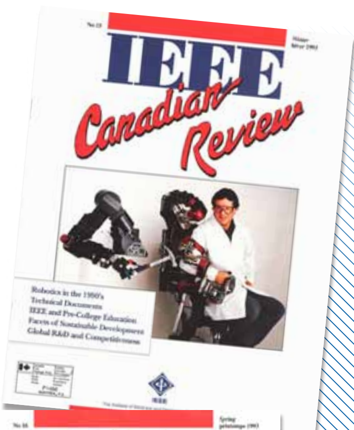
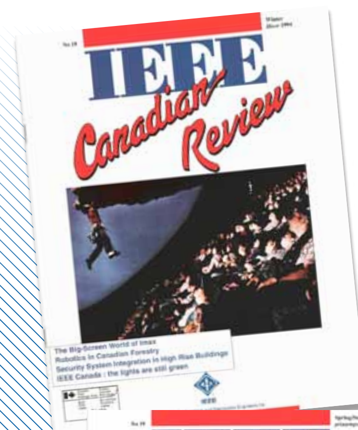
Women in Engineering - progress continues

Twenty years ago, 14% of Canadian engineering students were female. In 2011 that number had risen to 18%. Progress has been made, but there is still a big gender inbalance not found in other traditional faculties, (e.g., law, medicine). Why is this? A 1990s' Labour Canada study contemporary to the chosen article showed a shift downward in girls' interest in science careers around age eleven. With few female engineering role models, lacking confidence in their math abilities and little support, girls often dropped maths and sciences, eliminating options early. Thanks to WIE and other initiatives, that is less the case in 2013. However, both then and now, a finding cited for both males and females, is ignorance of the wide variety of engineering careers. Addresing this, IEEE's TISP workshops equip teachers to better promote these career options.

"So by grade six, boys and girls are making career guesses ..." (Women in Technology — Where are They?)





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Women in Technology– Where are They?

by Win M. Torchia
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A look at why young women are not entering technology, and some suggested initiatives to overcome this trend.

Une constatation: les jeunes femmes n'embrassent toujours pas les carrières technologiques; on propose quelques remèdes pour contrer cette tendance.

Why do we need women in technology?

The Canadian Engineering Manpower Board predicts that by the year 2000, Canada will have an estimated shortfall of at least 10,000 engineers. Despite this shortfall, enrolment of women in engineering schools remains dismally low with a national average of 14% in 1988-89. Less than 5% of all students enrolled nationally in technology programs are women.

The urgency to diversify women's participation in the labour force grows out of the rapid pace at which changes are taking place in the technological realm. These employment projections indicate a rising need for technically competent workers at every level. Unless we reverse the current trend, there will not be enough engineers to meet the challenges of the future.

Why don't young women consider careers in technology?

Well, for one thing, many young girls drop Math 300 (which includes algebra, trigonometry, differential equations and calculus) before they realize it is required for university and college programs such as computer technology, and electrical, civil and mechanical engineering. They close the door to over 100 occupations by dropping math and science 300 courses, mainly because they lack self confidence in their own abilities to do well in subjects that require mathematical manipulations. They are not encouraged by parents, teachers and guidance counsellors to stick with these courses.

A study by Labour Canada shows that the most significant shift in girls' openness to scientific/engineering occupations occurs at age eleven or twelve. So by grade six, boys and girls are making career "guesses" based on what they have learned is appropriate for them. They don't necessarily select a specific occupation at this age, but rather they eliminate some options. This happens because they have internalized the cultural/social expectations for their gender.

Cheryl Van Nest (foreground) and **Angela Rinella,** both students in the Pre-Technology for Women class, learn the engineering applications of computers. *(photo by Jim Woroniuk, RRCC)*

Occupational sex stereotyping is still prevalent among Canadian children and adolescents, because children learn at a very young age that the world is polarized to male and female. In society's eyes, young boys are expected to be active, dominant and rational which translates into being oriented towards scientific, technical and management areas and are rewarded for these characteristics. Girls, on the other hand, are typified as passive, submissive, and emotional, which translates into an orientation to naturalistic and social areas, and are also rewarded for having these characteristics.

This polarization applies to all areas of society, not just to divisions in the labour force. Young people receive the message loud and clear that if you don't fall on the correct side of the line for your gender, your sexuality and identity are in question. It's no accident, then, that the workforce is similarly polarized into "male" and "female" jobs.

Donna Stewart, M.A., reported in The Manitoba Teachers' Society Equality News (Sept. 1991), that many adolescent girls still believe in the "Cinderella Syndrome" ("happily-ever-after" theory). The facts, however, are that men ("modern princes") have a tendency to:

- die young (1 in 10 before the age of 50),
- get sick or suffer an injury on the job,
- be laid off,
- earn too little to support the family,
- often leave the family.

"Modern Cinderellas" need to understand the realities of the modern workplace:

- They will need at least two years of post-secondary education to access stable, well-paying jobs - with a future.
- Most of them will be back in the paid workforce before their children are three years of age and they will remain in the workforce 28 to 48 years.
- In "good" jobs, those with responsibility and a living wage, they will be adding to their skills and knowledge on a regular basis, so the better their

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The Canadian Space Agency

A brief history.

In December 14, 1990, the Canadian Space Agency was officially established by an Act of Parliament, with the following mandate:

- to promote the peaceful use and development of space;
- to advance the knowledge of space through science; and
- to ensure that space science and technology provide social and economic benefits for Canadians.

Dr. Larkin Kerwin, former President of the National Research Council of Canada, was the first president of the newly-established Canadian Space Agency. He was succeeded in May 1992 by **Dr. Roland Doré**, former Principal and Chairman of École Polytechnique de Montréal.

Canada's experience in space began in 1962, with the launch of **Alouette I**, a research satellite. Canada was the third country in the world, after Russia and the United States, to design and build its own satellite. With the launch of **Anik A1** in 1972, Canada became the first country in the world to have its own commercial, domestic, geostationary communications satellite. In 1976, a Canada-U.S. cooperative effort led to the launch of the **Hermes** communications satellite, which subsequently served as a prototype for direct broadcast satellites.

In 1981, Canada confirmed its position as a world leader in space robotics technology with the development of the **Canadarm** or **Shuttle Remote Manipulator System (SRMS)**, which is used to deploy and retrieve satellites in space from the Space Shuttle. The ***Canadarm*** was used for the first time aboard the U.S. Space Shuttle **Columbia** in 1981. A few years later, in October 1984, Dr. Marc Garneau became the first Canadian in space when he conducted the **CANEX-1** series of experiments.

More recently, in January 22, 1992, **Dr. Roberta Bondar** became Canada's second astronaut and first Canadian woman in space when she participated in the first **International Microgravity Laboratory** mission (**IML-1**) aboard the **Spacelab** on Space Shuttle **Discovery**. A few months earlier, in September 1991, Canada had provided the **WINDII** instrument, or **Wind Imaging Interferometer**, as part of NASA's **Upper Atmosphere Research Satellite** (**UARS**) program, designed to study global ozone change.

The Canadian Space Agency brings together the larger part of the existing space activities of the federal government. It coordinates all elements of Canada's Space Program and manages major space-related activities in Canada. Its headquarters are temporarily located in Montreal, pending completion of the new headquarters under construction in St-Hubert, a suburb of Montreal. The $72.2 million complex will be set on 40.7 hectares of land in St-Hubert. With occupancy scheduled for mid-1993, it is designed to provide work areas, laboratories and other facilities for Agency personnel and visitors from institutions, companies and other partners of the Canadian Space Agency.

The Canadian Space Agency is also maintaining and upgrading the ***David Florida Laboratory*** (***DFL***) in the Ottawa area, which is dedicated to the assembly and testing of space hardware, satellites and remote sensing equipment.

MSS Canada: Robotics for the Space Station

The **Mobile Servicing System** (**MSS**) is Canada's contribution to the international Space Station *Freedom*. This next generation of the **Canadarm** is a crucial component of Space Station. Designed to play the predominant

by Dr. Roland Doré, P.Eng.
President, Canadian Space Agency

This article is an overview of the Canadian Space Agency's main programs and activities. The Canadian Space Agency brings together the larger part of the existing space activities of the federal government. It coordinates all elements of Canada's Space Program and manages major space-related activities in Canada. Thus, it administers projects such as RADARSAT *– a remote sensing satellite to be launched in 1995; the Mobile Servicing System (MSS) – Canada's contribution to Space Station Freedom; the David Florida Laboratory – A spacecraft testing facility; the Astronaut Program; the Space Science and Space Technology Programs; as well as Canada's cooperation with international partners such as NASA, the European Space Agency (ESA) and other foreign space agencies.*

Le présent article constitue un aperçu des principaux programmes et activités de l'Agence spatiale canadienne. L'Agence spatiale canadienne regroupe la plupart des activités spatiales du gouvernement fédéral. L'Agence coordonne l'ensemble des éléments du Programme spatial canadien et gère les principales activités liées au secteur spatial au Canada telles que : RADARSAT *– un satellite de télédétection qui sera lancé en 1995; le Système d'entretien mobile (SEM) – la contribution du Canada à la station spatiale Freedom; le Laboratoire David Florida – une installation de mise à l'essai d'engins spatiaux; le Programme des astronautes; les Programmes des Sciences et de la Technologie spatiales; ainsi que la coopération du Canada avec ses partenaires internationaux comme la NASA, l'Agence spatiale européenne (ESA) et les autres agences spatiales étrangères.*

role in the assembly and maintenance of the Space Station, the **MSS** will be used to help move equipment and supplies, release and capture satellites, service instruments and other payloads attached to the Station, and support astronauts working in space. It will also be used for berthing the shuttle to the Space Station and then loading and unloading materials from its cargo bay.

The **MSS** will be a roving space robot, able to travel the full length of the Space Station on its rail-mounted base. The first elements of the **MSS** are scheduled to be flown to Space Station orbit in the mid-1990s, aboard one of the first Space Shuttle missions dedicated to the Station's assembly. The rest of the equipment will be delivered on several shuttle flights throughout the four years it will take to make Space Station permanently habitable. Space Station *Freedom*, 450 km above Earth, along with the **MSS**, will have an expected working life of thirty years.

A major component of the **MSS** will be the **Space Station Remote Manipulator System** (**SSRMS**). About the same size as **Canadarm**, but over three times as strong, it is being designed to handle loads as big as the Shuttle as it approaches to resupply the Space Station. The **SSRMS** will also be able to detach itself from its movable base and crawl hand-over-hand to different points of the Station's structure to service hard-to-reach objects. When operated by astronauts, the **MSS** will be an extension of their own senses – able to see and touch. Artificial intelligence will even give it an I.Q.

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HYDRO-QUÉBEC POWER SYSTEM SIMULATOR

The complexity of power transmission systems has increased dramatically over the past 20 years as a result of economic and environmental constraints. Multiterminal HVDC (High Voltage Direct Current), SVCs (Static VAR Compensator), series capacitors, FACTs (Flexible AC Transmission Systems) as well as sophisticated protection and control schemes have ever greater impact on modern power system performances. Utilities that face these problems must therefore have access to real-time simulation facilities in order to cope with any problem not recognized at the design stage, but detected at the commissioning or operating stages.

During the sixties, Hydro-Quebec made extensive use of transient network analyzers (TNAs) for the design and commissioning of the world's first 735 kV transmission system interconnecting the 5000-MW Manicouagan hydro electric plants to the main power grid. Recognizing, on the one hand, the strategic importance of such tools for the development of its power transmission system, and, on the other hand the limited capability and excessive losses of commercially available TNAs, IREQ (Institut de Recherches d'Hydro-Québec) designed and built a real-time power system simulator capable of simulating large high voltage transmission systems.

First commissioned in 1973, the IREQ simulator (cover picture) has undergone continuous upgrading and evolution over the past 20 years to keep pace with technological advances. The simulator was used extensively for the design and commissioning of Hydro-Quebec's James Bay transmission system as well as by several other utilities around the world for the simulation of their own systems.

Simulation Technology

The simulator uses well proven and reliable analog, electronic and digital technologies for the simulation of power system elements by lumped reactors, resistors and capacitors, saturable cores, etc. Its rated operating voltage of 100 V phase-to-phase and maximum short-circuit current of 5 A were selected to minimize the losses and increase the precision of EHV (extra high voltage up to 400kv) and UHV (ultra high voltage, above 735kv) system simulation.

The simulator operates in real-time at the nominal system frequency (60 Hz or 50 Hz). Real-time behavior permits the verification and optimization of real controls and protection equipment which can be connected to the simulator, much as in the field, by special interfaces and models. The performance of the controls can thus be evaluated under realistic operating conditions, including very severe but probable contingencies that are difficult and often impossible to duplicate in the field.

Another advantage of the real-time capability is the speed of test execution. The simulation of a phenomena lasting 1 second takes 1 second instead of several minutes or hours as with conventional simulation software operating in deferred (non real) time. This makes it possible to perform detailed optimization studies that may include random variation of parameters such as circuit-breaker switching instants. Rapid interaction

by C. Gagnon, V. K. Sood, J. Bélanger, A. Vallée, M. Toupin, P. Mercier, and M. Tétreault

Over the past 20 years, IREQ (Institut de recherches d'Hydro-Québec) has built up a strategic simulation facility for the design and commissioning of power transmission systems. This real-time simulator has been extensively used by Hydro-Québec and other utilities for the verification and optimization of real controls and protection equipment.

Au cours des 20 dernières années, l'IREQ (Insititut de recherches d'Hydro-Québec) a developpé des moyens stratégiques de simulation pour évaluer la conception et pour mettre au point avant la mise en route, les équipements de réseaux électriques. Le simulateur de réseaux de l'IREQ a été largement utilisé par Hydro-Québec elle-même et plusieurs autres sociétés de gestion de systèmes électriques pour la vérification et l'optimisation des équipements de régularisation et de protection des réseaux, assurant ainsi une meilleure sécurité et fiabilité de ces équipements.

with the user is vital in investigations of complex phenomena and controller trouble shooting. Such studies involve a "what if" type of analysis for which it is very important to minimize the simulation time, since the next test or actions depend upon the conclusions of the previous test.

The key features of the Hydro-Québec Power System Simulator are:

- Real-time simulation capability;
- Hybrid technology that includes passive and electronic analog models and also real-time digital models;
- Large numbers of low-loss analog models for the simulation of complex EHV networks;
- Large numbers of SVC and HVDC system models (Figure 1);
- Interconnection with commercial protection and control systems;
- Sophisticated software and computer system for test automation, data recording, on-line analysis, post-processing and report editing;
- Central-computer-controlled interconnection panels for control of network configuration from computer terminals;
- An integrated database for results and input data used for the real-time simulation and conventional off-line simulation software packages;
- A unique layout allowing system studies, control and protection validation tests, research projects and training sessions to be conducted simultaneously.

Passive analog components such as reactors, capacitors and resistors are used to model transmission lines, transformers (with saturation), shunt

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