasound is widely used in medical diagnosis and therapy. On the one hand, the ultrasound energy is a non ionizing radiation, which does not impose hazards such as chromosome breakage and cancer development. On the other hand, it has several physiological effects based on the increase of inflammatory response, on the repair of the damaged tissues and on the heating of soft tissues.

A number of medical applications such as the ultrasound therapy of the occlusion of blood vessels were proposed. The methods based on the application of ultrasound waves use either an ultrasonic energy guided by a catheter [2], or an ultrasound radiation [3]. The first method has been used to dissolve clots in vitro, in animal models and in patients [2], whereas the second method has been reported in vitro and in animal models [3].

Both techniques have engineering problems. Most of the technical disadvantages of a catheter system are due to its poor efficiency as a RF/W radiation source. Consequently, the power loss in the coaxial cable and its subsequent heating during power delivery lead to a breakdown in the dielectric and the catheter material. In addition, there is the difficulty of designing a unidirectional antenna that can radiate energy into the diseased and not the surrounding healthy tissues. These limitations are unacceptable when a catheter system is used to treat life-threatening venous disorders, stable and unstable plaque, arteriosclerosis, or deep-seated tumor. The technical problems related to the radiated waves take on a different form and concern both diagnostic and therapeutic aspects related to physics and to the engineering of hyperthermia. With this technique, the incident wave undergoes multiple scattering inside the patient's body and, because the evanescent waves are difficult to mea-

Abstract

Because the number of applications for therapeutic and diagnostic medical ultrasonound systems continue to increase, there is a need to improve the efficiency of these acoustic techniques. In this frame, this paper reports on a new mildly invasive therapeutic method to disrupt stroke. The proposed method is based on the propagation of ultrasound waves inside a carotid artery, which is viewed as an optical fiber. The challenge, then, is to determine the feasability and the efficiency of such technique. The preliminary results of this study are presented. At 1 MHz ultrasound frequency, the penetration depth is about 21.7 cm, which is sufficient to reach and dissolve cerebral clots by transmitting an incident wave relatively far from thrombosis location. To reach this penetration depth, a saturation acoustic pressure of 1.5 MPa must be not exceeded. A temperature rise rate of about 0.46 °C/s for an intensity of 100 W cm^{-2} is observed. Pulsed waves are used to enhance cavitation, which is considered as the most likely and dominant mechanism for blood clots disruption. The project is embedded in the framework of a collaboration project involving three Canadian universities namely, Université de Sherbrooke, Université de Québec à Montréal and Université de Moncton.

Sommaire

Puisque l'utilisation des ultrasons pour des applications thérapeutiques et diagnostiques continue à augmenter, il y a un besoin d'améliorer l'efficacité de ces techniques acoustiques. Dans ce cadre, cet article traite une nouvelle méthode thérapeutique modérément invasive pour le traitement des maladies thrombotiques cérébrales. La méthode proposée est basée sur la propagation des ondes ultrasonores dans l'artère carotide, qui est regardée comme étant une fibre optique. Le défi, alors, est de déterminer la faisabilité et l'efficacité d'une telle technique. Les résultats préliminaires de cette étude sont présentés. À une fréquence d'ultrasons de 1MHz, la profondeur de pénétration est environ 21.7 cm, qui est suffisant pour atteindre et dissoudre les caillots cérébraux en transmettant une onde incidente relativement loin de la thrombose. Pour atteindre cette profondeur de pénétration, une pression acoustique de saturation de 1.5 MPa ne doit pas être excédée. On observe un taux d'élévation de la température d'environ 0.46 °C/s pour une intensité de 100 W cm^{-2} Des ondes pulsées sont employées pour favoriser la cavitation, qui est considérée comme le mécanisme le plus susceptible et dominant pour la destruction des caillots de sang. Le projet entre dans le cadre d'un projet de collaboration entre trois universités canadiennes notamment, l'université de Sherbrooke, l'université de Québec à Montréal et l'université de Moncton.

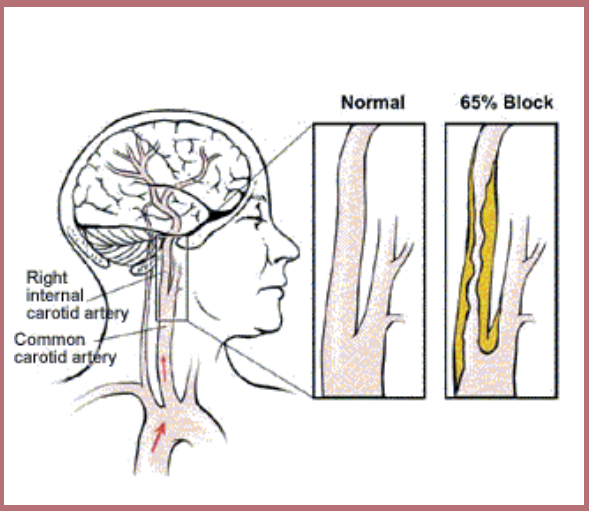

Figure 2: Artery hardening

sure, high spatial-frequency informations are mostly lost. Moreover, negative hyperthermal effects are associated with the exposure to external ultrasound energy [4].

To overcome many limitations of these ultrasound therapeutic methods, a new approach inspired from optical telecommunications has been recently advanced. The technique is based on propagating a pulsed ultrasound waves through the artery like light propagating through a single mode fiber. Cavitation effects near the solid boundary of the waveguide, namely the artery, are created to destruct the undesired obstacle. This quasi non-invasive ultrasound therapy for clots and strokes disruption has been proposed and investigated in the framework of a collaboration project involving three Canadian universities namely, Université de Sherbrooke, Université de Québec à Montréal and Université de Moncton.

In this paper, the new approach, inspired from fiber telecommunications, and the associated phenomena will be summarily described. Then, the relevant parameters related to this technique will be shown. Last, some interpretations and conclusions will be drawn based on recent results, and future prospects are considered.

2.0 From the optical fiber to the artery

Interest has grown in recent years in the use of ultrasound propagation as a therapeutic mean to treat the vascular disorders. The different therapeutic applications of ultrasound like stone destruction, cells ablation by cavitation and tissue heating by acoustic absorption, are the foundation of several medical applications. The power of ultrasound waves lies on their ability to reach deeply situated tissues using either in a non-invasive or an invasive method.

Essentially, the idea stems from the fact that an acoustic wave can propagate either as a radiated wave or as a guided wave, like light propagation inside the optical fiber. To guide a wave, either a transmission line or a waveguide must be used. In the problem at hand, where we want to get rid of some kind of obstruction within an artery, the transmission line approach did not quite solve the problem (see the previous discussion on catheter systems). The technique that we propose to study takes on the perspective that an artery can be considered as a dielectric circular waveguide like the optical fiber (Figure 3). Furthermore, to achieve a deep penetration sufficient to reach the defective location (sufficiently large skin depth) while maintaining the injected acoustic power, single mode propagation is desired like in the case of optical light transmission through the optical fiber. We remind the reader that one of the main advantages of the single mode optical fiber is its inherent low attenuation during propagation which leads to longer cable runs between repeaters, without forgetting its remarkably and excellent linearity and dispersion behavior.

Any ultrasonic field can create a mechanical disturbance in the propagation medium, namely the artery. The resulting changes of pressure, tension, shear stress, expansion, compression, velocity and acceleration can all have an impact on the biological system. In an absorbing and dissipative medium, part or all of the mechanical energy is converted to heat. Another important effect is cavitation, with the generation of local micro-currents associated to the presence of microbubbles in the medium [4].

To the best of our knowledge such a general model does not exist yet, and its formulation is beyond the scope of the review article presented here. The question therefore is: can an artery work as a waveguide (like the optical fiber) that can propagate energy until the location of the obstruction in order to dissolve it, by heating and/or by shaking using an acoustic wave? The artery including the obstacle becomes, with regard to the wave, a lossy waveguide (a fiber with attenuation). For our purpose, one of the carotid arteries is used as an ultrasonic biological fiber (Figure 4).

3.0 Model description

3.1 Physical properties of the carotid

The main arteries that supply blood to the brain are the two common carotids. They both originate from the arch of the aorta (via the brachiocephalic artery for the right common carotid), and each of them bifurcates at the level of the upper border of the thyroid cartilage into an internal and an external carotid artery. The internal carotid ascends to enter the skull via the carotid canal to the middle cranial Fossa. The external carotid, which begins opposite the upper border of the thyroid cartilage, has many branches along its course up the neck and supplies the neck and face [5]. Earlier studies have shown that the normal human carotid diameter varies between 3 mm and 5 mm [6] and its wall thickness is about 0.5 mm [7]. This results in an average interior carotid radius of 1.5 mm. The most common cause of a stroke is in general due to the development of clots in the carotid arteries. This may be the consequence of a thickening and/or hardening of the artery walls [5].

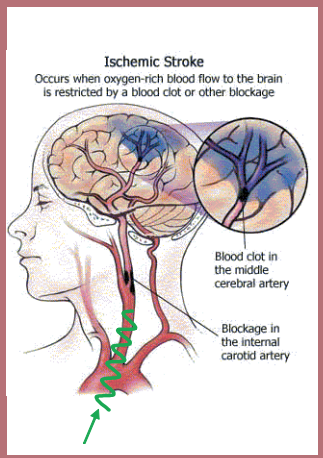

Figure 3: Injection of ultrasound wave in the carotid

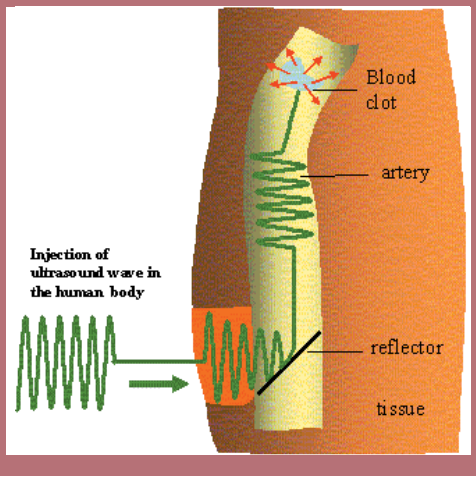

Figure 4: A model of ultrasound wave propagation in the artery

3.2 Physiological effects of ultrasound energy and the choice of the adequate mode

The study of acoustic properties of tissues and the investigation of the effects of ultrasound on biological cells have received attention in the last few decades because of its important role in therapeutic applications. Physically, because tissues are absorbent, they warm up during the travel of the ultrasonic field inside them. Generally, the ultrasonic field is not uniform and the absorption coefficient of tissues varies from one point to another.

Temperature rises by increasing the kinetic energy of tissue molecules, which is then converted into heat, and by increasing the production of unstable cavitation that occurs when the bubbles collapse violently under the pressure due to excessive energy accumulation, once a critical size is exceeded. A large, brief, local pressure and temperature increase are the results of this implosion. Moreover, the reflection of the ultrasounds on the dense structures also causes a significant temperature increase in the tissue/obstacle interface.

Besides, the enzymatic activity within the body doubles for each increase of 10°C. If the temperature becomes higher than 45°C, the enzymes are denatured, so that their activity is initially decreased and then stopped. This has a significant impact on the cellular structure and its metabolism. Two different therapeutic ultrasound modes are typically used, namely pulsed non-thermal and continuous thermal ultrasound therapy.

A pulsed ultrasound wave produces a mechanical pressure during its travel through soft tissues. As a result, microscopic bubbles are generated in living tissues, the intra-cells are activated and the cell membrane is deformed. This phenomenon of cell membrane distortion is divided into three mechanisms [4].

The first one is the acoustic streaming that can be described by the radiation force or deformation of the tissue molecules (cell membrane) due to the compression phase of an ultrasound wave. The second mechanism is bubble formation, which is affected by the radiation force in the tissue fluids. The bubbles expand and contract under the effect of the radiation force (compression and rarefaction), adding further stress to the cell boundaries. Bubble expansion and contraction without growing to a critical size is referred to as stable cavitation. The last mechanism is microstreaming, which is a microscopic fluid movement, described by the phenomenon of cavitation.

The cavitation effect depends on the pulsed ultrasound properties such as low-intensity, high frequency, which limit the bubble growth. The lifespan of the cavities is short and is only determined by the frequency of the ultrasound wave. Cavitation decreases in reverse proportion to frequency increase. As a result, it requires more power to occur as frequency increases [3].

Our approach for stroke disruption is mainly based on acoustic cavitation [4], the phenomenon of nucleation, growth and collapse of vibrating microscopic bubbles when ultrasound waves pass through a liquid. A mechanical shock due to the oscillation of the microbubbles and their rapid collapse due to pressure effects may be felt up to a few radial distances from the collapsed cavitation [4].

In the immediate vicinity of the collapsing bubble, an intense shear stress may occur, especially in solids, which can change the erythrocyte membrane, break fibrin bonds, affect platelets and finally lead to stroke disruption [3]. This phenomenon is more effective when a gas bubble is close to a solid boundary (coagulated blood or other obstacle). An acoustic micro-current is generated meadows of the bubbles causing a great collapse, which can dissolve the clots.

4.0 Heat propagation

A thermal effect is also generated during the propagation of ultrasounds in the arteries. For solving the governing heat partial differential equation (PDE) the Laplace transform and the Fourier method were used. According to our numerical results shown in Figure 5, the temperature rise rate in blood and clot are: (dT/dt)blood=0.00095 °C/s and (dT/dt)clot=0.00015 °C/s.

5.0 Discussion

The focus of this presentation was to describe a new ultrasound therapeutic technique for the treatment of stroke. The main finding of the study was the study of the applicability of a new ultrasound therapeutic approach based on the modeling of an artery as a dielectric cylindrical waveguide, like the optical fiber. An acoustic wave propagates through this biological fibre, attains the obstacle and disrupts it by means of cavitation.

A growing number of laboratory and theoretical studies on bioacoustics suggest that the ultrasound application time depending on the frequency, the intensity and the rate of temperature rise must be respected. As the ultrasound frequency increases, more energy is lost and more power is required to produce cavitation. As a consequent, the heat deposition per unit volume increases causing therefore an overheating during a shorter time. All these parameters must be adjusted to avoid cell destruction [8].

A preliminary investigation shows that the use of arteries as dielectric circular waveguides (optical fiber) may lead to a potential thrombolytic therapy without incurring the limitations of the non-invasive therapeutic method based on the ultrasound radiation and the invasive ultrasound technique using the catheter [9].

Following this preliminary stage, we intend to carry out clinical and medical tests in vitro, on animal models and finally on patients.

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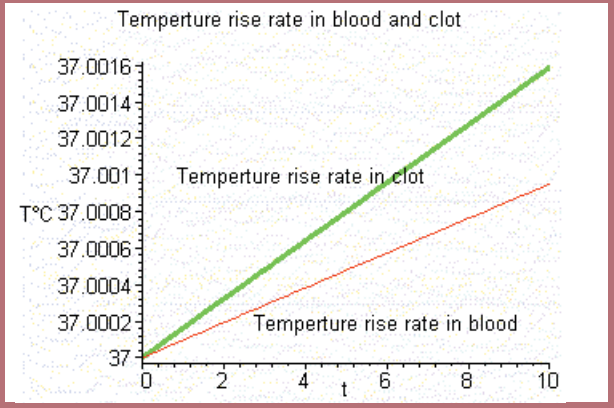

Figure 5: Temperature rise rate in blood and clot.

About the authors

Zoubeir Hajri is currently a Ph.D. student in the Department of Electrical Engineering at the University of Sherbrooke. His research work is the conception and the development of a new therapeutic method for the treatment of thrombotic diseases and stroke using microwaves and ultrasounds.

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Meeting between IEEE Montréal Conférences Inc. and the IEEE Canadian Foundation

At the recent annual meeting of the Montreal Conferences Inc. held on the 1st Sept. 2004 in Montreal, the following motions were adopted unanimously.

1. Motion to disburse the funds of the MCI as follows:
   - 150 K$ to be transferred to the IEEE Canadian Foundation (ICF). This transfer shall form the basis of a Special Fund called the IEEE MCI Fund of the ICF. The funds to consist of a cash donation of 50,000$ and a Term Deposit of 100,000$ and its revenues.
   - A donation of 5000$ to be earmarked for the annual Expo Science Awards, for the next 3 years. There are two awards of 500$ each for projects in Electrical Engineering and Computer Engineering.
   - A transfer of 3000$ to an advocate for defraying the costs of an accountant and notary for the dissolution of the corporation.
2. The treasurer will pay for all outstanding items before closure of the books. The remaining funds will be transferred to IEEE Montreal Section before closure of the bank account.
3. Motion to thank all previous Directors and Founders of MCI, in particular Mr. Len Ruggins and Mr. Flip Lunan.

Present at the Directors meeting were: (From left to right in the photo) Adam Skorek, Guy Olivier, Eric Holdrinet, Pierre-Luc Rigaux, Frank Laveaux, Maurice Huneault, Vijay Sood, Luc Matteau (ICF). Robert Alden (ICF) was unable to attend but sent in his proxy vote.

IEEE Canada

New Co-Editors of IEEE Canadian Review commencing May 2005

Eric Holdrinet détient un BSc en Informatique de l'Université de Sherbrooke, 1987 et un MBA en Marketing International de McGill, 1995. Il a travaillé huit ans comme consultant et oeuvre depuis 1996 pour le Conseil national de recherches Canada à l'encadrement des entreprises technologiques.

Eric a débuté au IEEE en 1988 comme correcteur d'épreuves pour la Revue canadienne et occupé divers postes à la Section de Montréal - dont Editeur - et président en 1994, 1995 et 2000, puis président du Conseil de l'est du Canada.

Ses intétêts autant techniques que littéraires et son expérience de gestion seront mis à contribution.

Terrance J. Malkinson is a graduate of the University of Calgary, B.Sc. 1971, has completed his Information Technology Professional Certificate in 1999 and his B. Tech. in Applied Information Systems Development in 2001 at the Southern Alberta Institute of Technology.

He was most recently employed as a Proposal Manager/Business Analyst/Documentation Specialist with GE Capital Information Technology Solutions Inc. Employment responsibilities included providing professional support to the sales and technical functions throughout North America in the development of information technology proposals and solutions to meet customer requirements.

He is a recipient of the Institute of Electrical and Electronics Engineers "Third Millennium Medal," October 2000. He received a Certificate of Recognition from GE Capital IT Solutions in 2001. He is an elected Governor of the IEEE Engineering Management Society and Editor of their quarterly newsletter Engineering Management.

An Interactive Software for Designing Nonlinear Controllers Based on Feedback Linearization Technique

by *A. Kaddouri [1], S. Blais [1], M. Ghribi [1] and O. Akhrif [2]*
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Abstract

This paper describes new software developed for the design of nonlinear controllers based on the well-known feedback linearization technique. NLSoft is a software package containing several symbolic manipulation modules, which includes differential geometric tools for the design and simulation of control systems. NLSoft presents a user-friendly graphical user interface (GUI) as well as a new and powerful module allowing the calculation time of linearizing control laws considering several Digital Signal Processors (DSPs) characteristics. These facilitate the real-time implementation of the control system. NLSoft is validated considering an example.

Sommaire

Le présent article décrit un nouveau logiciel (NLSoft) dédié à la conception des contrôleurs nonlinéaires basés sur la technique de la linéarisation par retour d'état. NLSoft est présenté sous forme d'une interface graphique (GUI) et possède beaucoup de modules à manipulation symbolique incluant entre autre plusieurs outils de la géométrie différentielle nécessaires pour la conception et la simulation numérique des systèmes dynamiques non-linéaires. De plus, il contient un module très puissant permettant l'évaluation du temps de calcul de la loi de commande linéarisante en considérant plusieurs processeurs numériques de signal (DSP). NLSoft a été validé en considérant un exemple.

1.0 Introduction

The nonlinearities of nonlinear dynamic systems have been traditionally handled in the literature by the use of classical linear control methods, which rely on linearized models approximating the dynamic system's equations. These methods are just valid in a small operation range. When the required operation range has to be larger, the linear controller is likely to perform poorly. Nonlinear controllers, however, may handle the nonlinearities in large range operations directly. The nonlinear control considered here is based on the feedback linearization technique (static and dynamic) which gives a good solution for tracking control problems. Several accessible references describing its constructions are now available ([1] to [4]] as examples). This well-known nonlinear control technique has been successfully applied to the control of dynamic systems, even those with high nonlinearities in their model. However, this technique needs an extensive knowledge of differential geometry which provides a very useful framework for the analysis of nonlinear control systems. Differential geometric objects (Lie brackets, Lie derivatives, etc.) are not easily manipulated by hand. In order to facilitate this process, many new CAD tools appeared in the last decade (AISYS, AP_LIN, SCILAB, CONDENS, REDUCE, PROPAC etc.). They offer the possibility of designing and/or simulating nonlinear dynamic systems. In the real-time applications, the main problem encountered with these nonlinear control techniques is that they need an important calculation time which makes implementation impossible on a general use microprocessor. Fortunately, a new class of digital signal processors (DSPs) is making this implementation possible. The software presented in this paper (NLSoft) is developed in order to design nonlinear controllers, to simulate the closed-loop systems and to give useful information for the real-time implementation considering real DSPs characteristics (TMX320F2812, ADMC401 etc.). Furthermore, it is capable to inform us about the stability of the zero dynamics if they exist. NLSoft uses several subsystems expressed as classes which permit the design of nonlinear controllers and the plotting of the results obtained from the simulation of the closed-loop system.

The block diagram of the closed-loop system to be designed and simulated using NLSoft is given in Figure 1.

2.0 Description of NLSoft

NLSoft consists of a design environment built in Visual C++. This design environment, hereafter referred to as "NLSoft Design Environment" or NODE, contains functions which can be grouped into five different subsystems. The first subsystem, the GUI, guides the user into making important design decisions at each step of the design process. The four remaining subsystems - Acquisition and Display, System Analysis, Storage and Symbolic Subsystem - contain several functions to adapt, save and recall the information provided by the user, perform

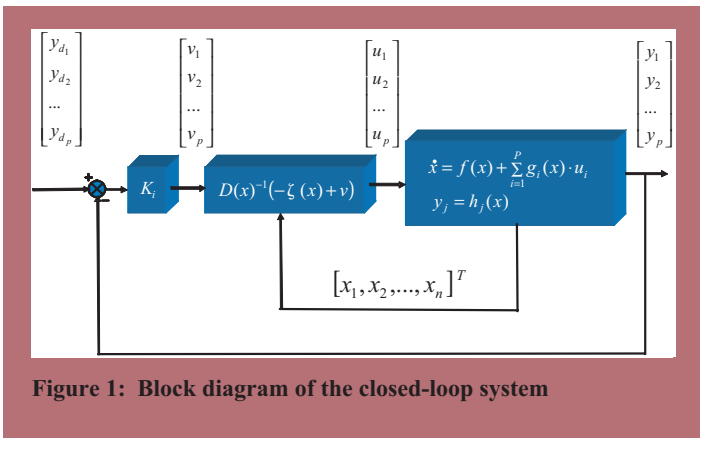


Figure 1: Block diagram of the closed-loop system

analysis on a system, display and print results, launch symbolic algorithms and more.

The NODE has the following characteristics:

- It contains several design packages which use the feedback linearization technique to design a control law that forces the output of a nonlinear system to follow some desired trajectory. It also contains a dynamic linearization package and a package for the analysis of the existence and the stability of the zero dynamics.
- The NODE also includes a new and powerful module permitting the calculation time of the designed nonlinear control laws. Two Digital Signal Processors (DSPs) characteristics are already included in NLSoft (TMX320F2812, ADMC401 etc.). The user may also consider other DSPs.

Finally, it permits the pole placement, the simulation of the closed-loop system and the visualization of its performance.

The NODE's architecture is given in Figure 2.

2.1 Graphical User Interface

The GUI included in the NODE presents several controls which are available with the click of a button. The GUI is modified when results are displayed at each step of the design process. Figure 3 shows the main controls of the NODE. The controls are grouped in three classes. The Data Input Controls allow the input of parameters characterizing either the nonlinear equations of dynamic systems or the DSP used to implement the designed nonlinear controllers. The data input controls are working closely with Acquisition and Display Functions to verify

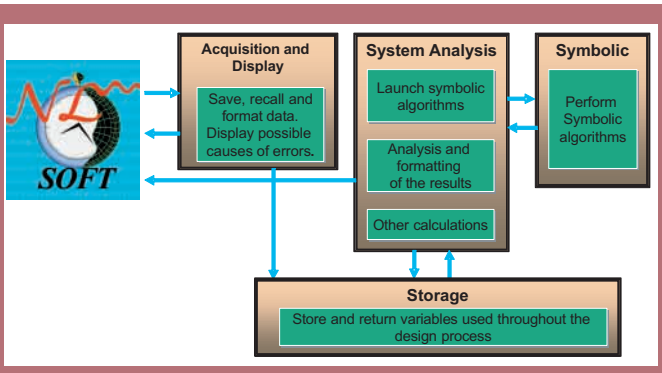


Figure 2: NODE architecture

basic syntax as data is entered. These functions prevent the launch of an erroneous algorithm in a future step of the process. The Action Controls execute a different step of the nonlinear control design process. These steps include finding the linearizing control law of a nonlinear system, calculating the corresponding calculation time required for the specified DSP to implement the linearizing control law and to simulate the linearized system with several customizable input commands. The simulation results may be shown directly or stored in a Matlab m-file for the user to plot the different graphs. The Options Control allows users to modify registered variables. The Print control allows users to print previously calculated and displayed results.

2.2 Acquisition and display subsystem

The acquisition and display subsystems contain functions that can be grouped in three categories: Syntax Functions, File I/O Functions and Formatting Functions. Firstly, the Syntax Functions allows the analysis of the input entered by users. Several syntax rules are checked, such as the closing of parenthesis and brackets, the syntax of built-in functions and more. If not properly followed, error messages are displayed with the proper syntax rules to follow. Secondly, File I/O Functions allow parameters to be saved, recalled and modified. Specifically, these File I/O functions are used for the storage of the system and DSP parameters.

2.3 System analysis subsystem

The System Analysis Subsystem contains the required functions to analyze the parameters of a system and to interpret results at all stages of the design process. It acquires data from the Storage Subsystem, generates symbolic algorithms and launches them. Upon completion of the algorithm, the results are interpreted, formatted and stored in the Storage Subsystem. The algorithms included in this subsystem are used to perform the following tasks: find the relative order of the nonlinear system, find the linearizing control law, transform the resulting system in a canonical form, find the calculation time on the designed controller and simulate the controlled closed-loop system under specific consideration. All these algorithms are executed by the NODE.

2.4 Storage subsystem

The Storage Subsystem consists of a global class used to store data required by different subsystem functions. The indexing of the stored data is made on a per function basis. The data is stored in private variables available through specific functions in order to minimize the possibility of errors.

2.5 Symbolic Subsystem

NLSoft provides a large set of symbolic functions embedded in the design environment. These functions are used by the symbolic algorithms described previously. Object-oriented programming allows the easy reuse of these functions in the different algorithms. The symbolic functions can be classified in four different groups.

- First, functions performing basic mathematical operations are developed. Amongst these are functions performing derivatives, variable replacement, parameter matching, etc.
- Second, symbolic functions for matrixes are also included. Functions finding the size of the matrix, its transpose, inverse, performing row reduction, finding the null space matrix, and more are developed.
- Third, differential geometry functions are developed. These functions reuse the functions in the first two groups to calculate their results. They include the Jacobian matrix, Lie Derivative and more.
- Finally, simplifications functions are included in the package to optimize the output results and eliminate redundancy in the output equations.

3.0 Illustration Example

The mathematical model of the salient Permanent-Magnet Synchronous Motor in the d-q synchronous reference frame [8] is given by:

$$\dot{x} = f(x) + \sum_{i=1}^{2} g_i(x)u_i = f(x) + g_1(x)u_d + g_2(x)u_q \quad (1)$$

With:

$$f(x) = [f_1 \quad f_3 \quad f_3]^T = \begin{bmatrix} -\frac{R}{L_d} i_d + \frac{L_q}{L_d} pw_r i_q \\ -\frac{R}{L_q} i_q - \frac{L_d}{L_q} pw_r i_d - \frac{\Phi_v}{L_q} pw_r \\ \frac{1}{J}(T_{ém} - Bw_r) \end{bmatrix} \quad (2)$$

$$x = [i_d \quad i_q \quad w_r]^T \quad et \quad u = [u_d \quad u_q]^T$$

$$g_1(x) = [\frac{1}{L_d} \quad 0 \quad 0]^T \qquad g_2(x) = [0 \quad \frac{1}{L_q} \quad 0]^T$$

$$T_{ém} = \frac{3p}{2J}(\Phi_v i_q + (L_d - L_q) i_d i_q)$$

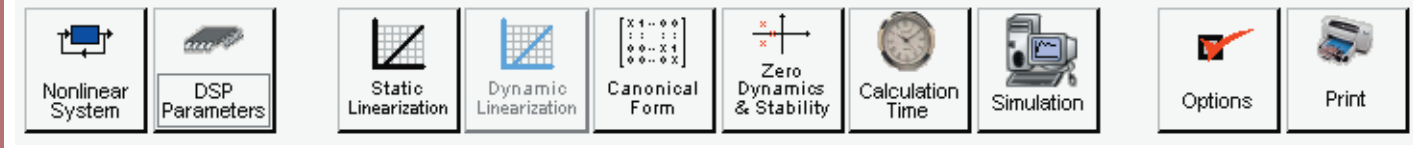


Figure 3: Main control of the NODE

where ud and uq are the d-q axis voltages, id and iq the d-q axis currents, L is the stator inductance, R is the stator resistance and wr is the rotor speed. v is the flux linkage due to the rotor magnets, p is the number of pole pairs, B is the damping coefficient and J is the rotor moment of inertia. Tém is the electromagnetic torque.

We choose the speed (wr) and the direct current (id) as output variables, then:

$$y = [y_1 \quad y_2]^T = [i_d \quad w_r]^T \tag{3}$$

The linearizing control law becomes:

$$u = D(x)^{-1} \cdot [-\zeta(x) + v] \tag{4}$$

where:

$$D^{-1}(x) = \begin{bmatrix} L_d & 0 \\ \dfrac{(L_q - L_d)L_q}{(\Phi_v + (L_d - L_q)i_d)} i_q & \dfrac{JL_q}{1.5p[(L_d - L_q)i_d + \Phi_v]} \end{bmatrix} \tag{5}$$

which is non-singular with: $\Phi_v \neq (L_q - L_d)i_d$

and:

$$\zeta(x) = \begin{bmatrix} -\dfrac{R}{L_d} i_d + \dfrac{L_q}{L_d} p w_r i_q \\ \lambda(L_d - L_q) i_q f_1 + \lambda(\Phi_v + (L_d - L_q)i_d) f_2 - \dfrac{B}{J} f_3 \end{bmatrix} \tag{6}$$

$$\lambda = 1.5p / J$$

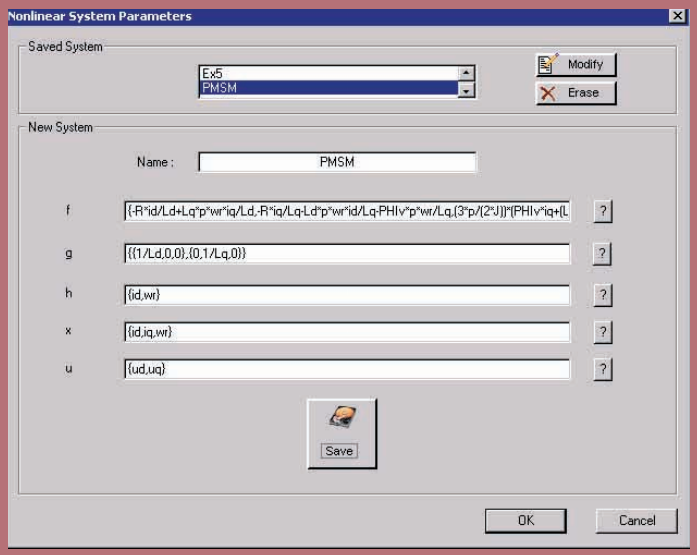
The total relative degree is r =1+2=3. Since the system order is 3, the system is then completely linearizable and there is no need to check the internal dynamics stability.

The results obtain by NLSoft are given in Figure 4.

The simulation results and the calculation-time of the linearizing control law are given in Figure 5. For the calculation time of the linearizing control law, we consider the TMX320F2812 DSP chip. The calculation time (90 sec.) is evaluated considering floating-point operations.

4.0 Conclusion

The paper presented a new CAD tool (NLSoft) oriented to the design and simulation of nonlinear controllers based on the feedback linearization technique. NLSoft was developed in a compact and user-friendly GUI interface. Two examples are given to validate the proposed Tool. We are working to integrate a dynamic linearization algorithm and an adaptive version to solve the problem of parameter uncertainties.



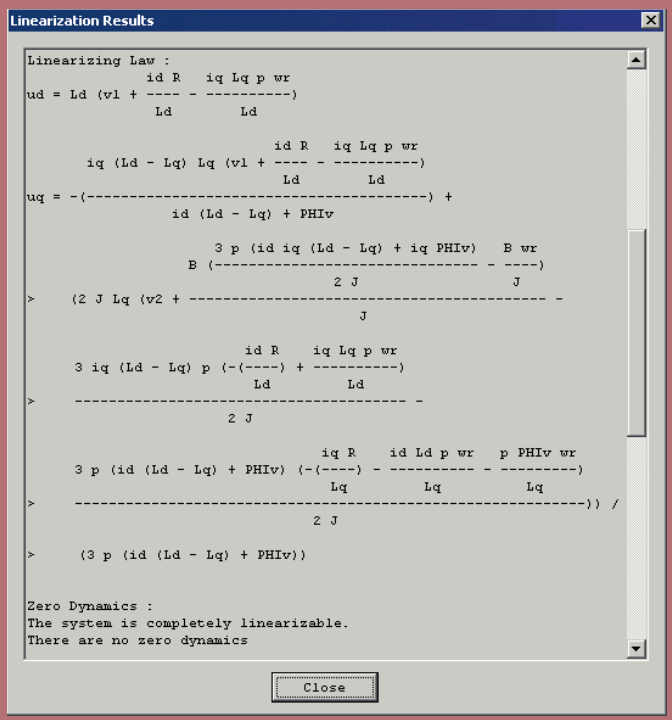


Figure 4: Results for the illustration example using NLSoft

(a) Data input of the dynamic system

(b) The Linearizing control law and zero dynamics stability check.

5.0 Acknowledgment

The authors gratefully acknowledge the financial support of the Natural Sciences and Engineering Council of Canada (NSERC).

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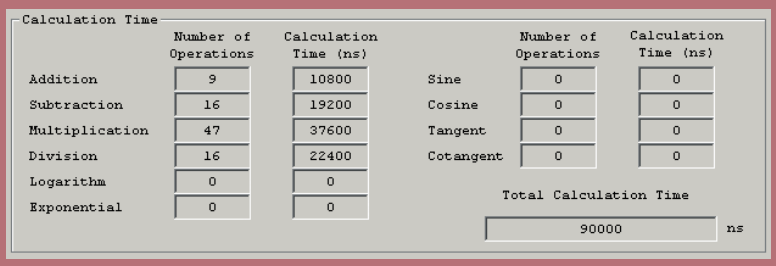
(a)



(b)

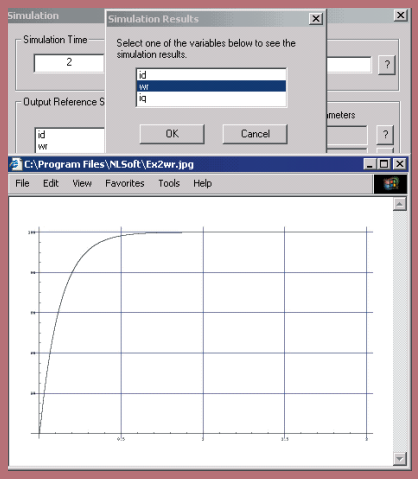


Figure 5: Output data for the example (a) Calculation time of the linearizing control law and (b) Simulation results showing the angular speed of the motor

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Azeddine Kaddouri received the Diplôme of ingénieur d'état in electrical engineering from Batna University, Algéria in 1988 and the M.Sc. and the Ph.D. degrees in electrical engineering from Laval University, Canada in 1993 and 2000 respectively. From 1993 and 1999 he was a research assistant with GREPCI research group, École de Technologie Supérieure, Montréal, Canada. In 1999, he joined the Université de Moncton, NB, Canada, where he is currently professor of Electrical Engineering. His research interests are the nonlinear control of electric drives.

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Potential Security Problem looms for users of PC-based VoIP products

by *Dennis Estacion*
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Abstract

As Voice over Internet Protocol (VoIP) technologies enjoy growing acceptance and increasing use, there's an expectation that a variant of the modem hijacking problem that used to affect only the dialup modem users may soon surface. Those using PC-based VoIP dialers whose computer's security weaknesses have been exploited could find themselves with significant VoIP long distance charges for calls they did not place. It is important that this issue be considered now to avoid problems for the users faced with the disputable charges; and for the VoIP service providers and government agencies who will have to deal with the resulting complaints. This article investigates the existing types of VoIP service offerings, cites some examples and assesses how vulnerable the user of each type could be. It then provides recommendations of what the service providers should make available to the users to help minimize any impact.

Sommaire

Comme les technologies de voix sur IP (VoIP) sont de plus en plus acceptées et utilisées, il est possible qu'une variante du problème de détournement de modem, qui n'affectait autrefois que les usagers de modems RTC, surgisse. Un usager de VoIP pourrait faire face à d'onéreux coûts d'interurbains pour des appels dont il/elle n'a pas eu connaissance si les faiblesses de son ordinateur ont été exploitées par des tiers. Il est donc important que cette problématique soit traitée dès maintenant pour éviter des problèmes potentiels tel qu'un usager qui reçoit des factures d'interurbains discutables et les compagnies de service VoIP et les agences gouvernementales qui doivent répondre aux plaintes. Le présent article présente une étude des différents types de services VoIP, cite quelques exemples et détermine le degré de vulnérabilité de l'usager pour chaque type de service. L'article propose aussi des recommandations quant aux solutions possibles au problème.

1.0 Introduction

With the growing use of Voice over Internet Protocol (VoIP), even non-dialup users may soon find themselves with huge long distance bills for calls they did not make.

"Modem hijacking" victimizes users of regular dialup modems by enticing them to install a piece of software that promises to enable them to view, play or have access to games, videos, music, psychics or adult sites. If the user agrees with the installation without bothering to understand the fine print, then the modem dialer software gets installed and executed [1,2]. Without any additional permission from the user, the PC is then used to dial to a long distance internet provider number, a 1-900 number, or FTP site, to accrue per-use charges which the user will then be responsible for [3]. The user won't be aware that his existing internet connection is dropped and that another connection has been redialed because the software will shut off the modem's speaker [2] or it would wait until the user has moved away from the PC by detecting idle time.

Faced with the charges, the victimized users either pay up or lose their phone service. In the US, people have filed complaints with the FCC and FTC, and in Canada, with the CRTC. Generally though, the phone companies treat these on a case by case basis [5].

2.0 Why Voice Over IP?

VoIP allows you to make telephone calls using a computer network, over a data network like the Internet. VoIP converts the voice signal from your telephone into a digital signal that travels over the internet then converts it back at the other end so you can speak to anyone with a regular phone number. When placing a VoIP call using a phone with an adapter, you'll hear a dial tone and dial just as you always have. VoIP may also allow you to make a call directly from a computer using a conventional telephone or a microphone [6].

An AT&T paper declares that since voice is now being treated as an IP network application, long distance and local service telephone providers run VoIP for an increasing portion of total traffic to save on circuit and toll costs. It also enables cable operators to offer VoIP and cable telephony services. Innovative IP-based applications like call routing and integrated messaging are written for the IP network. Phone numbers can be location independent and phone calls can be distance independent [7].

VoIP then generally means a win-win for both the consumer and the service provider in terms of costs and available features.

3.0 Emerging Threats - Recommendations

Until now, the modem hijacking victims were limited to dialup internet users because only the regular dialup modems could be used to rack up charges for the unsuspecting user. Presently, users of PC-based dialers of Voice over IP services could potentially find themselves in a similar situation. The fact they don't even have a dialup modem and that they're using an ADSL or a cable modem won't offer them any shielding from this problem.

The old suggestion, "disconnect the dialup modem, you may leave the broadband connection on [4]"as a defence, may no longer hold true. Judging from the relative ease that new hacks are able to exploit Windows weaknesses [3], it is reasonable to expect that a VoIP version of the modem hijacking scam would soon surface.

Although this article is focused on Windows vulnerabilities, this doesn't mean that Macintosh users are safe. There are enough threats to the Macintosh platform [8]. If a Mac-based VoIP dialer is released, that would certainly be targeted by hackers.

The potential headaches are ominous. Many companies in this field are envisioning major expansions of their VoIP hardware offerings for use in VoIP services. Among them are Texas Instruments [9], where VoIP is viewed as the next "killer app;" Comcast, which is "aiming to offer it to 40 million households by 2006 [10];" and Ace Comm, whose white-paper quotes a source that the worldwide VoIP equipment market for public networks will surpass US $20 billion by 2012 [7].

Not all VoIP service providers are offering PC-based VoIP dialers, but it is hoped that if they do, that consumers are:

- Forewarned of the risks,
- Provided with tools to secure the VoIP dialer, and/or
- Provided with easier recourse procedures on how to contest questionable charges [2, 5].

From the Windows side of things: "Microsoft continues on its path of incorporating much of the nuts-and-bolts functionality now handled by third-party communications vendors -- like chat, Web conferencing, and VoIP players -- on the operating system level [11]." The current Microsoft white paper on VoIP mainly deals with Windows CE version 5 [12].

VoIP dialers therefore don't rely on Microsoft (or Apple)-supplied utilities but are applications by themselves. The security of the VoIP dialer then depends on its own security features and that of the underlying Windows or Macintosh OS.

From what is now available, VoIP services could be categorized as follows in terms of being prone to a broadband modem hijacking scheme:

1. Dedicated VoIP hardware used exclusively with no need of a PC. This would be the safest. Users keep it secure the same way they keep their regular phone secure (i.e. be aware where is the portable handset, for example). An example would be the service provided by Primus Canada [13].

2. VoIP hardware with the option of using PC-based VoIP dialer. The hardware portion should be as secure as the one above, but users availing of the Windows-based dialer could expose themselves to upcoming threats. An example of an optional dialer would be the SoftPhone X-PRO utility which is the VoIP dialer included with the service provided by Vonage [14, 15].

   A quick look at its features indicates that there is an option to block international call dialing, which should alleviate some concerns. Connection to 1-900 numbers is also not allowed [16]. However, the quick start guide for SoftPhone X-PRO [17] recommends allowing the software to remember the login phone number and password fields. This author did not check further if login access to SoftPhone would allow changes to the call blocks, but it would suffice to say that this may make it vulnerable to take-over tools, keystroke monitors and other exploits. It is also to be noted that even though long distance and 1-900 call blocking have been available for the regular phone lines, people have not opted for them and so have been victimized.

3. PC-based VoIP dialer with option of using VoIP hardware. Being mostly reliant on the underlying PC operating system, it's more vulnerable to take-over tools, keystroke monitors and other exploits as mentioned above. An example would be the PC-to-Phone service of the iConnecthere consumer division of deltathree [18].

4.0 Concluding Remarks

In summary, broadband internet users availing of PC-based VoIP dialers need to be made aware of the possible risks arising from the PC's security vulnerabilities. They should be provided with step-by-step procedures that minimize the chances of success of any Windows or Macintosh hack or exploit. And if they still got victimized despite their best efforts, they should be accorded a smoother process to be spared the resulting disputable charges.

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Quelques mots du rédacteur en chef

Suite de la page 3:

autres, pour la traduction d'articles en français. Merci à Bob Alden pour avoir implanté le site Internet de la revue canadienne et avoir réalisé un si bon travail. Et merci à Bruce Van-Lane et son équipe pour leur soutien à l'édition.

Finalement, un gros merci à Vina pour avoir passé de longues heures à réaliser l'éditique, taper et re-taper, finaliser, expédier et organiser en général la revue canadienne. Ça n'aurait certainement pas été possible sans son soutien et habiletés. Aussi, pour m'avoir enduré durant ces longues heures quand j'étais loin de la maison et je négligeais mes autres tâches. Elle a été la colonne vertébrale de tout ce travail.

Ce fut un privilège et un honneur de servir en tant que rédacteur en chef de ce prestigieux magazine. Je remercie tous les lecteurs et les membres d'IEEE Canada qui m'ont rejoint par courrier électronique ou par la poste, et m'ont livré des messages d'encouragement et des suggestions pour améliorer la revue.

Je souhaite bonne chance et beaucoup de succès aux nouveaux rédacteurs de la revue canadienne (voir leurs profiles dans ce numéro). A vous tous lecteurs et membres, je souhaite une bonne et heureuse année.

Vijay Sood

Redacteur en chef

Stochastic Image Processing

Author(s) - Chee Sun Won and Robert M.Gray

Publisher - Kluwer Academic/Plenum Publishers

ISBN - 0-306-48192-8

Year of publication - 2004

No of pages - 166

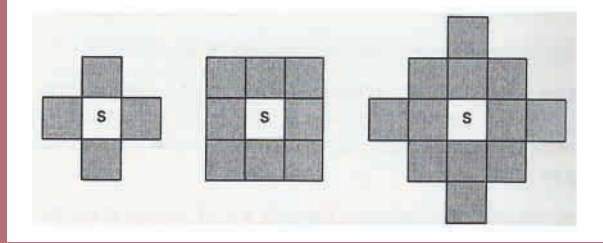
by *April Khademi*
Ryerson University, Toronto, ON

Stochastic image processing is a rapidly advancing field of signal processing that many technological devices, users and beneficiaries have come to be heavily dependant on. A particularly good example of this is the sophisticated image processing devices that have become vital tools in disease and illness identification for health practitioners. Although medical image processing and its applications are extremely valuable, many other multimedia image processing applications are just as widespread. Specific image processing techniques generally include image restoration, segmentation and feature extraction.

Some of the common problems surrounding stochastic image processing revolve around the development of a sound model that will accurately describe the image while allowing for easy data manipulation with minimal computational complexity. Once such a model is established, other mathematical methods and techniques are needed to correctly estimate each class label with minimal classification error.

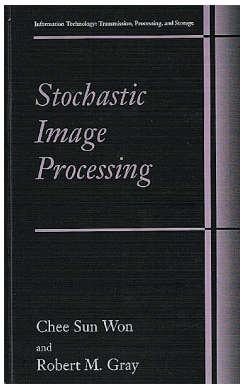
The mathematical models that are discussed in this book focus on Markov Random Fields and its many variations. Chapter 1 describes the model identification and class labelling issues in detail and also gives a general overview of the optimal solution, which is thoroughly described in the rest of the chapters. Also included in chapter 1 is a complete description of the variable notation used throughout the text as well as some common examples of stochastic image processing.

Chapter 2 discusses noncausal Markov Random Fields. The authors define several important parameters, models and mathematical definitions such as neighbourhoods, cliques, clique potentials, Markov Random Fields (MRF) and Gibbs Random Fields (GRF), to name a few. The GRF-MRF equivalence is shown by the Hammersly-Clifford theorem. Optimal class labelling schemes are investigated for both supervised and unsupervised problems and solutions to the maximum a posteriori (MAP) estimation are shown for both cases. Due to the computational demand of finding the MAP estimate by conventional means, simulated annealing (SA) procedures are explored as an alternative. The end of the chapter shows parameter estimation and a method to determine the appropriate number of class labels for unsupervised noncausal MRF images.



Examples of hierarchical neighbourhoods used for pixel-wise noncausal Markov Random Fields (MRF)

Chapter 3 extends the principals and techniques of 1D Markov Chains (MC) to 2D image data by methods that order the image's pixels in a causal manner. However, as a result of the ambiguous definition of image causality, several causal models can arise. A few of the causal models that are considered in this chapter are: Pseudo Hidden Markov Models (PHMM), Markov Mesh Random Fields (MMRF) and multidimensional Markov Chains (MDMC). For each situation, to find the optimal class labelling scheme, the MAP estimation is solved using recursive algorithms, namely the Viterbi algorithm. For parameter estimation, the Baum-Welch algorithm, which is a specific implementation of the expectation and maximization (EM) algorithm, is demonstrated for each causal model discussed. The chapter finishes off with a brief description of 3-D Causal Markov Models.



Unlike all of the other data models previously examined, multiscale Markov models can deal with image texture very well. This subject is treated in Chapter 4 where Multiscale Markov models are used to describe the interscale and intrascale statistical dependencies and relationships. Furthermore, by finding and using an appropriate Multiscale model, the development of an optimization strategy for class labelling is feasible. The appropriate treatment for textured images is shown to be a pyramid structure which would require a specific multiscale representation depending on the application. The multiscale representations discussed are the Renormalization Group (RG) approach, which uses a course to fine scale MAP optimization approach via the RG algorithm, multiscale transforms such as block-to-point mapping and wavelet coefficient modelling and interscale models which result in methods that model the scale dependencies as a time ordered Markov Chain. In order to manipulate such a representation, the principles of hidden Markov trees (HMT) are applied. In this chapter, HMT are shown to aid in parameter estimation via the EM and upward-downward algorithms. HMT are also demonstrated to simplify the process of obtaining the optimal solution to the MAP estimate. The end of the chapter introduces the optimal class labelling scheme for multiscale Markov models by using the sequential MAP estimate (SMAP).

Using a multiscale representation for an image allows for image texture to be accounted for via large scale feature extraction. However, although this may be beneficial, the computational demand for parameter estimation is discouraging. Block-wise image modelling poses a positive alternative and is discussed in Chapter 5. The discussion first begins with block-wise noncausal MRF models and then block-wise neighbourhood systems are defined. The global optimal solution for the MAP estimate is demonstrated to be similar to that of pixel-wise noncausal MRF, however is less computationally complex. Secondly, block-wise causal MRF are presented and the principles and techniques from Chapter 3 are extended from pixel-wise to block-wise causal MRF. Just as before, the MAP estimate is obtained via the Viterbi algorithm and parameter estimation is demonstrated by the EM algorithm. The last block-wise structure considered is a Multiresolution HMM and the chapter finishes off with some block-wise image processing applications such as aerial segmentation and feature extraction.

In conclusion, this book was very thorough, both mathematically and descriptively. If someone who is particularly interested in image processing and its applications desires a reference for the various techniques and mathematical models that can be used for digital images, this book will serve as an excellent resource. As a first year Master of Applied Science student in Electrical and Computer Engineering, I did find the book a little beyond my mathematical scope; however, I still have learnt a lot about stochastic image processing from it and found this to be an overall valuable experience.

The CR Editor acknowledges the support of Mr. Alex Greene (email: Alex.Greene@wkap.com), Kluwer Academic Publishers for his support of this Book Review.

A History of Electric Power Development in Manitoba

by *Leonard Bateman*
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Abstract

Today, with deregulation in the power industry occupying a good deal of public attention, this article presents the history of power development in Manitoba. Winnipeg was probably the only place in North America where competition between the private company and the municipal utility for customers was possible using the same power poles. This situation prevailed from 1912 to 1955. Manitoba is well endowed with rivers with significant hydroelectric power sites. The paper outlines the history of development up to and including the development of the Nelson River in the late 1960's. This involved the diversion of the Churchill River into the Nelson River and the regulation of Lake Winnipeg. The largest capital expansion program in the history of the utility was undertaken during this period and involved moving the power from the north using direct current transmission at +/-500 kV. The various stages of evolution and consolidation of the power industry are covered, with Manitoba Hydro ending up as the only utility in Manitoba serving all the citizens at a uniform rate.

Sommaire

De nos jours, avec la déréglementation de l'industrie énergétique qui reçoit une bonne part de l'attention du public, cet article présente un historique du développement de l'énergie au Manitoba. Winnipeg était probablement le seul endroit en Amérique du Nord où la compétition entre des compagnies privées et les services publics municipaux utilisant les mêmes poteaux électriques était possible. C'était le cas de 1912 à 1955. Le Manitoba regorge de complexes hydroélectriques. Cet article dresse un historique du développement hydroélectrique, des débuts jusqu'au projet de la rivière Nelson à la fin des années 60. Durant ces années-là, il y eut diversion de la rivière Churchill vers la rivière Nelson et la régularisation du Lac Winnipeg. Le plus grand programme d'expansion dans l'histoire du service public a été entrepris durant cette période et a exigé le transport de l'énergie du Nord par des lignes de transmission de courant à plus ou moins 500kV. Les différentes étapes de l'évolution et de la consolidation de l'industrie énergétique sont discutées, avec Manitoba Hydro devenant le seul service public au Manitoba offrant aux citoyens l'électricité à un taux uniforme.

1.0 Early History

Electric Arc Lamps were first seen in Winnipeg, Manitoba in March 1873, just three years after the Province of Manitoba was formed. This was six years before Edison invented the incandescent lamp. It was not long after this that a newly incorporated company received a contract to install arc lamps in the City. This was the beginning of several business ventures by a variety of new companies, and when electric trolley conveyance was demonstrated in 1891, it was the Winnipeg Electric Railway Company (WECO) that received the franchise from the City. This company built a thermal generating station on the banks of the Assiniboine River. It purchased its last competitor in the mid nineties. With a rapidly growing city and the demand for more uses of electricity, WECO looked to the Winnipeg River for hydroelectric development.

It was not the first company to develop a hydro plant in Manitoba. This was done by a company in Brandon some 120 miles west of the City of Winnipeg. They developed a plant on the Minnedosa River (now known as the Little Saskatchewan River) but the flow was such that the plant could only operate for a maximum of eight months of the year. The plant served the City of Brandon using an 11 kV wood pole line. The plant was dismantled in 1924.

2.0 Development of the Winnipeg River

At the beginning of the 20th century, WECO examined the possibility of a development on the Winnipeg River. The consultants that they engaged selected the Pinawa Channel, which is a channel parallel to the Winnipeg River, partially bypassing the Seven Sisters Falls site. It required the construction of a weir to divert the water into this channel with some enlargement of the intake. To build a hydroelectric plant in the wilderness with horses was a remarkable achievement. There were no roads or railways; access was by river or winter road. Construction started in 1902 and the first power was delivered using a 60 kV steel tower line to Winnipeg in 1906. The output of the plant was 22 MWs.

The WECO had a monopoly on the supply of electric power and was charging twenty cents per kWhr, which did not sit very well with some of the aldermen of the City. The company did lower its rate to 10 cents per kWhr when the Pinawa plant was completed. One alderman in particular, Alderman John Wesley Cockburn, managed to get the water rights for the Pointe du Bois site on the Winnipeg River and when the City Charter was amended to permit it to float a bond issue for the development of a hydroelectric site, he transferred the rights to this site to the City. The citizens of Winnipeg voted in favor of developing Pointe du Bois with the promise of power at 3 cents per kWhr. A railway was constructed from the nearest CPR line at Lac du Bonnet. This involved building bridges over the Winnipeg River and the Pinawa Channel. This site was developed into what is now the oldest plant still operating on the Winnipeg River. It has a 46-foot head and is rated at 78 MW. The first power was delivered in October 1911. The rate was set at 7 and cents per kWhr. This sparked a vehement protest from the citizens who had been promised 3 cents. The public outcry resulted in City Council lowering the rate for power to 3 and 1/3 cents per kWhr, which the private company met. This rate remained in use until 1968.

The delivery of power from the City's plant caused a mad scramble to connect customers. It was not uncommon for the City to begin construction of a line on the opposite side of the street on a Saturday morning to supply an industrial customer on Monday morning. The multitude of lines eventually resulted in a judicial decision in 1912 to require both utilities to share the same poles. This arrangement continued until the power industry was rationalized in 1955.

3.0 Rural Electrification

The settlements in rural parts of the province also wanted to share in the benefits of this new form of energy. It spawned a multitude of entrepreneurs; all charging what they thought was reasonable. In order to rationalize this, the Government created the Manitoba Power Commission in 1919 and undertook to sell power to the municipalities, much the same as Ontario was doing, but by 1933, when the depression forced many municipalities into financial difficulties due to residents not paying their electric utility bills, they amended the legislation to permit the Commission to sell directly to the customer and do away with the so called middle man. The growth of consumption required Winnipeg to complete the second half of Pointe du Bois, a project they commenced in 1919 as they had a contract to supply the Commission with its requirements. The WECO also undertook to develop a new site at Great Falls on the Winnipeg River with a capacity of 132 MW. This was the first use of propeller type turbines and resulted in some interesting developments. The admission of air to the draft tube to reduce cavitation was first used at this plant and was soon to be the norm.

The growth in the twenties required the City and WECO to seek new sites for development on the Winnipeg River. The City received the license to develop Slave Falls [1], while WECO received the license to develop Seven Sisters, with a reservation of 35 MW for the Power Commission. The contract that the City had with the Government to supply the Commission was terminated in 1935 when the Company supplied the power from its Seven Sisters Plant. With the

Figure 1: Slave Falls Plant (Source: Manitoba Hydro)

simultaneous development of two sites, nobody foresaw the crash of 1929, and the result was rather catastrophic. The City actually ran its Slave Falls plant with only two units installed on a one-shift basis and incurred a deficit. Units three and four were installed by 1938. The Company shut the three units installed at Seven Sisters down and defaulted on the bond interest. In one respect it was provident that this surplus capacity was available when the 1939 war broke out. It made it possible for the Province to assist in the war effort. However, the growth in the war years required the City to develop a water heater control program, which shut the water heater load off at noon and again during the evening peak, using carrier current injected frequencies into the residential feeders. These were picked up by relays installed in each household. These measures to control the peak demand, along with the use of thermal generation from the Amy Street standby plant that was installed in 1924, resulted in the City meeting its firm load requirements. This thermal plant was built as a result of the loss of all transmission from the Pointe du Bois plant due to a very severe windstorm. It was combined with a central heating system to supply central heat to the downtown city area. Three electric boilers, in addition to the coal-fired boilers, were installed. The operator of these boilers had a recording totatalizer of the Winnipeg Hydro load at his workstation. His job was to utilize all the spare capacity in the system as load on the electric boilers with a resulting saving in coal for the central heating plant. This resulted in a very high load factor on the City's two hydro plants.

The supply of some defense industry load during off peak hours, by arrangement with the WECO, further helped the City to meet its firm load requirements.

Even before the war ended, the City received permission from the Wartime Prices and Control Board to order the steel for the extension of the Slave Falls Plant, which was commenced in 1945. The plant with a total of eight units was completed in 1948. The transmission voltage was raised to138 kV - the first use of this voltage in Manitoba. Meanwhile the WECO undertook the completion of the Seven Sisters Plant to a capacity of 150 MW by raising the head and excavation in the tailrace. This utilized the full flow of the river. The retirement of the Pinawa Plant occurred in 1951.

The Government undertook a study of farm electrification in 1942 and with the completion of the war, commenced this program. The growth of the farm and rural load made it evident that someone had to add new capacity to meet these requirements. The private company would not invest in a new plant unless they received an agreement from the Province for a long-term commitment. The City was in a similar position. Without a guarantee, they were reluctant to commit the necessary funds for expansion of either of the two remaining hydro sites on the Winnipeg River.

4.0 Birth of The Manitoba Hydro Electric Board

This stalemate resulted in the Government creating the Manitoba Hydro Electric Board and the development of the Pine Falls site on the Winnipeg River. The City protected its position during the rather prolonged negotiations on how the power industry should be rationalized, by installing two thermal units of 15 and 25 MW capacity in the Amy Street thermal plant it built in 1924.

The plan for reorganization of the power industry, proposed by the Government, was turned down by the citizens of Winnipeg in a referendum. As a result, the Government forged ahead with its plans and bought the WECO and sold the load in the City, formerly supplied by the Company, to the City in exchange for the City load outside the City boundaries. It also agreed to leave the two City plants at Pointe du Bois [2] and Slave Falls with the City, but undertook to develop all future generation needs for the Province and entered into a cost sharing agreement with the City in 1955, based on the peak demand of the City load and the Provincial loads. The latter soon outdistanced the City load, due to the farm electrification program. Thus the competition for customers in Winnipeg by the two suppliers of power came to an end.

An interesting development occurred in January of 1957, when Manitoba Hydro Electric Board received a letter of intent from INCO to supply power for their new nickel mine being developed at Thompson Manitoba. This was a wilderness location, but the Hudson Bay Railway was some 50 miles away to the south. A hydro site on the Nelson River named Kelsey was available some 60 miles away and Manitoba Hydro undertook to develop this site on the Nelson. The schedule was very demanding, requiring power by 1960. This involved building a railway into the site, building dikes on perma-frost, and building the final earth and rock fill closure dam under a hoarding in the wintertime. The INCO estimated load required four units, but in anticipation of growth in the new town at Thompson, a fifth unit was added, and unit Number 7 was installed by 1972. This five-unit plant rated at 160 MW supplied an isolated load, including two arc furnaces rated at 18 MW each. Special governor characteristics were developed to handle the sudden loss of this furnace load, and governor development tests were run on the Pine Falls plant using electric boilers at the Paper Mill, close by, to simulate the condition of the loss of a furnace under load conditions. These tests were run with the help of Woodward Governor engineers to validate the anticipated governor performance. They are reported in a paper at the 1961 meeting of the AIEE and are recorded in the Transactions of the Institute. INCO placed limits on the amount of load that could be dropped; however very shortly after the tests, but before the instrumentation had been removed, an interruption of greater than one furnace occurred, and the governor performance for control of the machines was superb.

This first plant on the Nelson River was a good experience for future developments.

5.0 Formation of Manitoba Hydro

By 1961 the Government again moved to rationalize the power industry by an amalgamation of the Manitoba Power Commission and the Manitoba Hydro Electric Board. The new organization was called Manitoba Hydro.

With the growth of load in the fifties, the newly created Manitoba Hydro was struggling to stay ahead of the demand. It completed the last two sites on the Winnipeg River at Pine Falls and McArthur Falls and constructed a thermal generating station at Brandon, and another at Selkirk, while it studied its options for more hydro development on the Saskatchewan and Nelson rivers. The decision was made in 1960 to develop the Grand Rapids four-unit site with a capacity of 479 MW on

Figure 2: Pointe du Bois Plant (Source: Manitoba Hydro)

Figure 3: Kelsey Generating Station (Source: Manitoba Hydro)

the Saskatchewan River where it empties into Lake Winnipeg. This was, and still is, the largest head in Manitoba at 120 feet. The decision was made to use Kaplan units. The site was unique, in that it was built on a porous limestone foundation. This required extensive grouting, and became the largest grouting program ever encountered by any geophysical consultant. One sinkhole under the powerhouse location required approximately 6,000 cubic yards of grout.

6.0 Nelson River Sites

While this construction was progressing, studies were underway on future Nelson River sites. The Federal Government participated in these studies, which involved the future development of the northern Manitoba rivers for supplying the growing electrical load of the province. The outcome of these studies was an announcement in February 1966 of an agreement between the Federal Government and the Province of Manitoba to proceed to the Northern Sites for the future power requirements of the province. This agreement required Manitoba Hydro to build a 1272 MW power plant at the Kettle Rapids site [4] on the Nelson River, control Lake Winnipeg for storage for this and future Nelson River plants, and divert the Churchill River into the Nelson at a point above Kettle. The license from the Provincial Government to undertake these projects provided for four feet of storage on Lake Winnipeg and ten feet of storage on South Indian Lake, the reservoir for the Churchill River flow. The Federal Government agreed to lend the Province money, which the Federal Government would use to build a DC transmission line from the Nelson River Kettle site to a point near Winnipeg. Atomic Energy of Canada was the federal agency assigned to build the line. This loan was to be repaid by Manitoba Hydro when the load growth was sufficient to carry the financial burden of the line. In the meantime the interest was accumulating and being charged to the line capital account. This loan was discharged in 1992 when Manitoba Hydro bought the line and the accumulated debt.

To supply power to the construction site of the Kettle Plant, a 138 kV line was constructed from Kelsey [3] in 1966. In 1997, the Kelsey station was connected to the southern system by construction of a 230 kV line from Kelsey to Grand Rapids.

This present and future system expansion required additional revenue. As a consequence of this, the first rate increase in 57 years went into effect in July 1968.

7.0 Interconnection with the United States Utilities

This ambitious construction program with the many unknowns caused the Utility to look at alternatives to meet its load requirements in 1970. One option was the addition of another thermal unit at the Selkirk Plant, and an option on a shaft was actually bought. Another, which proved to be the preferred option, was to interconnect with the three utilities south of the border, namely Otter Tail Power, Northern States Power, and Minkota Power Cooperative Inc. and buy capacity for the winter of 1970. This alternative was pursued successfully and a 230 kV line was constructed after receiving approval from the National Energy Board. This line permitted the purchase of 90 MW of capacity for the winter of 1970. It also permitted the export sale of surplus energy, which proved to be very beneficial to all parties.

The first unit of the Kettle Plant [4] came on line in 1970, however the DC transmission terminal equipment was not ready. The two completed DC lines, approximately 900 km in length were used as a temporary 230 kV line with a reactor hung on at approximately the mid point at Grand Rapids to inject this power into the 230 kV system. It meant that Manitoba not only had the US utilities to support the Manitoba System, but the first unit at Kettle also improved the reserve and energy position. Long Spruce came on line in 1976 associated with the second bipole of the DC transmission Line. The converter station, named Henday was located at the site of the future Limestone plant to facilitate the conversion of this plant to DC. All Nelson River plants are interconnected with 230 kV transmission lines. The Limestone Plant came into service in 1990. There are still several sites on the Nelson and other rivers in the north to develop. Wuskwatim, on the Burntwood River, which carries the diverted Churchill River into the Nelson, is on the verge of being developed. The largest site in Manitoba is on the Nelson at Conawapa below Limestone and is being considered for a sale of power to Ontario Power Generation. A fourth interconnection, rated at 230 kV, has been added to the US system from the western part of the Manitoba system.

8.0 Interconnections

The first Interconnection from the Manitoba Hydro system was with Ontario Hydro's isolated Northwest system in 1957. This was followed by an interconnection with Saskatchewan Power Corporation in 1960 between their Estevan Plant and Brandon. This was initially operated at 138 kV, but designed to be raised to 230 kV, which was accomplished in a few years. With the completion of the first 6 units of the 12 unit Kettle plant, Manitoba had a surplus of generation and negotiated a sale to Ontario Hydro commencing in 1972, but by this time the Northwest Region of Ontario Hydro was interconnected with their main system. This meant there would be a circulation of power around the Great Lakes unless phase shifting transformers were installed on this interconnection. Two 200 MVA phase shifting transformers with a 180 degree shift capability were installed to supply two new 230 kV lines to the Ontario System. This rather large angle was determined by test of an isolated machine on the tie line to Ontario and the Manitoba system tied to the US system.

A second 230 kV line was constructed between Saskatchewan and the Manitoba system in 1973.

The operation of the first tie to the US proved so successful that another utility, Minnesota Power and Light, negotiated a tie to their system near Duluth, which went into service in 1976. An agreement was reached with Northern States Power to interconnect their system with Manitoba Hydro at 500 kV. This was negotiated using seasonal diversity as one of the economic justifications for the line. It also provides the Manitoba system with a good backup in case of trouble on the DC system [5] from Northern Manitoba. The line came into service in 1980.

Figure 4: Kettle Plant (Source: Manitoba Hydro)

Figure 5: A view of the largest mercury arc rectifier ever built - this type of valve was originally used in the AC-DC conversion stations in the Nelson River DC transmission system. Most of these valves have now been replaced by thyristors. (Source: Manitoba Hydro).

The value of this 500 kV interconnection [6] with the US system was very vividly demonstrated in 1997, when a wind shear toppled 19 towers on the DC line. This occurred in the early morning hours, before daybreak. The Manitoba system went from an export mode to an import mode without any customer interruptions. The public and some large industrial customers were asked to conserve energy and capacity for the few days it took to build a temporary line around the downed towers. This 500 kV interconnection has had series compensation installed to increase its export capabilities. It has proven to be a valuable source of revenue as well as a source of energy during the 2002-03 years, when one of the worse droughts on record was experienced on the Prairies.

9.0 Winnipeg Hydro

The agreement between the Province and the City of Winnipeg in 1955, which provided for the City to retain its two generating stations and share in the cost of new generation, transmission, and interconnection revenue, was renegotiated each 10 years. The ratio of peak demand and energy use on the two systems had increased to approximately 90/10 and in 2002 Manitoba Hydro purchased the Utility, resulting in one utility supplying the entire province [7] with rates uniform throughout the system and one of the lowest rates in Canada.

Figure 6: 500 kV HVDC transmission line over the new 230 kV North Central transmission line from Kelsey Generating Station. (Source: Manitoba Hydro).

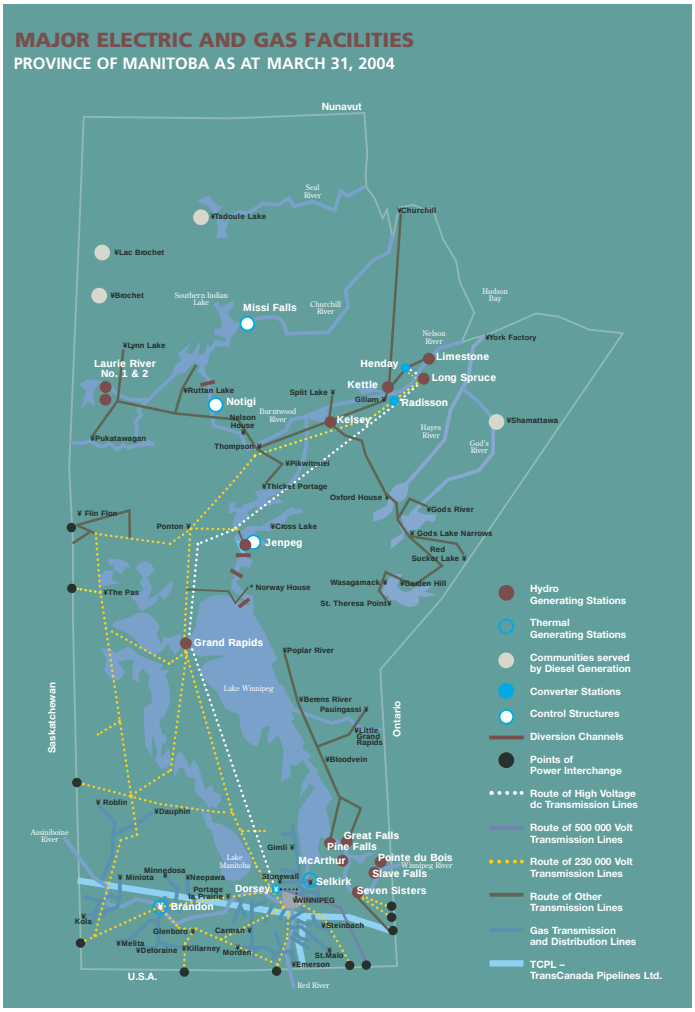
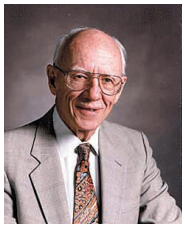


Figure 7: Major electric and gas facilities in the Province of Manitoba, as of March 31, 2004. (Source: Manitoba Hydro-Electric Board 53rd Annual Report).

About the author



Leonard A. Bateman is an electrical engineering graduate from the University of Manitoba with post-graduate qualifications in Engineering and Business Administration. His career spanned thirty-six years in the utilities of Manitoba. His last six years were spent as Chairman and CEO of Manitoba Hydro. He was the last person to hold both of these positions. He has served as President of the Canadian Electrical Association, The Association of Professional and Geophysical Engineers of the Province of Manitoba. He was the first and founding President of the Canadian Society for Senior Engineers. When he left Manitoba Hydro in 1979, he formed his own consulting company - Bateman and Associates Ltd., of which he is still President. As a consultant he has worked and presented papers in many countries of the world. He has received recognition by his peers in many organizations, and in 1994 received the Canadian Engineers' Gold Medal. In 2002 he was awarded the highest recognition that the Province of Manitoba bestows on its citizens - The Order of Manitoba. He is still interested in traveling as well as volunteering in seniors' organizations, having served the two thousand members of Creative Retirement Manitoba as their President in the years 2001 and 2002.

Mobility Management in Wireless Networks - Data Replication Strategies and Applications

Authors: Karen Q. Tian and Donald C. Cox

Publisher: Kluwer Academic Publishers

ISBN: 1-4020-7897-8

Year of publication: 2004

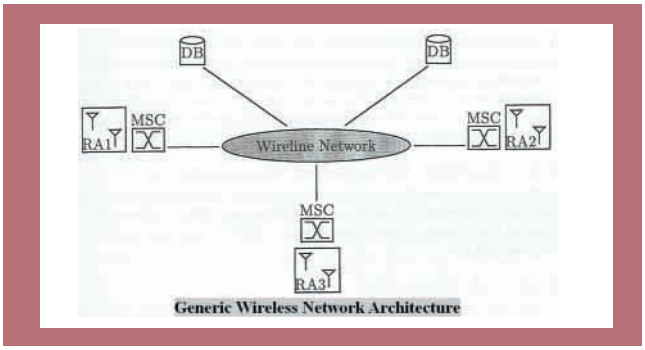
No of pages: 166

by *Alagan Anpalagan*
Ryerson University, Toronto, ON

The advances in mobile communication continue to improve human's quality of life. Traditional mobile communication applications were in two-way voice communication, text emails and remote file downloading. The emerging applications in video streaming, sensor networking, telemedicine and surveillance are expected to dominate and shape the next generation of mobile communication systems. One critical feature that enables the ubiquitous communication is the mobility management - which is perceived to provide continuous constant quality of service even under very harsh and unexpected conditions.

Basic mobility management operations include location update as mobile units move around and location lookup as mobile units are wanted. The performance of mobility management techniques can be enhanced by using replicas of user profiles that are kept at various locations. The purpose of replication is to make profile information readily accessible and to reduce the lookup cost and latency. However, to keep these replicas consistent and up-to-date, they must be updated whenever necessary. It is hence worthwhile to replicate if benefit is greater than the overhead.

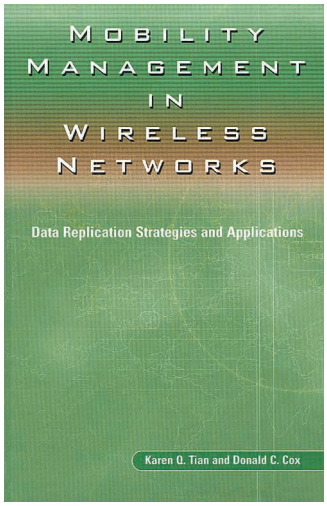
The text book Mobility Management in Wireless Networks by K. Q. Tian and D. C. Cox discusses various techniques to replicate the (mobile) user profiles and performs the comparative study of these techniques. Interestingly, the authors relate the profile replication problem to file allocation problem, and treat as such. With an introduction to mobility management problem including the wireless network architecture and concept of user profile in Chapter 2, authors proceed to discuss two commonly used techniques in mobility management, namely, the use of: location registers (home and visitor) and hierarchical structure. While delaying the answers to the question of "where should a replica of a user profile be kept?" to later chapters, the authors chose to address an architectural question first in Chapter 2. The hierarchical mobility management problem is discussed and solved first on a special type of network - the tree network and generalized later in the book. In order to reduce the number of database lookups, replica pointers are introduced - that avoids searching the hierarchy for the closest replica. Towards the end of the chapter, user profile replication is introduced and it is concluded that the performance of mobility management techniques can be improved by user profile replication.



Generic Wireless Network Architecture

Chapter 3 addresses the question of "where to keep the replicas?". In off-line replication approach, complete knowledge of user calling and mobility statistics are assumed apriori.

This chapter begins with a survey of replication algorithms for mobility management followed by a description of discrete location problem in tree networks. Minimum-cost maximum-flow replication algorithm and threshold-based replication algorithm are discussed. It is shown that the profile replication problem belongs to the family of file allocation problems computer scientists were researching. Discrete location theory originates from the study of the facility location problems in operations research. Recent algorithms in discrete location theory provided the efficient solutions of the file allocation problem on tree networks. The authors went on to develop an optimal off-line replication algorithm that minimizes network cost based on the network structure, communication link costs, user calling and mobility statistics. Optimal replication algorithms were developed for both unicast and multicast replica updates.



In on-line replication algorithm where no prior knowledge of traffic patterns are assumed, the replicas are managed with real-time data. Chapter 4 begins with a survey of the replication algorithms in the literature and then focuses on solving the replication problem on a single edge, followed by solving the replication problem on a tree. A unified framework for the on-line edge replication problem is developed using the offset transit diagram. By fitting previously proposed algorithms into the framework, the relationship between them is demonstrated. It was noted that, though both the tree-based algorithm and threshold-based algorithm follow the same principle, that is, if the benefit of replication is greater than the cost, their scope is quite different. In this chapter, optimal on-line replication algorithms are also developed that adjust the replica placement based on the user calling and mobility patterns. Finally, implementation issues related to on-line replication are discussed.

Chapter 5 was devoted to the demonstration of the performance of off-line and on-line replication algorithms introduced in Chapters 3 and 4 respectively. Extensive computer simulations were performed using realistic traffic models, that confirmed the proposed tree-based off-line and on-line replication algorithms outperform the previously proposed threshold-based algorithm. In particular, the proposed algorithms incur smaller network cost and enable more lookups to be resolved locally than the threshold-based algorithm.

A rich set of references is provided in the book which can serve as a useful tool for any one interested in embarking on advanced studies, research or design in the mobility management particularly in wireless networks. In each chapter, the authors survey the related work - which gives specific references to the problem at hand. The book will be very useful to graduate students in electrical engineering, computer engineering, computer science and industrial engineering disciplines to do advanced study on the mobility management techniques.

The CR Editor acknowledges the support of Mr. Alex Greene (email: Alex.Greene@wkap.com), Kluwer Academic Publishers for his support of this Book Review.

IEEE Awards

Uno Lamm High Voltage Direct Current Award

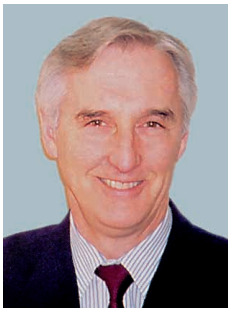
Dennis A. Woodford

2004 Recipient

The IEEE Power Engineering Society awards the **Uno Lamm High-Voltage Direct-Current (HVDC) Award** to recognize outstanding contributions to HVDC technology. The technology has developed into an effective power system tool for long-distance energy transport, ac network interconnections, and system stability enhancement. These developments have come from the work of dedicated engineers and scientists in many countries throughout the world.

The award consists of a bronze medal, an engraved certificate, and an honorarium of $1,000. The award is named for the man most responsible for the research and development that led to the first practical application of an HVDC connection between ac systems.

The 2004 receipient of this award is Dennis Woodford.



Dennis Woodford received his B.E degree in 1967 from the University of Melbourne and his M.Sc. degree in 1973 from the University of Manitoba. Following four years with the English Electric Company he was Special Studies Engineer in the System Planning Department of Manitoba Hydro. In 1986 he joined the newly-formed Manitoba HVDC Research Centre as Executive Director. He held that post until 2001 when he and a colleague formed Electranix Corporation where he is president.

His key contribution to HVDC technology was his development of the initial software and subsequent leadership of the team that developed EMTDC, one of the world's most widely used transient simulator programs. In the early 1970s the only practical way to perform electromagnetic transient studies on a dc system was with an analog simulator. Set-up time and accuracy of results were major concerns. In carrying out studies on the newly-developing Nelson River HVDC system, Dennis Woodford became convinced that future studies could be conducted more accurately and efficiently if done digitally. Using the concept of the BPA Transients Program developed by Hermann Dommel (later known as the EMTP) he wrote new code for decoupled portions of the network, created control modules, and developed an interface to the base code. He subsequently led the development of a graphical user interface which resulted in the commercial development of the PSCAD/EMTDC package, now used world wide.

Other contributions include leading the work that resulted in the world's first commercial real-time digital simulator for power system studies; building the Manitoba HVDC Research Centre into a successful, self sustaining research establishment; and presently through Electranix Corporation studying the integration of wind farms into ac networks.

Dennis Woodford has been an active member of IEEE and CIGRE with over 70 publications and numerous committee and working group activities. He currently is Chair of the DC and Flexible AC Transmission Subcommittee of the PES Transmission and Distribution Committee. He is a registered Professional Engineer in the Province of Manitoba and an Adjunct Professor at the University of Manitoba. He is the recipient of the Nikola Tesla Award from Westinghouse (1981) and the Merit Award from the Association of Professional Engineers of the Province of Manitoba (1985).

International Teaching Award

Professor Parham Aarabi

2004 Recipient

The Mac Van Valkenburg Early Career Teaching Award, named after a former Princeton professor, recognizes outstanding contributions to teaching by faculty in the first ten years of their careers. The international teaching award is given by the Institute of Electrical and Electronics Engineers' (IEEE) Education Society.

The award is based upon evidence of distinction in teaching by faculty at an early stage in their careers, including teaching performance, development of new teaching methods, and curricular innovation, in fields of interest to the Education Society.

The award consists of a $1,000 stipend, a commemorative plaque, and paid registration to the Frontiers in Education (FIE) conference.

Professor Parham Aarabi, of The Edward S. Rogers Sr. Department of Electrical and Computer Engineering (ECE) at the University of Toronto, has been named the inaugural recipient of an international teaching award given by the Institute of Electrical and Electronics Engineers' (IEEE) Education Society.

The award was given to Aarabi on October 22, 2004 at the IEEE Frontiers in Engineering Education conference in Savannah, Georgia.

Aarabi, now 28, is one of the youngest academics to join the Faculty - he was only 24 when he began teaching at UofT in 2001 after completing his doctoral degree at Stanford University in only two years. Letters of support from Aarabi's students played a role in his selection by an expert committee.

He holds the Canada Research Chair in Multi-Sensor Information Systems and has made headlines around the world for developing "talking" robots carrying a customized microchip and four-way speakers that are able to navigate a venue such as a museum and act as guides, or that could be deployed in hazardous environments such as chemically contaminated buildings.

Aarabi has previously distinguished himself in UofT lecture halls by receiving the Early Career Teaching Award from the Faculty of Applied Science and Engineering in 2003. Students in the ECE Department also voted him "Professor of the Year" in 2002 and 2003.

IEEE Technical Activities Vice-President Elect 2005

Congratulations to **Celia Desmond** on being elected as IEEE Technical Activities Vice-President Elect for 2005. Celia was elected to serve as vice president-elect of IEEE Technical Activities. She will succeed 2005 Technical Activities Vice President John Vig on 1 Jan. 2006.

	Name	Contributions / Citation	Section
1	**Dr. Wilsun Xu** University of Alberta Dept. of Electrical & Computer Engineering Edmonton, Alberta T6G 2V4 wxu@ece.ualberta.ca	For contributions to the analysis, simulation and measurement of power system harmonics.	Northern Canada Section
2	**Dr. Septimiu (Tim) Edmund Salcudean** University of British Columbia Dept. of Electrical & Computer Engineering UBC, 2356 Main MallVancouver, BC V6T 1Z4 tims@ece.ubc.ca	For contributions to haptic interfaces, teleoperation systems and applications.	Vancouver Section
3	**Prof. Vikram Krishnamurthy** University of British Columbia Dept. of Electrical Engineering University of British Columbia, Vancouver, BC V6T 1Z4 vikramk@ece.ubc.ca	For contributions to adaptive sensor signal processing.	Vancouver Section
4	**Prof. Ljiljana Trajkovic** Simon Fraser University School of Engineering Science 8888 University Drive Burnaby, British Columbia V5A 1S6 ljilja@cs.sfu.ca	For contributions to computer aided design tools for circuit analysis.	Vancouver Section
5	**Prof. Rodney Lynn Kirlin** University of Victoria 924 Robins Place Everson, WA 98247, USA L.Kirlin@ieee.org	For contributions to the application of signal processing for geophysics.	Victoria Section
6	**Mr. William Malcolm McDermid** Manitoba Hydro 1840 Chevrier Blvd. Winnipeg, Manitoba R3T1Y6 wmmcdermid@hydro.mb.ca	For contributions to the development of rotating machine insulation testing.	Winnipeg Section
7	**Dr. Innocent Kamwa** Hydro-Quebec Research Institute (IREQ) 1800 Lionel-Boulet Varennes, Quebec J3X 1S1 kamwa@ireq.ca	For contributions to the identification of synchronous generator models and innovations in power grid control.	Montreal Section
8	**Prof. Mohamed Kamel** University of Waterloo Department of Systems Design Engineering University of Waterloo, 200 University Ave. Waterloo, Ontario N2L 3G1 mkamel@uwaterloo.ca	For contributions to pattern recognition and intelligent systems.	Kitchener-Waterloo Section
9	**Dr. Robert Thomas Harold Alden** McMaster University Department of Electrical & Computer Engineering Hamilton, Ontario L8S 4K1 r.alden@ieee.org	For contributions to eigenvalue analysis of power system stability.	Toronto Section

The Roman god Janus, a two-headed deity, adorned major gateways into and out of ancient Rome. Janus had the ability to look both forward and backward. Our month of January is named after Janus. It's appropriate as I pass the mid-point of my stewardship of Region 7 that I look both backward at what was accomplished in 2004 and forward at what is left to be done in 2005.

Some major and far-reaching changes occurred in Region 7 over the past year. A revised Governance Structure for Region 7 was approved at the Calgary Region Meeting and came into being on January 1, 2005. Among the approved changes, the revised structure for Region 7 will see representation of all Region Committees on the IEEE Canada Board, a more effective ExCom and the creation of a Steering Committee. The approved Governance Structure is posted on the IEEE Canada website in both official languages. The Region Committee instructed the Steering Committee to revise IEEE Canada's Bylaws and bring them back to the Saskatoon meeting in May 2005 for discussion and approval. In addition, the Region Committee approved the Region operating under the new governance structure pending revision of the bylaws. This was a vote of confidence for the new structure and will allow the Region to iron out any bumps in the road as we implement the revised governance model.

Training for all Section Executive was completed this year. It's been a long time since Region 7 conducted training sessions for Section Executive. In addition, we held focused training for the Section Membership Development Chairs at the Niagara Falls Region Meeting. We need to do more! Thanks go to the three Council Chairs and the Region Membership Development Chair for making this training happen.

Region 7 struck a goal of elevating 100 qualified members to Senior Member status. As I write this article in late November, we elevated 98 members to Senior Member in 2004. This is a major accomplishment demonstrating that setting and pursuing targets works. In September 2004, the ExCom held a face-to-face meeting in Fredericton to discuss the governance, budget and goals concurrent with the SAC meetings. Joint receptions were held with and presentations made to the students to introduce them to the people who run IEEE Canada. Feedback from the students stated this was a success and the Region needs to hold more joint meetings with the students.

One of my stated goals is to visit every Section in Region 7 over my two year term of office. In 2004, I visited nine Sections and presented the Power System Seminar to three. My intention is to visit the remaining eleven Sections in 2005 and give the seminar to those Sections requesting it. I only have to be invited, resolve any scheduling conflicts and I will come.

Another goal is to bring IEEE education programs and activities to the attention of and incorporation into provincial licensing bodies increasing competency requirements. Some progress was made in 2004, however it was slower than I wanted or expected. Continuing education or more importantly increasing competency is an area where IEEE has a major role to play. Most provincial bodies require licensed engineers and technicians/technologists to do self-improvement through self-study every year. IEEE membership satisfies this requirement. Society membership increases the compliance with this requirement. IEEE educational programs qualify for the formal part of the continuing competency requirements. This is a potential source of revenue for Sections. It's a great recruitment tool! A major initiative in 2005 will push this effort forward.

Two other achievements of note in 2004 were the increase in number of affinity groups for Women in Engineering and GOLD. For GOLD, Region 7 leads the IEEE world. Twelve of the twenty Sections have GOLD affinity groups - 60%. This is twice the average of the rest of IEEE. WIE has also made significant gains in the number of affinity groups. Congratulations to the Chairs of both committees for jobs well done.

Other items approved at the Calgary Region Meeting in October included the 2005 budget and a set of goals and measurables. For the first time the Region Committee approved a set of goals and measurables for IEEE Canada. These goals and measurables will be monitored by the revised ExCom. A reporting from will be developed for Sections to allow them to monitor and report on their progress towards achieving these goals and measurables. The 2005 goals are very ambitious;

Le dieu romain Janus, une divinité à double-tête, ornait les principales artères de la Rome antique. Janus avait la capacité de regarder devant et derrière lui. Étymologiquement, le mois de janvier nous vient de cette divinité. À mi-chemin de mon mandât, en charge de la Région 7, il est approprié à ce moment de regarder les accomplissements de 2004 et le travail qui reste à accomplir pour 2005.

Au cours de la dernière année, quelques changements majeurs avec des implications de longues durées ont été institués dans la Région 7. Un nouveau modèle de gouvernance pour la Région 7 a été approuvé lors du Comité Régional à Calgary et est en force depuis le 1er janvier 2005. Parmi les changements en vigueur, la nouvelle structure de gouvernance pour la Région 7 aura représentation de tous les Comités de la Région 7 au Conseil de direction de IEEE Canada, un comité exécutif (ComEx) plus efficace et la création d'un comité directeur (Steering Committee). La nouvelle structure de gouvernance peut être revue sur le site Web de IEEE Canada, dans les deux langues officielles. Le Comité de direction de la Région 7 a donné comme mandat au comité directeur de revoir et réviser les Règlements de IEEE Canada, et de présenter leurs recommandations lors de la réunion de Saskatoon en mai 2005 pour revu et approbation. De plus, le Comité de direction a autorisé la continuation des opérations sous la nouvelle structure de gouvernance, jusqu'à l'adoption des Règlements révisés. Ceci est un vote de confiance envers la nouvelle structure, et va permettre à la Région d'éliminer les accros inévitables lors de l'implémentation du nouveau modèle de gouvernance.

L'entraînement des exécutifs de Sections a été complété cette année. Ceci était dû depuis longtemps pour la Région 7. De plus, une session portant spécifiquement sur l'augmentation des membres de la société lors de la Réunion de Niagara Falls. Nous nous devons de faire encore plus! Sincère remerciement aux trois directeurs des Conseils régionaux et au Directeur du Recrutement des membres pour la mise en place de cette session.

La Région 7 avait comme but de promouvoir 100 membres qualifiés au titre de Membre Senior. Au moment d'écrire ces lignes, à la fin novembre, nous avons promu 98 de nos membres au titre de Membre Senior en 2004. Ceci est un accomplissement de taille, qui prouve que l'établissement et la poursuite d'objectifs précis fonctionnent. En septembre, le comité exécutif a tenu une réunion en personne à Fredericton pour discuter de gouvernance, budget et objectifs pour la Région 7, durant les réunions du SAC. Des réceptions et présentations conjointes ont eu lieu pour introduire le personnel de IEEE Canada auprès des étudiants. Les commentaires reçus des étudiants indiquent un franc succès et la Région se doit de tenir plus de réunion conjointe avec les étudiants.

Un de mes objectifs est de visiter toutes les Sections de la Région 7 au cours des deux années de mon mandât. En 2004, j'ai visité neuf Sections et présenté le séminaire sur les Systèmes de Distribution (Power System Seminar) à trois d'entre elles. J'ai l'intention de visiter les onze autres Sections et présenter ce séminaire aux Sections qui le désirent. Sur réception d'une invitation, je n'ai qu'à résoudre mes conflits d'horaire et je me ferais un plaisir de vous visiter.

Un autre de mes objectifs est de promouvoir auprès des corps professionnels provinciaux les programmes d'éducation de IEEE en tant que programmes qualifiés rencontrant les demandes requises pour les certificats de renouvellement et d'améliorations des compétences des membres. Des progrès ont été accomplis en 2004, mais à un rythme beaucoup plus lent qu'espéré. L'éducation permanente ou, plus important encore, l'amélioration des compétences est un secteur où IEEE a un rôle majeur à jouer. La majorité des corps provinciaux demande que les ingénieurs licenciés et les techniciens/technologues s'améliorent en faisant des études personnelles. L'adhérence à IEEE rencontre cette exigence. Les programmes d'éducations de IEEE se qualifient pour les exigences formelles de renouvellement et d'améliorations des compétences. Ceci peut être vu comme une source de revenu pour les Sections. C'est aussi un outil de promotion pour l'enrôlement de nouveau membres. Une nouvelle initiative en 2005 va promouvoir cet aspect.

Deux autres accomplissements pour 2004 ont été l'augmentation des affiliations avec deux groupes affiliées spécifiques: Femmes en ingénierie (FEE) et GOLD. Pour GOLD, la Région 7 est en tête à l'échelle mondiale. Douze des vingt Sections ont des groupes affiliés avec GOLD - 60%. Ceci est le double de la moyenne pour l'ensemble de IEEE. FEE

however they can be met with everyone's assistance. One goal is to increase our membership by 10%. This seems like a huge step; however IEEE Canada membership grew at over 3% in 2004 and as a group, we did very little in the way of recruitment. Ten% is achievable with everyone's help. Ask a colleague, ask a friend - let's grow by *more* than 10%!

To all of the IEEE volunteers who made all of the 2004 accomplishments possible, I thank you very much. I didn't do it by myself. The members of the Region Committee and their counterparts on the Sections all worked together to make 2004 a very successful year for IEEE Canada.

I look forward to working with you in 2005 to exceed the accomplishments we achieved in 2004. Finally, I want to thank my very good friend JF Forget, an accountant by profession, who has translated my columns for the Canadian Review and translated the Governance Structure which has been posted to our website. Merci beaucoup, mon ami.

As we begin the New Year, I wish you and your families a very prosperous 2005.

W.O. (Bill) Kennedy, P.Eng., FEIC
IEEE Canada & Region 7 - Director/Président, Calgary, AB
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a aussi fait des gains importants en terme de groupes affiliés. Félicitation aux directeurs de ces comités pour leurs accomplissements.

Lors de la réunion régional de Calgary en octobre, le budget pour 2005 a été adopté, ainsi que des buts et objectifs avec des valeurs établis. Pour la première fois, le comité de la Région a approuvé des buts et objectifs avec des valeurs établis pour IEEE. Ces buts et objectifs vint être suivi par le nouveau Comité Exécutif. Un rapport pour les Sections sera produit pour leur permettre de suivre et de rapporter leur progrès dans l'accomplissement de ces buts et objectifs. Les buts pour 2005 sont très ambitieux, mais ils peuvent être atteints avec l'aide de tous. Un des buts est d'augmenter notre enrôlement de 10%. Cela semble être un pas de géant. En 2004, l'enrôlement avec IEEE a augmenté de 3%, sans grand effort de notre part en tant que groupe. Une augmentation de 10% peut être atteinte avec la participation de tous. Demandé à un collègue, a un ami - ensemble nous pouvons y arriver!

Je tiens à remercier tous les volontaires de IEEE qui ont permis les réussites de 2004. Je n'y suis pas arrivé par moi-même. Les membres du Comité de la Région 7 et ceux des Sections ont tous travaillé ensemble pour faire de l'année 2004 un succès pour IEEE Canada.

C'est avec plaisir que j'entrevois travailler avec vous en 2005, espérant surpasser les résultats de 2004. Finalement, je voudrais remercier J-F Forget, un ami et comptable de profession, pour la traduction de mes articles et celle de la structure de gouvernance, qui se trouve sur notre site Web.

Avec l'Année Nouvelle qui commence, je voudrais vous souhaiter et aux vôtres santé et prospérité pour 2005.

Engineering Institute of Canada Conference

Climate Change Technology: Engineering Challenges and Solutions in the 21st Century

May 9-12, 2006 - Ottawa Congress Centre, Ottawa, Ontario, Canada

www.ccc2006.ca

The EIC is taking the lead to raise engineering awareness and action to find solutions that mitigate or adapt the effects of climate change.

It is unprecedented in recent times for so many societies band together on a common theme. Such is the importance of global climate to human existence, that this initiative was immediately endorsed by the EIC's member societies with collaboration by CCPE, ACEC, CAE, OSPE, and PEO.

This conference will interest engineering and environmental technology practitioners of all disciplines.

1.0 Conference Tracks:

1. Policy, Strategy and Regulations
2. Monitoring & Recording GHG Emissions & Climate Indicators
3. Engineering for Mitigation (Reductions and removals of GHG)
4. Engineering for Adaptation (Allowing for CC in infrastructure design)
5. Financial & Risk Management
6. Continuing Education & Engineering Roles
7. Standards & Protocols
8. Modeling & Analysis

2.0 Information:

2.1 Guidelines for proposing abstracts:

Terrance Malkinson at malkinst@telus.net, Phone: 403-282-1065

2.2 General Information:

John Plant, Executive Director EIC, jplant1@cogeco.ca, Phone: 613 547 5989

John Grefford, Chair Conference Organizing Committee, grefford@ieee.org, Phone: 613-839-1108

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IEEE Canada

CCGEI 2005

"Eclairons nôtre future"

18e Conférence Canadienne de génie électrique et informatique

1 – 4 mai, 2005, Saskatoon Inn

Saskatoon, Saskatchewan, Canada

La conférence canadienne de génie électrique et informatique 2005 de l'IEEE offre un forum pour la présentation de travaux de recherche et de développement dans les domaines du génie électrique et du génie informatique provenant du Canada et du monde. Des communications en français ou en anglais sont sollicitées sur des sujets qui incluent, mais ne sont pas limités à :

- Systèmes à base d'agents et sur Internet
- Communications et systèmes sans fil
- Traitement de signal et conception de filtres
- Électromagnétisme, optique et photonique
- Contrôle de procédé/Automation industrielle
- Robotique et mécatronique
- Réseaux et systèmes informatiques
- Réseaux neuronaux et logique floue
- Bases et exploration de données
- Électronique et systèmes de puissance
- Machines électriques et entraînements
- Circuits, Systèmes et ITGE
- Microélectronique et Optoélectronique
- Systèmes en temps réel et embarqués
- Architectures avancées d'ordinateurs
- Production de l'énergie et énergies renouvelables
- Informatique nomade
- Calcul haute performance
- Génie logiciel
- Systèmes intelligents
- Calcul évolutionniste
- Réalité virtuelle et vie artificielle
- Simulation et visualisation
- Interaction personne-machine
- Nanotechnologie et nanorobotique
- Antennes et EMC/EMI
- Micro-ondes et RF
- Bioinformatique
- Télédétection et applications
- Théorie du Contrôle et applications
- Ingénierie biomédicale
- Instrumentation et mesure
- Aérospatiale et Avionique

1.0 Compétition de soumission par étudiants

Veuillez soumettre votre article en suivant la procédure décrite ci-haut. S'il vous plaît, lisez les informations trouvées sur la page "Français", sous "Appel de communications" et "Fonds pour étudiants".

2.0 Dates Importantes

Date limite pour l'inscription: **Vendredi, 28 février, 2005**

Date limite pour la soumission finale des articles: **Vendredi, 28 février, 2005**

3.0 Expositions industrielles

Veuillez contacter le responsable des liaisons industrielles et des expositions afin d'obtenir des informations au sujet des présentations industrielles durant la conférence.

Si vous êtes intéressés par CCGEI 2004 et voudriez être ajouté à notre liste de distribution, veuillez contacter le secrétariat de la conférence à l'adresse inscrite à gauche. Notre site Internet sera mis à jour régulièrement.

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IEEE Canada

CCECE 2005

"Shining Light on Our Future"

18th Annual Canadian Conference on Electrical and Computer Engineering

May 1 - 4, 2005, Saskatoon Inn

Saskatoon, Saskatchewan, Canada

The 2004 IEEE Canadian Conference on Electrical and Computer Engineering provides a forum for the presentation of electrical and computer engineering research and development from Canada and around the world. Papers are invited, in French or English, including but not limited to the following topics:

- Advanced Computer Architecture
- Agent-Based & Internet-Based Systems
- Bioinformatics
- Circuits, Systems & VLSI
- Computer Networks & System
- Database & Data Mining
- Electromagnetics, Optics & Photonics
- High-Performance Computing
- Instrumentation & Measurement
- Microelectronics & Optoelectronics
- Nanotechnology & Nanorobotics
- Power Electronics & Systems
- Process Control/Industrial Automation
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- Aerospace & Avionics
- Antenna & EMC/EMI
- Biomedical Engineering
- Communications & Wireless Systems
- Control Theory & Applications
- Electrical Machines & Drives
- Evolutionary Computation
- Human-Machine Interactions
- Intelligent Systems
- Mobile & Pervasive Computing
- Neural Networks & Fuzzy Logic
- Power Systems & Renewable Energy
- Real-Time Embedded Systems
- Robotics & Mechatronics
- Software Engineering
- Virtual Reality & Artificial Life

1.0 Student Paper Competition

Please submit your paper using the on-line submission process using the same web page as noted above in 1.0. Please read the information provided in the "Call For Papers" and "Student Funding" pages of our web site.

2.0 Important Dates

Registration must be received by: **Friday, February 28, 2005**
Final papers must be received by: **Friday, February 28, 2005**

3.0 Industrial Exhibits

Please contact the Exhibits Chair at the Conference Secretariat for information about industrial exhibits at the conference.

If you are interested in CCECE 2004 and would like to be added to our contact list, please contact the Conference Secretariat at the address on the left. Check our Web site regularly for news and updates.

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