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IEEE Canadian Review

The Big-Screen World of Imax
Robotics in Canadian Forestry
Security System Integration in High Rise Buildings
IEEE Canada : the lights are still green

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IEEE Canadian Review General Information

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

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

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

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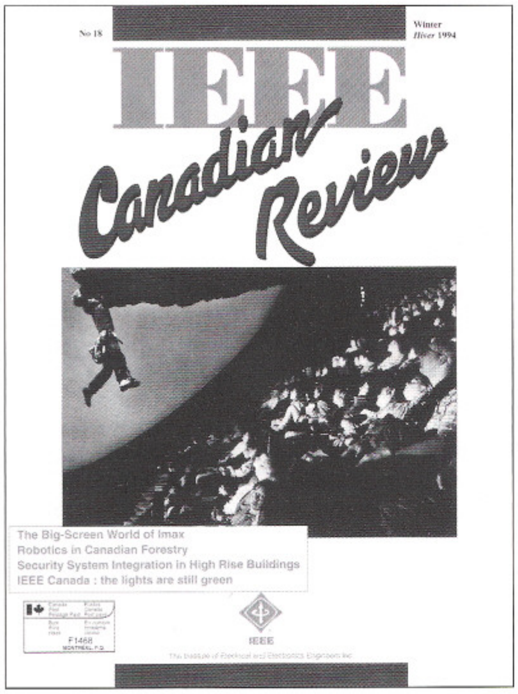
Cover picture

Imax Corporation of Toronto has seen its various IMAX® formats develop into a worldwide network of 106 theatres, with another thirteen to open this year. Here is the interior of an IMAX® DOME theatre

Tableau couverture

Au cours des 25 dernières années, la Société IMAX de Toronto a réussi à implanter les formats IMAX® dans 106 salles à travers le monde et elle prévoit l'ouverture de treize nouvelles salles cette année. Voici l'intérieur d'une salle IMAX® DOME.



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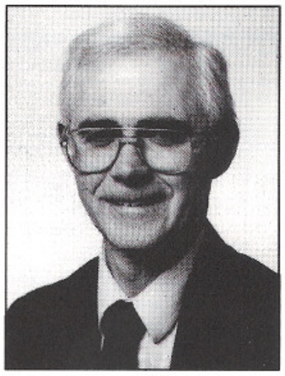
DIRECTOR'S REPORT

by Ray Findlay
Director, IEEE Canada
McMaster University
Hamilton (Ontario)
L8S 4K1
e-mail : atr.findlay@ieee.org.



How fortunate I am to be your Director at this exciting time in the history of IEEE Canada! We have wonderful opportunities to build in our one-country Region, opportunities unique to Canada. I would like to share my vision with you: that IEEE Canada cements its role as the leading Region in the world.

We are working together with the Canadian Society of Electrical and Computer Engineering (CSECE) to become Canada's largest national technical society. This year we are operating conjointly with CSECE until the legal arrangements can be worked through and we become one. Then we will be a national society within the largest technical society in the world!

We have the opportunity to build on a remarkable national conference, The Canadian Conference on Electrical and Computer Engineering. The conference, which we have jointly sponsored with CSECE for the past few years, is our Region's technical showcase. We need to support it, to help it grow. To that end, I am hoping that there will be a great flurry of activity to produce papers for the Conference, and that both practicing engineers and others will get behind it (see "Call for Papers" in this issue).

I am especially concerned that we develop applications-type papers, aimed at the working engineer. If you know someone with specialized expertise, encourage them to put it on paper and send a summary to the Technical Program Chair before 30 March. This Conference can grow to be an international showcase for Canada's technical excellence. Let's make it work!

We already have a great vehicle for communications, this Review. As some members told us in our survey last year, the IEEE Canadian Review is a tangible benefit for Canadian members. Let's help it to grow as well. To do that we need to advertize it, and to sell advertizing in it. When you are through with your copy show it to others who may be interested in joining IEEE, or use it in a campaign to tell the profession about its worth as an advertizing vehicle.

We have a strong and viable membership, people who care about their profession and are prepared to work to ensure its future. However, we need to promote our society more actively. For example, we can make a difference to Canada's economy, even at local levels, by encouraging educational opportunities in the high-tech business. We can use the resources of the profession wisely to help industry get back on its feet. Our Society Chapters can be excellent vehicles for developing a dynamic approach to promoting Canada's electrical and electronic industries. From power to satellite communications, Canada can be the technical leader.

Our graduates are among our best resources. However, I am not sure we are making best use of them. How do we keep them interested in the profession in these tough economic times? How do we provide them with the resources to find and hold onto a job while all the major employers are restructuring? We can help our younger engineers by using the strengths of our Sections to provide both training and job networking. For example, the hiring rate for last year's Electrical Engineering graduating class at McMaster University, at graduation, was only 38%. Statistics for related programs (computer science, computer engineering, ets.) at McMaster and at other universities in Canada are comparable, if not poorer. Canada cannot afford to lose these young technical specialists. So I hope every member in the Region will work with me to help put them to work in the profession.Finally, I come to our Student members, down by almost 9% from last year. We need to do more to help the students realize their potential within the profession. To do that, we need to capture their interest, support their endeavors, and provide encouragement. Sections, Chapters, and individual members can all make a difference. Those retired members with time on their hands, who might be looking for ways to improve the profession, could meet with the local Student Branches, act as mentors, assist students to find out about the real working world, and give sage advice on how to get projects underway.

We can be working to improve our Society, for the benefit of all, just as your Society is working to improve itself. There has been a great deal of activity at the IEEE Service Centre lately, including a strong emphasis on improving the quality of service to members. I shall have an opportunity to work on the Quality Committee in the coming months, so I will keep you informed of its progress.

As well, our new VP Educational Activities, Ken Laker, has undertaken a strong effort to improve the educational resources of IEEE worldwide. He has invited me to be a part of his team: on your behalf I accepted. I have already realized that there are many resources within that group, everything from Career Development to videos on leading edge technology, and these resources are available to us. In the coming months I will keep you informed about other opportunities.

As for the business of the Region, my predecessor, Vijay Bhargava, who took over the Region just when it was beginning to suffer from financial chaos, has turned the ship over to me with a shiny surplus to help get underway. From the many people who have taken the time to call me or drop me an e-mail, I have realized that the Canadian identity is an integral part of IEEE Canada. We need to give it a home, and we will. Your Region Executive Committee has endorsed my plan to open a Region Office again, but this time we will put safeguards in place to ensure that expenses do not exceed income.

What else? Well, if you have a problem with IEEE, please tell me and give me the opportunity to help you solve it. If you have great plans for your Section or Chapter or Student Branch but can't seem to get things going, let me help you, or if you have some ideas on how to improve IEEE or IEEE Canada, tell me about them. Let's work together. Drop me an e-mail at atr.findlay@ieee.org or write to me at McMaster University, Hamilton, Ontario L8S 4K1.

RAPPORT DU DIRECTEUR

par Ray Findlay
Director, IEEE Canada

Je suis privilégié d'être votre directeur en ce moment unique de l'histoire de IEEE Canada! Nous avons de magnifiques opportunités propres à notre réalité nationale à exploiter . J'aimerais partager ma vision avec vous : ***que IEEE Canada solidifie son rôle en tant que Région de pointe au niveau mondial.***

Nous travaillons de concert avec la Société canadienne de génie électrique et informatique (SCGEI) afin de devenir la plus grande société technique nationale du Canada. Cette année, nous opérons conjointement avec la SCGEI jusqu'à ce que les arrangements légaux soient complétés et que nous ne formions plus qu'une société nationale à l'intérieur de la plus grande société technique du monde!

Nous avons l'occasion de renforcer notre position par le truchement d' un congrès national remarquable : le Congrès canadien en génie électrique et informatique. Ce congrès, que nous avons conjointement commandité avec la SCGEI ces dernières années, est l'exposition technique de notre Région. Nous devons l'encourager, l'aider à grandir. À cette fin, j'espère qu'il y aura beaucoup activité en vue de préparer des articles pour ce congrès autant de la part des ingénieurs pratiquant la profession que les autres (voir "Call for papers" dans ce numéro).Je suis particulièrement intéressé à ce que nous favorisions des articles axés sur les applications et qui seront destinées à l'ingénieur au travail. Si vous connaissez quelqu'un qui possède une expertise spécialisée, encouragez-le(la) à l'écrire et à envoyer un résumé à la Chaire du programme technique avant le 30 mars. Ce congrès peut croître jusqu'à devenir une exposition internationale de l'excellence technique du Canada. Faisons en sorte que cela fonctionne!

Nous avons déjà un formidable moyen de communication : ce magazine. Comme quelques-uns de nos membres nous l'ont souligné lors du sondage de l'année dernière, ***IEEE Canadian Review*** est un bénéfice tangible pour les membres canadiens. Aidons-le aussi à grandir . Pour ce faire, nous devons annoncer et vendre l'espace publicitaire. Lorsque vous avez terminé la lecture de votre exemplaire, montrez-le à d'autres qui pourraient être intéressés à se joindre à IEEE ou bien mettez-le à l'affiche lors d'un évènement pour informer la profession de sa valeur en tant que véhicule publicitaire.

Notre membership est grand et durable. Nos membres s'intéressent à leur profession et sont prêts à travailler pour le futur. Cependant, nous devons promouvoir plus activement notre société. Par exemple, nous pouvons nous engager sur le plan économique canadien, même à un niveau local, en encourageant les occasions éducatives dans les entreprises de technologie de pointe. Nous pouvons utiliser les ressources de la profession avec sagesse afin d'aider l'industrie à se remettre sur pieds. Les différentes sections de la Société IEEE peuvent être d'excellents véhicules de développement avec une approche dynamique à la promotion des industries électriques et électroniques canadiennes. De l'énergie aux satellites de communication, le Canada peut être un meneur technologique.

Nos finissants comptent parmi nos meilleures ressources. Cependant, je ne suis pas persuadé que nous les valorisions comme il se doit. Comment conserver leur intérêt pour la profession dans un contexte économique aussi difficile? Comment pouvons-nous leur fournir les ressources nécessaires pour qu'ils trouvent et conservent un emploi tandis que les employeurs se préoccupent de restructuration? Nous pouvons aider les jeunes ingénieurs en utilisant les forces de nos sections pour fournir à la fois de la formation et un réseau d'emploi. Par exemple, l'an dernier, le taux d'embauche des finissants en génie électrique à l'Université McMaster, était seulement de 38% à la fin de l'année. Les statistiques pour les programmes rattachés à McMaster ainsi qu'aux autres universités du Canada sont comparables, sinon moindres. Le Canada ne peut pas se permettre de perdre ces jeunes spécialistes techniques. Ainsi, j'espère que chaque membre de la Région se joindra à moi afin d'aider nos finissants à pratiquer notre profession. Finalement, j'en arrive à nos membres étudiants, dont l'affluence a diminué de près de 9% depuis l'an dernier. Nous devons les épauler davantage afin qu'ils réalisent leur potentiel dans la profession. Pour ce faire, nous devons capturer leur intérêt, soutenir leurs efforts et les encourager. Les sections ainsi que les membres individuels peuvent faire la différence. Il y a sûrement parmi nos membres retraités des gens qui auraient du temps à consacrer à l'amélioration de la profession auprès de nos jeunes. Ils pourraient rencontrer les sections étudiantes locales et agir comme mentors; les aider dans leur recherche des réalités du marché du travail; donner des conseils éclairés sur la façon de démarrer des projets.

Nous pouvons travailler pour le mieux-être de notre Société, pour le plus grand bénéfice de tous, tout comme votre Société travaille pour s'améliorer elle-même. Il y a eu passablement d'activités au Centre de service IEEE ces derniers temps et une grande emphase sur l'amélioration de la qualité du service auprès des membres. J'aurai l'occasion de travailler au sein du Comité sur la Qualité lors des prochains mois et je vous tiendrai au courant de son progrès.

De plus, notre nouveau vice-président aux activités éducationnelles, Ken Laker, a entrepris un effort important afin d'améliorer les ressources éducationnelles de IEEE dans le monde entier. Il m'a invité à prendre place dans son équipe; j'ai accepté en votre nom. Je me suis rendu compte que le groupe possède plusieurs ressources, du développement de carrière jusqu'aux films vidéo sur les technologies de pointe. Dans les mois à venir, je vous tiendrai au courant d'autres occasions.

Quand aux affaires de la Région, mon prédécesseur, Vijay Bhargava, qui prit la relève de la Région alors qu'elle commençait à souffrir d'un chaos financier, m'a cédé les commandes avec un joli surplus pour aider à la reprise. Grâce aux nombreuses personnes qui ont pris le temps de me téléphoner ou de m'envoyer un message électronique, j'ai réalisé que l'identité canadienne fait partie intégrante de IEEE Canada. Nous devons lui donner un foyer, et nous le ferons. Votre comité exécutif régional a endossé mon plan d'action pour rouvrir le Bureau Régional, mais cette fois, nous établirons les structures nécessaires afin de s'assurer que les dépenses n'excèdent pas les revenus.

Quoi de plus? Et bien si vous avez un problème avec IEEE, veuillez m'en informer et me donner l'occasion de vous aider à le résoudre. Si vous avez des difficultés à démarrer un grand projet pour votre section étudiante, permettez-moi de vous aider. Si vous avez des idées sur la façon d'améliorer IEEE ou IEEE Canada, envoyez-moi un message électronique à atr.findlay@ieee.org ou écrivez-moi à l'Université McMaster, Hamilton, Ontario L8S 4K1. Travaillons ensemble!

THE BIG-SCREEN WORLD OF IMAX

New ways of seeing the movies

It is not the purview of this article, in an electrical and electronics magazine, to offer a treatise on motion picture technology. What follows is therefore much-simplified, which some readers will rightly object to on a variety of levels. To them, our apologies in advance.

It is important to understand that the quality of images projected from film is limited by the amount of image information per unit area on the film. Even with the best modern film stocks and processes, magnification much in excess of 400X results in "grain" (the particles of silver halide that make up the image) and other artifacts becoming objectionable in the projected image.

To show pictures that provide the audience with wide fields of view, on large screens and with acceptable quality, one must start with a correspondingly-large image on the film, and keep the magnification within bounds, considering the close proximity of the audience to the screen.

The "standard" motion picture format, since the days of Edison, has been based on an image four perforations (perf) high on 35mm wide film. With the advent of sound, the frame rate was standardized at 24 frames per second. However, because of the sensitivity of the human eye to flicker at 24 Hz, each frame is projected twice to give a 48 Hz flicker rate.

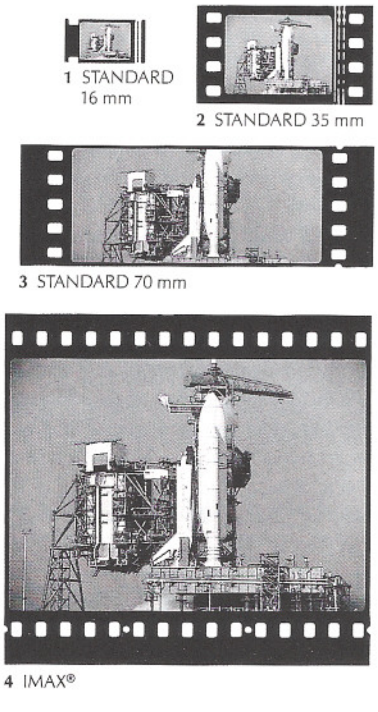


Figure 1 : Comparison of film formats, showing 16 mm, 35 mm, standart 70 mm, IMAX 70 mm 15 perforations

by J. Crieghton Douglas

Almost since the invention of motion pictures, large-screen "grandeur" film formats have been tried, only to disappear again. Best-remembered in recent times were Cinerama and the various "scope" formats of the 1950's and 60's. Over the past 25 years, Imax Corporation of Toronto has seen its various IMAX® formats develop into a world-wide network of 106 theatres, with another 13 to open this year. This article tells about it.

Depuis l'invention du cinéma, différents formats de film ont vu le jour pour disparaître presque aussitôt. Rappelons-nous le grand succès du Cinérama ainsi que des différents formats «Scope» dans les années '50 et '60. Au cours des 25 dernières années, la Société IMAX de Toronto a réussi à implanter les formats IMAX ® dans 106 salles à travers le monde et elle prévoit l'ouverture de 13 nouvelles salles cette année.

Throughout the history of motion pictures there have been sporadic attempts at "grandeur" formats. In the 1950's, prompted by the demon of television, there was renewed interest in large formats, which led to the introduction of 70mm film as a medium for "spectacle" films.

Flowing from this came *Cinerama* (1952), which used three adjoining 35mm full-frame 6-perf projectors to get beyond the traditional frame boundaries in both height and width. Projection was on a deeply-curved wide screen and the process used an eight-track magnetic reproducer to present sound quality commensurate with the 1950's concept of "high fidelity". The results were impressive, but the complications of multiple cameras, colour balance between multiple prints on multiple projectors running in interlock, proved too great for the system to become a commercial success.

History of IMAX

Imax Corporation (Imax) was incorporated in late 1967 as Multiscreen Corporation by founders Graeme Ferguson, Robert Kerr, and Roman Kroitor. They were joined early in 1968 by engineer Bill Shaw, an old friend from Galt Collegiate. The company name was changed to Imax in the mid-70's.

The Montreal International Exposition, Expo '67, became a focal point for avant-garde multi-screen audio-visual and film technology. Some of the best-remembered of these included Disney's 360° Circlevision for the *Telephone Association of Canada*, the *Czech Pavilion*, the *Cominco* pavilion, the 70mm film "A Place to Stand" at the *Ontario Pavilion*, the revolving multi-screen theatre of *Man and the Polar Regions* and multi-screen, multi-theatre *Labyrinthe*.

The founders of Imax played major roles in the latter two presentations, and wanted to apply their expertise in multi-image motion pictures to the World's Fair to be held in Osaka, Japan, in 1970. However, their experience with multiple projectors and complex hardware at Expo '67 prompted them to search for a better projection system which would avoid the problems inherent in conventional projectors and allow multiple images from a single strip of film.

The answer lay in a completely novel film-advance mechanism, called the "Rolling Loop". Instead of accelerating and decelerating the film 24 times a second by forces applied through the sprocket holes, the film was formed into successive "loops", each one frame in length, with the sprocket holes used only for final location of the frame in the aperture. Positioning accuracy was much better and wear and tear on the film greatly reduced. A simple analogy from the world of nature is the inchworm, which forms a series of loops as it crawls along the branch.

Getting Started

The fledgling company signed a contract with the Fuji Group to produce a film for Expo '70 at Osaka, Japan, and convinced the client to take their new Rolling Loop projection system as a condition of the deal. Beginning in January, 1968, they had a bare two years to produce the film "Tiger Child" for Fuji and design and build the large-format projector to run it. It all worked, and the pavilion was a huge success.

Figure 2 : IMAX ® projector of Scottsdale, Arizona

That first projection system came back to Ontario Place in Toronto, which was just being completed in 1971, and opened with the IMAX film "North of Superior". After Ontario Place, the company had no other presence in Canada until 1979, when a system was installed at Niagara Falls and the third four years later at the Edmonton Space and Science Centre.

In the interval, well over 40 systems were installed in the U.S., Europe, Indonesia, Japan and Mexico. The extensive network of theatres at last count (1994) was 106 in 18 countries. Of these, ten are in Canada (the most recent in Calgary), 51 in the U.S.A., with 14 in Europe, 13 in Japan, 3 in Australia, 6 in Mexico, and 3 in Australia. Staff now hovers around the 200 mark, not including subsidiary companies.

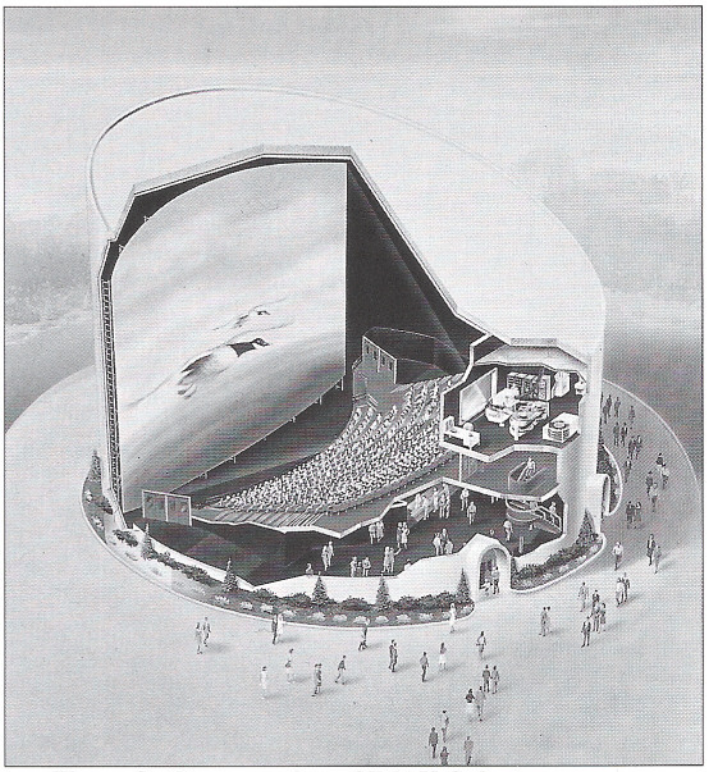


Figure 3 : Cut-away view of IMAX ® theatre

Variations on a Theme

The same basic film system appears in a variety of guises, often under different names. First was IMAX, with a very large rectangular screen up to 110 by 85 ft (33.5 by 26 meters), followed in 1973 by OMNIMAX® with tilted dome hemispheric screen which can be up to 89 ft (27 meters) in diameter. Both formats are still going strong, though the latter is now known as "IMAX DOME".

The IMAX theatre at the Canadian Museum of Civilization in the National Capital Region is interesting in that it has both a convertible projector, and convertible screens as well. The 23 meter IMAX DOME screen can be hoisted out of the way and a 19 by 26.6 meter rectangular IMAX screen raised at the front of the same seating deck, all in less than 5 minutes and with the audience present. An interesting show in itself!

Large-screen stereo pictures were provided by IMAX 3D at Expo'86, using two IMAX films with polarizing filters on the projectors and polarized glasses for the viewers.

IMAX SOLIDO®, premiered at Osaka Expo '90, provides three-dimensional wrap-around images on a wide-field dome screen. The images are carried on two films through a single projector head. Projector shutters are interlocked to show right eye and left eye images alternately, at a 48 Hz rate for each eye, 96 Hz total. The right-eye/left-eye images are sorted out at the viewers' eyes by cordless glasses incorporating LCD-shuttered lenses.

These viewing glasses (some would call them a headset or a mini-helmet) have a large LCD shutter lens for each eye. Battery-powered electronics mounted in the glasses drive the lenses and derive their synchronizing information from infrared signals broadcast in the theatre. Power consumption in both operating and quiescent states is low enough that primary battery life is several months.

Infra-red signals broadcast throughout the theatre synchronize the LCD shutters with the projector shutters. This show was repeated at Seville Expo '92.

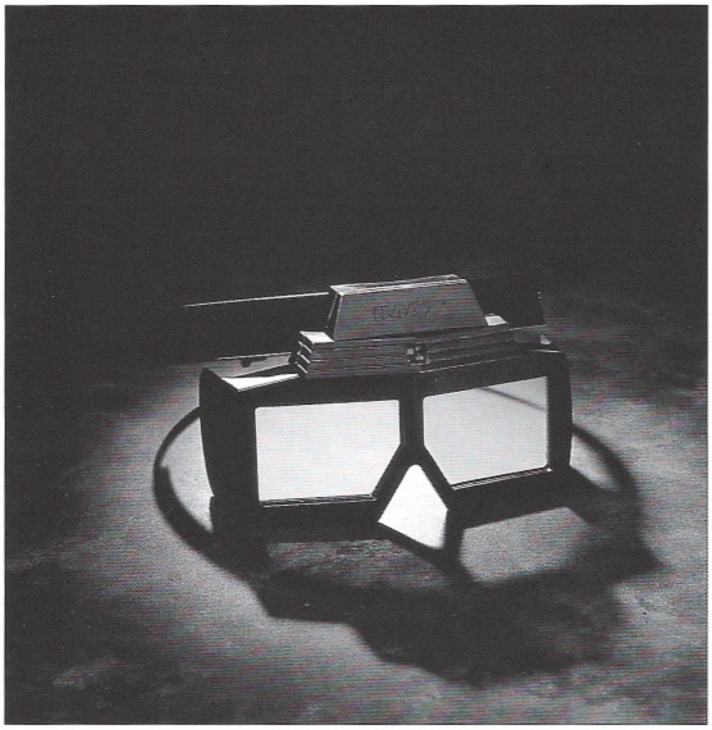


Figure : 4 IMAX SOLIDO ® battery-powered wireless LCD-shuttered glasses

IMAX Magic Carpet at Expo '90 offered "fly-over" capability, with a large rectangular screen at the front of the auditorium and a horizontal screen below a "see-through" deck for downward viewing.

IMAX HD is a high-definition enhancement first shown at the Seville World's Fair in 1992. It establishes a new standard for motion-picture image quality, with IMAX-format images running at 48 frames per second, and each frame projected only once. This greatly reduces strobing and other motion artifacts with subjects in rapid movement. There is also a subjective improvement in apparent resolution and a reduction in grain or noise, due to integration of grain between successive frames.

Yet another variant is the use of IMAX technology in simulators. Universal Studios in Florida includes a very effective "Back to the Future" ride with simulated automobile cars on motion-bases in an IMAX DOME screen.

The *Parc du Futuroscope*, near Poitiers, France, is interesting because it has almost every IMAX format, as well as some other audio-visual systems, in a compact audio-visual theme park. IMAX, IMAX DOME, IMAX SOLIDO and IMAX Magic Carpet.

Electronic Imaging

Imax has a natural enough interest in electronic imaging, but isn't worried by television (not even high-definition television) in the near term. An IMAX-grade picture would require the equivalent of about 6,000 lines by 8,000 lines of TV resolution, or $48x10^6$ pixels.

The company maintains an active electronic-imaging research unit, which provides electronic image processing for special scenes. One notable example was the California earthquake sequence in the film "Blue Planet".

The first film to be entirely computer-generated was *The Magic Egg*, followed by *We Are Born of Stars*. The IMAX Solido film *Echoes of the Sun* included much computer-generated footage, while computer sequences were included in *Urgence/Emergency* and *Blue Planet*.

Power Requirements

From an electrical engineering point of view, some of the interesting things are very big, others quite small. An IMAX system draws about 80 kVA all-in, 3D almost twice that, so one doesn't just plug it in the wall. Having gone into so many different countries, with differing standards and different electrical supply systems, voltages and frequencies, company engineers became quite adept at accommodating these variables. The solution: make sure that everything you provide will run happily on either 50 or 60 Hz. Also, go with your own multi-tapped isolation transformer to supply all the 4-wire 120/208 power you need, from whatever the local mains offer.

Interestingly, standards seem to cause more annoyance in North America than elsewhere. Manitoba Hydro had never heard of Ontario Hydro Special Inspection. Various jurisdictions in the U.S.A. don't want to know about C.S.A., some of them not much about UL, or anything but the fee to the local Electrical Inspector. But you haven't lived until you have had the engineers from C.E.P. (*contrôle et protection*) in Paris, demanding that branch circuit-breakers be two-pole, to interrupt the neutral as well as the hot wire, or checking the resistance of the longest run of control wiring to be sure that a short-circuit at the end will trip the breaker.

Projection light sources are short arc xenon lamps, ranging from 4 kW to 15 kW. The latter are water-cooled and the rectifier will provide up to 450 continuous amperes at about 37 volts dc. It's really a good-sized welding machine in drag.

Cameras and the Complete System

The first step is to record the *image*, by exposing a roll of *negative film* in a *ciné-camera* through a taking *lens*. The camera moves the film one frame at a time, normally at 24 frames per second (IMAX HD at 48 frames), and accurately *registers* each successive frame in the *aperture*. A *shutter* cuts off light to the film while it is being moved and opens again to expose the next frame of film.

Since all IMAX formats utilise 15 perforations per frame and the image size is ten times the area of standard 35mm, a complete film production system is required. This includes ciné cameras, taking lenses and accessories, underwater housings, print-down facilities for editing, high frame-rate cameras for IMAX HD, to name but a few items.

Ciné cameras, being relatively free-ranging devices, are normally battery-powered. The camera must operate reliably at sound speed (24 frames per second), crystal-controlled, or at other fixed or variable speeds for special effects. Feed and take-up magazines, holding up to 2,700 feet of film, must provide controlled torque from the same portable source.

Stereoscopic camera systems for 3D filming originally relied on mounting two standard cameras in a complex "rig" with synchronous drive. Mirrors were required to achieve the correct interocular spacing and the assembly was difficult to align and awkward to use. Imax has recently developed a compact stereoscopic camera, combining two film movements, taking lenses with the correct interocular spacing, and a viewfinder, all in a small, prealigned package.

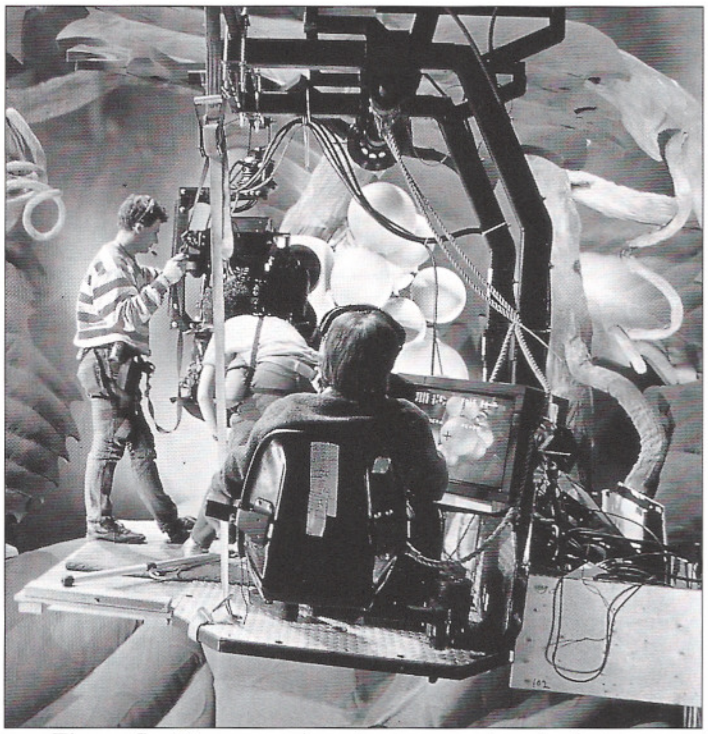


Figure 5 : 3D camera rig using two synchronized standard IMAX ® cameras

From a single camera and multi-screen editing system for Expo '70, all these have been developed as needed by Imax and made available to the large-format film industry on a conventional rental basis.

Sound

From the first permanent theatre installation, Imax and more recently its subsidiary sound company, Sonics Associates Inc. (Sonics), have been committed to truly high-quality cinema sound. IMAX films have always been *double-system*, that is with picture and sound on separate media. Until 1987, the six tracks for the multi-channel sound were carried on sprocketed 35mm magnetic film, running at 18 inches per second. The high linear speed, combined with wide tracks, provides good frequency response and excellent signal-to-noise ratio.

Since 1988, sound for an increasing number of IMAX films has been distributed in digital format. The playback system, developed by Imax and Sonics, uses three or four Compact Discs, controlled by *Samplelock®* technology. This provides not simply lip-sync between tracks, but phase-accurate sync between all six channels. Accuracy must be such that any two channels can be used as a stereo pair, whether from the same disc or not.

There are six main sound channels, each with a Sonics Proportional Point Loudspeaker™ system, especially designed to cover the wide seating angles typical of IMAX and IMAX DOME theatres. Proprietary asymmetrical constant directivity horns are concentrically mounted such that they do not cause the phase interference between elements so typical with "off-the-shelf" designs. Each channel is driven with 1,300 watts of power from amplifiers with built-in crossover networks specifically designed for these speakers. Each of these loudspeakers can deliver program levels of 105 dB SPL. There is also a sub-bass system with at least eight 18-inch drivers, each driven by a 400-watt amplifier. Added up, that's 11,000 watts of audio power available.

Sonics has also recently introduced the IMAX Personal Sound Environment system (IMAX PSE), which provides the sound equivalent of 3D at the listeners' ears by means of cordless head-worn transducers, for use with 2D, 3D and IMAX SOLIDO systems.

Imax Today

Imax is a private Canadian company and as such does not publish financial information. At last count, the world distribution of Imax 106 theatres is as follows : U.S. 51, Canada 10, Europe 14, Japan 13, Mexico 6, Asia 9, Australia 3. Recent news reports have estimated annual sales at around $75 million and a change of ownership is being negotiated.

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About the author

Creighton Douglas received his B.Sc. degree and a Graduate Diploma in Management from McGill University, and learned about hands-on electronics by repairing tube radios in his home town of Sutton, Quebec. With Canadian Marconi Company he was part of the team that brought television to United Nations in New York in 1950, moved from television to radio as Engineering Manager of CFCF. From there, he oversaw design and construction of one of the first private TV stations in Montreal.

At Expo '67 he encountered multi-screen and large-screen film formats as Technical Co-ordinator and later Manager of the NFB Labyrinthe Pavilion. In 1968 he joined the National Film Board, and went on to other Government assignments before joining Imax Corporation in 1981, from which he "retired" in 1991.

ROBOTICS IN CANADIAN FORESTRY

Four Approaches and Applications

by Jean Courteau
Forestry Engineering Research Institute of Canada

This article presents a brief overview of the Canadian forest industry, an analysis of woodlands equipment in terms of its potential for applications of robotics technologies, and associated operational constraints. A showcase of four Canadian development initiatives is also presented, ranging from improved operator interfaces to full-fledged robot autonomy. These examples illustrate different approaches and techniques used to formulate robotic solutions to the practical and demanding applications commonly found in forestry today.

Cet article offre un aperçu de l'industrie forestière au Canada et présente une analyse des équipements forestiers en termes d'applications potentielles des technologies robotiques. Quatre projets canadiens de développement en robotique y sont mis en évidence, allant d'interfaces opérateur améliorées à la robotique autonome. Ces exemples servent à illustrer l'approche et la technique utilisée dans l'élaboration de solutions robotiques répondant aux besoins pratiques et exigeants des applications forestières.

The forest industry

The forest sector is Canada's most important industry in terms of net contribution to the economy (in 1990 its contribution to the trade surplus was $19 billion, and it generated 3.1% of the GDP), numbers employed (293 000 jobs, of which 49 000 are in forest operations), and socioeconomic importance (300 communities are solely dependent on this industry). Forest operations, which encompass harvesting, forest tending and transportation, are highly mechanized, which accounts for Canada's unequaled productivity in this sector.

As has been the case for any other technology-intensive industry, forestry has undergone many adaptations and trends. Lightweight alloys developed during WWII led to the development of the modern chain saw, and advances in hydraulics led to the articulated skidder. These two innovations revolutionized the forest industry, transforming it from a labor-intensive seasonal activity that employed out-of-work farmers and fishermen during winters, into an industry with a professional work force, engaged in year-round and highly mechanized operations.

This is the third in a series of articles about robotics, of which the first was «Robotics in the 1990's» by Paul Freedman (Winter '93) and the second was «Robotics and Automation in Mining» (Fall '93).

Forest operations

Forest operations can be divided into three major activities: harvesting, transportation and silviculture. Although transportation is an important component of forest operations, it will not be described in depth in this article because of its limited potential for robotics applications. Canadian forest equipment manufacturers specialize in the design and production of implements and tools that are retrofitted to modified construction equipment or specially designed forestry carriers.

A wide variety of designs are used for off-road forestry equipment, each one adapted to particular operating conditions or functions. However, all types share a common characteristic: the use of diesel-powered mobile hydraulics to accomplish mechanical work. Electro-hydraulics have had limited use, being mostly limited to «on-off» functions rather than proportional control. Two fundamental harvesting methods are used in Canada: felling with processing at roadside (full-tree systems), and felling with processing at the stump (cut-to-length systems). Processing at the stump is more environmentally acceptable, as limbs and leaves are left to decay on the forest floor. This can be a more expensive alternative, however, as productivity is frequently lower than with full-tree harvesting.

Mechanization is now widespread in the Canadian forest industry. So is the need for improved controls and interfaces that relieve operators of low-level decisions to enable strategic decision-making. For instance, operator controls on articulated knuckle booms are not intuitive, which accounts for the lengthy and costly training periods required. Machines that must navigate on cutovers are particularly stressful as they require much of the operator's concentration to concurrently accomplish the work at hand while avoiding damage to the machine, or worse yet, personal injury. Even though modern forestry equipment provides adequate operator protection, tipping a machine or sliding down a hillside will still result in personal injury and/or equipment damage.

In summary, harvesting and silvicultural operations are inherently well suited for robotic applications for the following reasons:

- repetitive tasks must be performed;
- articulated or prismatic manipulators with simple geometries are widely used;
- operators must repeatedly make numerous low-level decisions (equipment operation, task planning), and have little time for the more profitable high-level decisions (maximize wood use, protect operating sites, control maintenance costs);
- qualified operators are rare;
- training and repair costs are disproportionate to the financial capabilities of forest contractors;
- despite widespread mechanization based on mature technologies, ergonomics continue to be a major concern for operators.

Although the advantages of robotic technologies are obvious, certain operational, economic and social factors characteristic of the forest industry must be considered:

- wood is a commodity; its price is regulated by commodity market conditions, thereby requiring production costs to be minimized, even at the expense of technological innovation (e.g., contractors will not invest in new technology until it becomes more profitable than old technology);
- from a control systems point of view, forestry equipment represents a technical challenge: nonlinear hydraulic systems are used exclusively, the operating environment is highly unstructured, and operating conditions are extremely harsh;
- service and maintenance must be technically simple, and the technology must be robust enough to survive erratic scheduling;
- the forest industry is the backbone of rural economies in Northern Canada. The social costs of labor displacement or reduction should be seriously considered before "inflicting" technological innovation on rural populations;
- sound forest management practice assumes that successive generations of technology improve the environmental impact of forest operations.

Research initiatives in Canada

Most of the research done in Canada has been guided by a very practical constraint: the maximum purchase price of harvesting equipment varies between $400 000 and $500 000, and marketing experience shows that the incremental cost of new technology should remain within 15 to 20% of the purchase price of new equipment. Developmental efforts have therefore been focused on cost-effective, efficient solutions, as demonstrated in the following examples.

Deterministic classical control

Dr. Stanislaw Tarasiewicz, Université Laval

This feasibility study was completed in 1989, on behalf of Industries Tanguay, a Quebec-based forest equipment manufacturer. The study was meant to be the first phase of a large development project aimed at the full automation of the Tanguay FB 221 feller-buncher . Later phases called for multi-sensor fusion (combining data from different kinds of sensors to obtain a single, more reliable datum) including automated tree species identification and the use of machine vision to position the boom and felling head.

The suggested control strategy was based on the premise that all inputs to the system are deterministic. In practical terms, it assumed that given a reasonably accurate model of the feller-buncher, PID (proportional integral derivative) control could achieve the desired performance and response. Using this approach, it was expected that the model could thus achieve automation through classical state-variable optimization. The typical work cycle of a feller-buncher consists of the following steps:

1) move the machine up to the tree line;

2) cut and accumulate trees in the felling head;

3) swing and pile the trees in a compact bunch while avoiding obstacles;

4) repeat steps 2 and 3 until the trees are outside the machine's work envelope;

5) repeat step 1.

Using this information, each possible output state was expressed as the combination of actions or work (e.g., swing, pile, cut) performed by the machine's four actuators (three lift cylinders and a slewing motor).

A natural extension to the output state description was to describe the input state variables as functions normally achieved by the machine's two joysticks. Since the machine would be operated automatically, combinations of functions normally unattainable by a human operator had to be avoided in order to avoid sudden pressure losses and erratic behaviour. A control computer or a PLC (programmable logic controller) was therefore proposed to synchronize spool displacements in the hydraulic valves to prevent these undesirable states when using multiple functions simultaneously.

The boom's work envelope was also divided into discrete cells, whose horizontal area was proportional to average tree diameters. Mapping the work envelope made it possible to plan trajectories from one cell to another.

The approach was mechanistic, and skirted the modelling of system dynamics and perturbations. However, given the state of the art in computing power and the cost of computer hardware at the time of this study, the proposed approach was certainly well founded, as its stated goal was the production of a commercial product. As proposed, the control system seemed simple enough to be implemented on a PLC. Unfortunately, a physical model was never built and its performance characteristics remain unknown. In retrospect this work does provide a starting point from which to formulate more complete control strategies for complex control systems such as those of a feller-buncher. Further, it provides useful insights on mobile hydraulic systems.

Physical Model Approach

Dr. Peter Lawrence, University of British Columbia

Logging operations in British Columbia are different from those in eastern Canada. Most operating sites are located on steep slopes and cable logging equipment is used instead of off-road equipment. The control systems in some machines, such as cable yarders (figure 1), can be an ergonomic nightmare. In some older machines, operators are required to use both feet, hands, knees and elbows simultaneously to actuate the throttle, winch clutches and brakes. To make matters worse, little or no standardization existed from one machine to the next when the project

Figure 1 : The Madili grapple yarder operating in Coastal British Columbia

started, even on «simple» machines such as excavators and knuckle-boom loaders. To researchers in Engineering and Computer Science at the University of British Columbia (UBC), the benefits of coordinating the control of the various moving parts of the cable yarder, were eminently clear. This recognition initiated the resolved-motion-rate control project, which was jointly funded by MacMillan Bloedel Inc., Robotics Systems International, and NSERC (Natural Sciences and Engineering Research Council of Canada) grants to UBC at its outset. This application was first investigated on a knuckle-boom type loader which was provided by Caterpillar.

The approach taken by UBC and its team was diametrically opposed to Industry Tanguay's, in that they systematically and thoroughly modeled all machine actuators, control valves and system dynamics instead of first modeling gross control functions and state variables. The UBC researchers subsequently verified the model with high-fidelity graphical simulations to determine if the system response was acceptable to experienced operators and also to study the learning curves of novice operators (university students). The results obtained continue to make waves in the Canadian forest industry and have also caught the attention of European equipment manufacturers. Coordinated control not only reduces operator fatigue, but also speeds up the learning process in novices and widens the range of potential operators. This innovation has had very practical repercussions: the overcrowded operator console typical of cable yarders can know be replaced by a single hand controller.

Resolved-motion-rate control dates back to the late 1960s; however, only recently have advances in electro-hydraulics and computing technology made it possible to obtain real-time control of a machine the size of an excavator. Real-time control with a detailed kinematic and dynamic model requires substantial computing power, and older technologies could not achieve the compactness or ruggedness required for operation in forest equipment. In this respect, the UBC researchers and its team deserve recognition for having realized the world's first working industrial electro-hydraulic resolved-motion-rate controller for excavator-based machines.

More recently (1993), a modified version of the system controller was installed in a feller-buncher and field-tested in British Columbia. In this version, each hydraulic actuator was powered by a dedicated pump instead of using an electro-hydraulic pilot to control the main valves. The system was well received by operators and machine owners alike; however, the cost effectiveness of such a system has not yet been proven. Consequently, this has prompted a return to electro-proportional valves and a new prototype currently undergoing field tests in Kelowna, B.C. Such systems are now commercially available from RSI Research in Victoria and this patented technology is available for licensing from UBC.

Applied Subsumption

Dr. Peter Kourtz, Petawawa National Forestry Institute (PNFI)

Approximately one billion trees are planted each year in Canada to ensure that forests are sufficiently regenerated to produce future crops. Achieving this goal is much more involved than simply planting seedlings and moving on to the next site. Competition from undesirable species, as well as diseases and insects, require that sites be overstocked (trees are planted on a 2 m by 2 m spacing) initially to ensure that enough crop trees remain at the end of the rotation. Regular tending is also necessary to weed or thin the plantations to maximize the final tree size. Because of public pressure, the forest industry can no longer rely on the practice of burning to re-establish stands, or use herbicides to control undesirable vegetation.

Such constraints have largely limited stand tending to mechanical treatments such as weeding and brushing. These are labor-intensive and

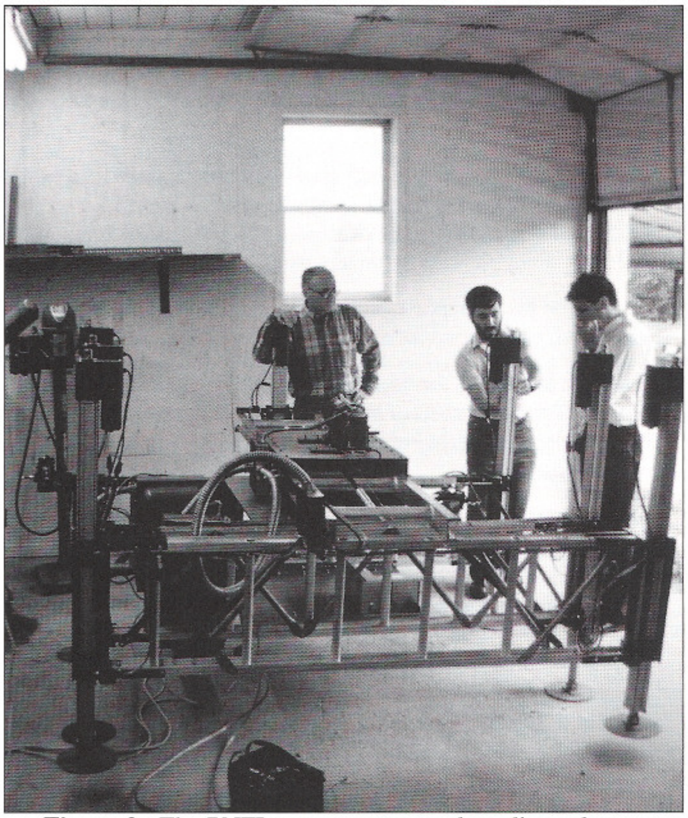


Figure 2 : The PNFI autonomous stand-tending robot

costly operations (costs range from $600 to $1000 per hectare versus harvesting costs of approximately $2000 per hectare). Such costs are difficult to justify financially, especially to an industry that for years has had a continuous supply of naturally regenerated forests. In this light, the Petawawa National Forestry Institute (PNFI) has initiated a project aimed at developing a fully autonomous stand-tending robot (Figure 2) based on the Martin Marietta Beam Walker configuration. PNFI's robot however, has been built at a fraction of the cost, and frugality permeates every aspect of this project. The robot's name («JACOB») for instance, is project leader Peter Kourtz's tongue in cheek way of alluding to the robot's structural members: aluminum ladders purchased at a local hardware store.

The control system is a practical application of the subsumption architecture developed by Rodney Brooks of MIT for his «robot-insects». This project is based on the underlying premise that using the subsumption architecture, a team of cheap robots could be trained to work cooperatively 24 hours a day with minimal supervision and servicing. The robot tasks would be planned and carried out based on proven heuristics. The sensory information needed to shape the robot's behaviour is provided by machine vision sensors, position actuators, GPS (Global Positioning System) positioning and a gyrocompass.

The robot's mechanical design is aimed at achieving maximum stability while providing sufficient agility to navigate over rough terrain. It consists of two main structural elements, a lower "table" with four legs and an upper "beam" that are connected by a rotational joint. Locomotion is achieved by lifting the beam off the ground and then moving it with respect to the table. The beam's legs are then lowered, the table legs lifted and then moved with respect to the beam. Steering is done by rotating the beam with respect to the table. The seven legs (three on the beam, four on the table) consist of electromechanical actuators with pressure pads on their ends, and can be individually actuated to level the robot on sloping ground.

The choice of control hardware also reflects the project's devotion to frugality. Dedicated Motorola 68HC11 microcontrollers form the backbone of the control system, and real-time operation is achieved with a realtime programming environment (REXIS). The subsumption architecture was implemented by assigning a hardware controller to each function. For instance, the locomotion function is controlled by three dedicated microcontrollers, each communicating with a fourth master microcontroller. Inhibition, an integral part of the subsumptive model, is achieved by disabling functions through special error lines.

The JACOB beam walker has a bright future ahead. Peter Kourtz and his team have managed to keep hardware costs below $10 000 and it is expected that a commercial unit would cost about $40 000. Such a low price should make JACOB a commercial success (the defense industry has already indicated that it would make an ideal expendable tool for land mine removal). The PNFI team is currently tackling the problem of machine vision and candidly admit that this problem holds no trivial solutions. Scene interpretation in structureless environments such as a weed-choked young plantation is a major challenge by any standard. The team is in no hurry, however, and has given itself a 10-year time horizon in which to teach JACOB the rudiments of forest stand tending.

ATREF: the integrated approach

Dr. Denis Poussart, Centre de recherche informatique de Montréal and Université Laval

The most recent Canadian initiative in applying robotic techniques to forestry equipment is ATREF, a French acronym for «Application des Technologies Robotiques aux Équipements Forestiers» (Application of robotics technologies to forestry equipment). The project is partly funded by the Quebec government's SYNERGIE program, whose objectives stress the acceleration of technology transfer from Quebec's research community to the private sector. The remainder of the funding comes from the project's industrial partners: the Forest Engineering Research

Figure 3 : The FERIC C-180 forwarder in operation

Institute of Canada (FERIC), Denharco Inc., and Autolog Inc. The research members are the Centre de recherche informatique de Montréal (CRIM), McGill University's «Research Centre for Intelligent Machines» and Université Laval's «Groupe de recherche pour l'avancement de la productique» and «Laboratoire de vision et de systèmes numériques».

The ATREF project has three major development components: an adaptive coordinated controller for the boom end-effector, design and engineering tools for simulating the dynamic behavior of alternative mechanical configurations, and a training simulator for operators. The approach taken by the project team is similar to UBC's in that a complete model of the system's static and dynamic behavior will be established before actually building a physical prototype. One difference in the two projects lies in the extent of the modeling effort: the ATREF model will also include system disturbances such as tire-and-soil deformation effects. The FERIC C-180 forwarder (Figure 3), an experimental full-tree forwarder designed in 1986, will be used as the system test bed.

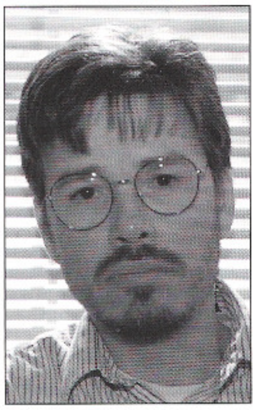
The controller will incorporate adaptive control strategies similar to those employed to stabilize the Canadarm manipulator's dynamics in zero gravity. Rubber-tired forest machines exhibit a similar type of rocking behavior and low pressure tires such as the ones used on the C-180 forwarder amplify this disturbance because of the greater tire deformation. The adaptive coordinate changer will also be designed to dampen the dynamic effects of freely coupled boom end-effectors such as loader grapples and processing heads, and will dynamically level the machine as it navigates in rough terrain.

What makes ATREF unique is its stated aim to produce a set of readily marketable technologies by the end of the project. The industrial partners are therefore obliged to take a hands on approach during the development phases to ensure that all components chosen are field proven and commercially available. The project is only in its initial stages and one can only conjecture if the proposed approach will restore technological leadership to Canada's forest equipment industry.

Conclusion

The forest industry is the locomotive of the Canadian economy and therefore deserves to be at the forefront of technology. The future holds many challenges such as tougher competition from timber-rich eastern Europe, and from countries that benefit from longer growing seasons. Stricter environmental regulation at home and abroad, and fierce marketing from foreign equipment manufacturers are also part of this new reality. Canadian equipment manufacturers will have to strive to develop homegrown technologies rather than adapt technologies developed elsewhere and designed for different operating conditions. As stated in a policy paper presented by the Canadian Science council in 1988, "Innovation can be done in two ways: either adapt existing technology to Canadian conditions or develop indigenous technology. The first method leads to technological dependence while the second leads to technological leadership and greater productivity gains" (Hayter 1988). The research and development efforts presented in this article are an encouraging step in the right direction.

About the author



Jean Courteau has been with FERIC since 1982, where he is supervisor of the Specialized Technologies Group. He has concurrent responsibilities in GPS-based land navigation, non-contact wood measurement techniques and is currently participating in the ATREF project. He has been a member of the IEEE and of the Ordre des ingénieurs du Québec since 1989.

SECURITY SYSTEM INTEGRATION IN HIGH RISE BUILDINGS

by Douglas A. Rowlands
Executive Director, Marketing, Sales and Service
ADT Security Systems

The purpose of an integrated system in a high rise building is to help the security manager control all aspects of a building situation without the need to individually operate independent systems. In a crisis situation, such as during a fire, integration can mean the difference between a compromised security system and a secure system or, worse yet, it might mean the difference between life and death.

As with any sophisticated electronics, an integrated security system is only as good as the people who understand, operate, and use it. With today's advanced technology, it is easy to inundate an operator with a myriad of controls and information.

An integrated solution is designed to automate the decisions and actions that security officers have to take without them being electronics specialists, and to allow them to concentrate on the most important tasks, not only in a crisis, but in their increasingly complex day-to-day activities which are having a significant impact on the profitability of building developers.

L'intégration des systèmes de sécurité dans de bâtiments d'envergure offre au personnel de sécurité un meilleur contrôle sur la gestion des événements qui pourraient se produire

Ainsi, on pourra agir plus rapidement pendant des crises telles que les incendies.

Néanmoins, un système intégré pose de défis techniques et cognitifs accrus car son utilisation efficace passe par la maîtrise de sa complexité par le personnel de sécurité qui ne sont pas, certes, des spécialistes en électronique.

De plus, le système devra offrir une certaine aide à la prise de décision pour que le personnel soit davantage en mesure de se concentrer sur les tâches importantes à la fois pendant des crises et dans la vie quotidienne, afin de veiller, en bout de ligne, sur la rentabilité même de l'opération de bâtiment.

High rise office buildings having a multitude of tenants represent one of the more difficult applications of integrated security equipment. Many building developers are asking security companies to provide solutions to meet the needs of their tenants, while minimizing maintenance and overhead costs. In this article, we examine how this challenge can be addressed through the integration of (a) fire alarm, (b) intrusion detection, (c) access control, and (d) closed circuit television (CCTV) systems.

First, it is important that the developer understand why an integrated system is required. This may not be intuitively obvious, but once he examines each of the security system components and understands their possible interrelationship, a clear advantage for an integrated approach can be seen. A case can also be made for cost savings, since an integrated system should be easy to operate, and the same central control equipment can quite often provide a variety of security services.

The best approach for offering an integrated system is to participate in the design phase of the high-rise building. This can be done by dealing with the customer's Security Director and Facilities Planning Group, or through direct contact with the developers. In most instances, a consulting engineer is employed to design basic electrical services. Assisting him in the specification stage is instrumental.

FIRE ALARM SYSTEM

The fire alarm system is often overlooked by security companies because it requires compliance with published codes and, in some jurisdictions, a special installation license is mandated. However, many corporations do not have a Life Safety Director, and the operation of the fire alarm system usually falls under the responsibility of security personnel.

Think about it! Any time a fire alarm is initiated the security guard must, by building code, unlock all electrically controlled means of egress and evacuate all personnel by the most expedient means possible. In a high rise building all elevators are returned to their designated fire positions or to the ground floor. A high rise building usually permits people to evacuate the fire floor, the floor above and the floor below the fire. During this time most security precautions are ignored or bypassed and people are allowed to evacuate the building using the stairs.

Traditional security devices can be used in an integrated fashion with the fire alarm system to augment fire detection capabilities while maintaining security. An example of this would be the ability to activate and automatically orient CCTV cameras based on input from the fire detection system. An integrated system can accomplish this without operator involvement; the security staff can visually examine the area for smoke before physically investigating the premises. This is a distinct safety feature because investigating a fire in a high rise building could be time consuming and perhaps prove dangerous to an investigator. It is also a benefit for fire fighters since they know what to expect before overriding the elevator control system and proceeding to the fire floor.

CCTV cameras located at the exits can also be automatically activated to begin recording in a high speed switching format for later review. With a digital switcher/recorder several cameras can be recorded on a single video tape and, later, individual cameras can be viewed to examine the sequence of events.

The access control system would automatically be disabled during a fire but it too can be used as a tool to augment the fire security system. Since the central computer in an integrated system would know where people were before the fire, an access control reader could be used outside the

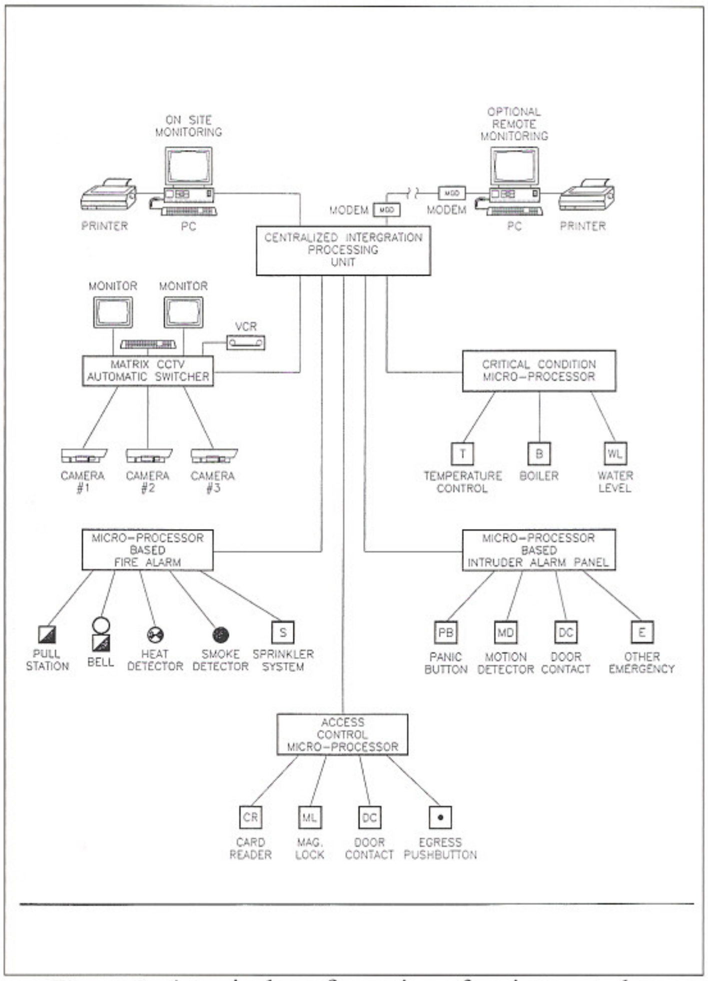


Figure 1 : A typical configuration of an integrated system (courtesy of ADT Canada Inc.)

building to ensure all people located in the fire areas have evacuated. A list of persons who had logged into the fire areas but did not log in on the reader outside the building could be generated by the security staff and presented to the fire fighters.

The design of a fire system for a high rise building should consider these system integration possibilities in addition to the standard requirements of a fire system.

Standard fire system integration requirements for a high rise building would include connection to the heating, ventilation and air conditioning (HVAC) systems for fan control, pressure level controls, supply and exhaust damper controls and manual override capability. As mentioned previously, an interface to the elevator controller is required to return all elevators to the ground floor or the next lowest means of egress. All electric door locking mechanisms must be bypassed and all fire doors must be automatically closed for compartmental containment. When desired or required by building code, an emergency voice evacuation system would also be incorporated providing two-way fire fighter communication with each floor.

Most jurisdictions require the use of smoke detectors in all public areas, or full sprinkler systems (many new buildings use both).

Further design requirements can be found by using the National Fire Protection Association (NFPA) standards in addition to local and national building codes and may, in fact, be required by the authority having jurisdiction.

ACCESS CONTROL

Access control, as part of an integrated security management system, provides an effective, flexible and reliable solution to security control problems. The system can operate with card readers, keypads or combination units (which provide for validation by personal identification numbers (PINs). Identification technologies such as Wiegand, magnetic strip, proximity, bar code and biometric recognition (such as hand geometry) can be utilized.

The basic operation of a card access system remains the same regardless of the number of doors connected and offers efficient solutions for key control problems, lost keys and illegal duplicates while facilitating easy access for authorized personnel.

Access control systems are more and more being used to control elevators in high rise buildings or, more precisely, the elevator floor selection. Some manufacturers of these control systems have formed partnerships with major elevator control companies to accomplish this "elevator control" via a digital interface. This is very important in a multi-tenant building since once access past the lobby has been gained most buildings permit tenants to wander freely. This means each tenant must take steps to provide his or her own security measures.

Access control systems are also being used to allocate energy usage for after-hours activity. Since a record of who-went-where-when is maintained, the building management group can easily provide special billing. Naturally, access during after-hours can be controlled through the access control system, thereby minimizing security staffing requirements.

The access control system is an ideal candidate for integration with basic perimeter intrusion detection. If a person is authorized to gain access, then the security detectors for that area should automatically be turned off for a sufficient time to allow perimeter access. This function should be accomplished in the software of the system rather than simply relying on a hardware solution, which could be compromised.

INTRUSION DETECTION

Basic lobby perimeter protection should be provided by the developer to detect unauthorized entry after regular hours. Doors and windows permitting access to the lobby should be protected by means of magnetic contacts, glass break sensors and/or electronic motion sensors.

In a multi-tenant, high-rise office building, tenants should have complete local control over their interior intrusion detection system. For alarm reporting these systems can be integrated with the central building security computer or linked to a remote central monitoring station.

Multiplex wiring techniques should be used within each tenant's area to accommodate changes and permit easy expansion. Point addressable systems are most widely used in this application since they use multiplex communication technology and permit individual identification and location of security sensors.

CLOSED CIRCUIT TELEVISION (CCTV)

Closed Circuit Television cameras are ideal for monitoring outdoor parking areas, parking garages and other areas which are normally not visible to the security guard. Recent technological advances in CCTV cameras which now use micro-chip technology, make them highly reliable and almost maintenance-free.

Cameras provide an excellent means for verification (as was described in a fire situation). Cameras can also be used to confirm the presence of an intruder or provide additional access control verification. Even in instances where security officers are not on site, camera systems can be used to automatically transmit still frame images to a remote monitoring point.

Visible camera systems offer a deterrent to crime since the presence of a camera suggests someone is watching or a video recording is being made of all activities. The video recorder can prove an invaluable tool in determining exactly what happened

Technological advances in CCTV equipment have had a significant impact on user friendliness and cost. Digital switching/recorders permitting the recording of several cameras on one tape with individual playback capabilities, quad splitters permitting the monitor screen to be divided into quadrants for simultaneous viewing have all contributed to CCTV equipment gaining wide acceptance.

CENTRALIZED INTEGRATION (CI)

In a high rise office building, integration of services has many installation advantages. A security system communications network can be wired from the ground floor to the roof in a "riser" fashion. This network can provide all necessary communication with the central computer. The number of data-gathering panels (controllers) can be selected based on building requirements and wired into the network.

The type of data-gathering panels will vary with building particulars, but it is usually better to provide a panel designed with a specific task in mind. In this manner the Fire Alarm Panel, Access Control Panel, Intrusion Detection Panel and CCTV Controller can be connected to the network (if permitted by the building code), but each will be capable of functioning independently of the central computer. This provides the best of both worlds : stand-alone local capabilities and integrated network capabilities.

The CI computer would be used to tie all of the independent systems together and form a unified network of security systems. Any event which could be augmented with other security equipment operation would be initiated automatically through the CI which would also act as a central means of logging historical information. This, combined with the relational database, gives the security management group a very powerful means of collecting data.

The relational data base would also be used for day-to-day security functions normally handled manually. This could include such things like logging the removal of equipment from the building, keeping track of visitors, tracking maintenance activities, and so forth.

CONCLUSION

Integrated security systems are one of the fastest growing segments within the security industry. They offer much more than conventional security systems in providing effective management controls at substantial savings, flexibility, and accountability are maintained along with interactive ease of use, while providing maximum security.

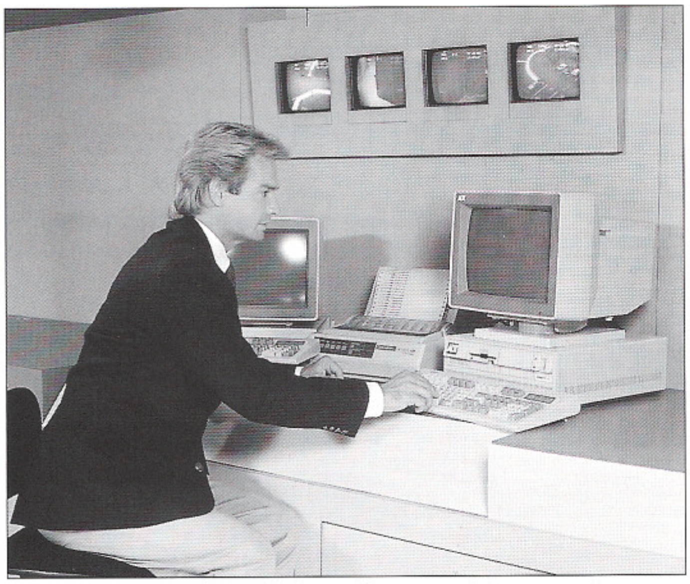


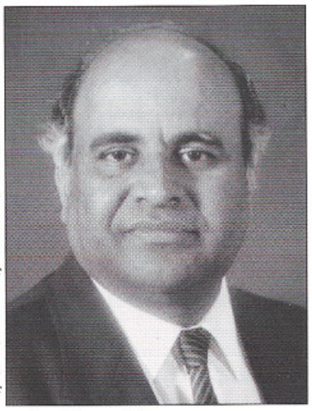
Figure 2 : An installation of an actual integrated system (courtesy of ADT Canada Inc.)

About the author

Douglas A. Rowlands joined ADT in 1958 as a sales representative. He has held assignments in all Canadian regions and joined the Corporate staff in 1983 as executive Director, Marketing, Sales, and Service. He is currently responsible for marketing, national account sales, technology, telecommunications as well as supply and distribution.

Mr. Rowlands was a long-term director of CANASA (Canadian Alarm and Security Association) and served as President in 1987 and 1988. He is past chairman of several national committees, and received the R.A. Henderson Memorial Award in 1992 for "extraordinary achievements within the alarm industry and who has made significant contributions to the advancement of the interests of the entire industry".

Dr. Vijay Bhargava Elected IEEE Vice President



Dr. Vijay K. Bhargava, Professor in the Department of Electrical and Computer Engineering at the University of Victoria in British Columbia, has been elected 1994 Vice President of Regional Activities by the Assembly of The Institute of Electrical and Electronics Engineers, Inc. (IEEE).In this capacity he will serve as Chairman of the Regional Activities Board and as a member of the IEEE Board of Directors and Executive Committee.

The IEEE is the world's largest technical professional society, with approximately 320,000 members in 150 countries. The IEEE Assembly consists of 23 members in leadership positions, all of whom have been directly elected by the voting members.

An active member of the IEEE since 1970, Dr. Bhargava served the Institute in 1992-93 as Region 7 Director. Among his other IEEE activities, Dr. Bhargava has been a member of the Regional Activities Board and the Educational Activities Board.

Dr. Bhargava has written numerous books and publications, and has served as a consultant for various industries and government agencies. In addition, he developed several short courses for practicing engineers. He is a Fellow of the IEEE, the Engineering institute of Canada and British Columbia Advanced Systems Institute. He received Bachelor's, Master's and Doctoral degrees from Queen's University in Kingston, Ontario.

IEEE CANADA :

The lights are still green

by *B. John Plant, Tony R. Eastham, Robert, T. H. Alden, Raymond D. Findlay*

The memberships of both IEEE Region 7 and CSECE have signalled their approval of the move towards amalgamation of these two organizations to form IEEE CANADA, by referendum and by Special General Meeting, respectively. The two organizations, while still legally separate, are now collaborating with Board/Executive Committee linkages and joint activities. It is anticipated that IEEE CANADA will be established with legal status in Canada effective from January 1, 1995.

Les membres de IEEE Region 7 et de la société canadienne de génie électrique et informatique ont tous les deux approuvé la démarche vers la mise sur pied d'un seul organisme, IEEE Canada. Pour l'instant, les deux organismes existants fonctionnent toujours de façon distincte, mais ils continuent à renforcer les collaborations afin de rendre plus facile la fusion éventuelle prévue pour janvier 1995.

Background

The Fall '93 issue of the IEEE Canadian Review carried an article entitled IEEE CANADA: The Decision is Yours. In this article, the authors reviewed the background and process by which IEEE Region 7 and the Canadian Society of Electrical and Computer Engineering (CSECE) were moving towards amalgamation to form IEEE Canada. The rationale for the merger and the benefits that should accrue to electrical and computer engineers in Canada were presented.

The article provided information about the budget and mode of operation of IEEE CANADA during 1994, and it concluded with a description of the process by which the memberships of CSECE and Region 7 would decide upon the merger issue.

CSECE Decision

CSECE is separately incorporated in Canada and is a Member Society of the Engineering Institute of Canada. Accordingly, a Special General Meeting of the Society was called for November 6, 1993 in Montréal. All members of CSECE received notification that four motions would be offered at this meeting, as follows:

1. Whereas Article V of the Letters Patent (dated August 22, 1990) for the incorporation of the Canadian Society for Electrical and Computer Engineering provides as follows:
   «It is specially provided that in the event of dissolution or winding-up of the Corporation all its remaining assets after payment of its liabilities shall be distributed to one or more recognized charitable organizations in Canada».

   It is moved that said Article be amended as follows:
   «It is specially provided that in the event of dissolution or winding-up of the Corporation all its remaining assets after payment of its liabilities shall be distributed to one or more organizations carrying on similar or cognate objects.»
2. Whereas it is understood that a new organization, IEEE CANADA, will seek recognition as the Canadian Region of IEEE and as a Member Society of the Engineering Institute of Canada, it is moved that the CSECE approve the collaboration of CSECE with IEEE Region 7 to form said new organization, to be called IEEE CANADA, to represent the interests of electrical and computer engineers in Canada.
3. Whereas it is anticipated that IEEE CANADA will be established with legal status, it is moved that CSECE approve collaboration with IEEE Region 7, through the offices of the President of CSECE and the Director of IEEE Region 7, such that activities be amalgamated in such a way that IEEE CANADA, although without legal status, will be operational with effect from January 1, 1994.
4. It is moved that CSECE be dissolved and its assets transferred to IEEE CANADA on condition that:
   (i) IEEE Region 7 members approve the merger.

   (ii) IEEE CANADA be established with legal status in Canada.

   (iii) The establishment of IEEE CANADA with legal status in Canada be approved by the IEEE Board of Directors and that IEEE CANADA be recognized as the Canadian Region of IEEE.

   (iv) IEEE CANADA be recognized by the Engineering Institute of Canada as a Member Society. All motions were passed unanimously by members attending the Special General Meeting.

IEEE Region 7 Decision

At the last Regional Meeting of IEEE Region 7, held in Vancouver in September 1993, it was agreed that it was necessary and appropriate for the members of IEEE Region 7 to have the opportunity to express their opinion on the merger in a referendum. The article in the Fall '93 issue of the IEEE Canadian Review, which was mailed to all members, therefore included a ballot with a simple statement:

I am in favour of the merger of IEEE Region 7 and CSECE to form IEEE CANADA : YES / NO

Gerry Turcott, President of the Ottawa-Carleton Research Institute (OCRI) agreed to receive the votes, by mail or by fax, and to act as official teller. He reports that, as of December 31, 1993, the following ballots had been received:

YES: 240 **NO: 10**

At a meeting in Montréal in January, the 1994 Executive Committee of

IEEE Region 7 agreed that the results of this vote provided a mandate from the membership to proceed towards amalgamation with CSECE to form IEEE CANADA.

The Way Ahead

Both memberships have now approved the move towards amalgamation. CSECE and Region 7, while still legally separate organizations, are therefore collaborating with a common set of activities such that IEEE CANADA, although without legal status, has been operational since January 1, 1994. Each organization retains a separate Board/Committee for administration purposes, but a number of common links are facilitating joint operations. Thus:

- Ray Findlay serves as Director of Region 7 and IEEE representative on the Board of CSECE
- Tony Eastham serves as President of CSECE and Vice Chair of Region 7
- Louis-André Poulin serves as Treasurer of both organizations, with the assistance of Micha Avni, Past Treasurer of Region 7
- Mo El-Hawari serves as Awards & Recognition Chair of both Region 7 and CSECE
- Michael Lecours serves as Editor of the Canadian Journal of Electrical and Computer Engineering and as Secretary of Region 7.

The Bylaws of IEEE CANADA have been drafted and, after further amendment, will be distributed to all Section Chairs of Region 7 for approval at the Regional Meeting in Ottawa in early May 1994. These Bylaws will then be submitted to the IEEE Board of Directors at its Summer 1994 meeting with a request to formally approve the formation of IEEE CANADA and to recognize this organization as Region 7 of the IEEE.

We are currently seeking legal advise upon the matter of whether or not IEEE CANADA should be separately incorporated as a non-profit organization in Canada. The resolution of this question will, of course, have an impact on the Bylaws of IEEE CANADA. This question therefore needs early resolution.

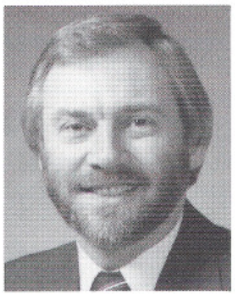
As the title of this report indicates, the lights remain green for the establishment of IEEE CANADA. We believe that it can and should be achieved with effect from January 1, 1995.

Thank you all for your continuing support of the good cause.

Authors

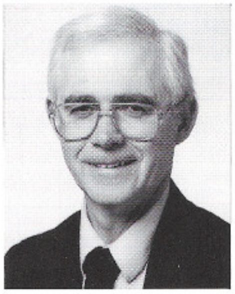
B. John Plant
Past President, CSECE
First Vice-President, Engineering Institute of Canada

Robert T. H. Alden
Past Vice-President IEEE (Regional Activities)
Past Director
IEEE Region 7



Tony R. Eastham
President CSECE
Vice Chair IEEE Region 7

Raymond D. Findlay
Director IEEE Region 7



CANADIAN JOURNAL OF ELECTRICAL AND COMPUTER ENGINEERING

The *Canadian Journal of Electrical and Computer Engineering* is a Canadian Scientific Journal published quarterly by the Canadian Society for Electrical and Computer Engineering.

Material is accepted for review and possible publication under three main headings:

A) **Technical papers** of between 3,000 and 8,000 words concerned with original research, current electrical and computer engineering practice or the history of electrical and computer engineering relevant to the Canadian scene.

B) **Short papers** directed to brief descriptions of new technical achievements, comments on the contents of previously published papers, or items of general interest to Canadian Electrical Engineers.

C) **Application articles** related to novel realizations, or major system implementations.

For information : Professor **Michel Lecours**, Director, CJECE, Electrical Engineering Dept., Université Laval, Quebec, Que G1K 7P4. Tel: (418) 656 2966, Fax: (418) 656 3159 e-mail: mlecours@gel.ulaval.ca

A few words from the Managing Editor

By Paul Freedman
Managing Editor
Lead Researcher
CRIM
1801 McGill College, suite 800
Montréal (Québec)
H3A 2N4
Fax : (514) 398-1244
e-mail : freedman@crim.ca

In the Fall '93 issue, I tried to describe the kinds of things I think are important when developing new articles to appear in the IEEE Canadian Review. They should be topical, technically informative, and somehow Canadian. And that's why I am especially pleased with the Winter '94 feature article about IMAX, and I hope to be publishing many more articles about Canadian success stories in the future.

De plus, pour la toute première fois, les propos du nouveau directeur, Ray Findlay, sont présentés en français.

Behind the scenes, things are also changing. Thanks to the «Call for Associate Editors» which appeared in the previous issue, there are some new names on the magazine masthead and some new articles in the works.

In the Fall '93 issue, I also suggested that steps would be taken to try to reduce the costs of preparing and printing the IEEE Canadian Review. As the results in Table 1 indicate, real costs (before any advertising revenue) were only slightly reduced, even though we are now working with the printer in electronic form. . The figures in parentheses indicate the number of copies actually printed and mailed.

In addition, for the first time, the Review has obtained a fixed price contract with the current printer, Productions DDO, for the three issues to be published in 1994. While I hope to further reduce some of the magazine layout costs here at CRIM, it's clear that advertising revenue also deserves special attention (see Ray Findlay's comments in the "Director's Report"). In October 1993, I consulted with the Publishing Editor of IEEE Spectrum to define some advertising guidelines for the Review (what is suitable, what is not). Then in January 1994, I sought the help of the Region 7 Executive Committee to develop what I hope will become an effective way of generating advertising revenue: a professional to be paid on commission working with a volunteer «Advertising Coordinator» in each of the three Councils.

In the beginning, the Review relied exclusively upon a professional based here in Montréal for advertising but this policy was abandoned in favour of a volunteer «Advertising Manager». Well, there was just one paid ad in the Fall '93 issue, and there are none in this issue. Clearly, something must done, and long before the next issue goes to press, I plan to have the new team up and running.

But the key to attracting advertising is planning and for this reason, I have added actual publishing dates for the Winter, Spring/Summer, and Fall issues to the inside front cover. With enough planning, I also hope to be able to give the advertising team advance notice about the articles coming up in each issue, so that certain business sectors may be more carefully targeted.

Table 1: Comparing costs for the Spring '93 and Fall '93 issues

Description	Spring '93 (16,860)	Fall '93 (17,200)
Magazine preparation (including printer's setup)	12,621.46	10,293.36
Magazine printing	10,169.28	10,373.82
Total cost	22,790.74	20,667.18
Cost per copy	1.25	1.20

And if you have read all the way down to here, I'd like to think that it's because you care about the IEEE Canadian Review and its future. Even at $1.20 a copy, it still seems like very good value to me, and I hope to make it better value still.

1994 CANADIAN CONFERENCE ON ELECTRICALAND COMPUTER ENGINEERING

September 25-28, 1994 - World Trade & Convention Center, Halifax, Canada

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. Electromagnetics
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Please submit three copies of a 400-500 word summary (or one copy via Internet) by **March 30, 1994** to the Technical Program Chairman. Please indicate the most appropriate topic(s) for your paper in order of preference. Notification of acceptance will be sent by **May 16, 1994**. Accepted papers will be published in the conference proceedings. A camera-ready version of the paper must be received by the Technical Program Chairman no later than **July 1, 1994:**

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Department of Electrical Engineering
Technical University of Nova Scotia
P.O. Box 1000, Halifax, Nova Scotia, B3J 2X4
Tel:(902) 420-7717 Fax: (902) 422-7535
E-Mail - Bairdrc @ Newton•CCS•TUNS•CA

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P.O. Box 970, Saint John, New Brunswick, E2L 4E5
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Jacek Chrostowski
National ResearchCouncil, Institute for Information Technology
Ottawa, (Ontario) K1A 0R6
fax: 613-952-0215
E-mail: j.chrostowski@ ieee.org

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