IEEE Canada

KITCHENER-WATERLOO SECTION

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The Kitchener-Waterloo Section of the Institute of Electrical and Electronics Engineers serves members whose mailing address is in Bruce, Grey, Perth, Waterloo or Wellington counties. It collects news relevant to local engineers and is published bi-monthly.
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Upcoming Events

Check http://kw.ieee.ca/activities.html for updated information.

Presentation On Reginald Fessenden

Friday 2nd June 2006, 7.30 pm*.
Luther Village Sunshine Centre, 141 Father David Bauer Drive, Waterloo

Dr. Thomas East will give a talk, followed by a short play, on the life of Reginald Fessenden. The Canadian inventor was the first person to broadcast speech and music, but he invented much more, such as microfilming, sonar, and depth sounders. He struggled to achieve recognition and rewards.

The play will represent some of the events in his life, including a re-enactment of the first broadcast in 1906.

Dr. East has a B.A. from Cambridge and a Ph.D. from McGill University, Montreal. He worked on radar in World War 2, and on weather radar at McGill. From 1958 to 1987, he was with Raytheon Canada Limited in Waterloo, working on air traffic control radar, navigational aids and telecommunications. He is co-author of "Satellite Communication Fundamentals".

*Enter at 139-141 Father David Bauer Drive and drive round the back of the main building to the Sunshine Centre. Or enter the Recreation Complex at 101 Father David Bauer Drive, park in the C-D lot and walk over the footbridge to the Sunshine Centre.

Recent Events

Senior Member Upgrades

The following local member has earned the professional recognition of peers for technical and professional excellence.
Daniel Ashlock
Daniel Beausoleil
See http://www.ieee.org/ra/md/smprogram.html for more information on this program.

The History of High Definition Television

Brian James, Reported by Tom East

At the end of the short Annual General Meeting of the KW Section on February 20th, Brian James told an interesting story of a slow, ponderous industry and of government committees trying to keep ahead of technology.

It all started in 1986 when the broadcasting industry was told that the FCC (Federal Communications Commission) Land Mobile committee wanted them to give up some TV channels to make way for essential mobile radio communications. Alarmed, they lobbied for more, not less channels, which they said they would need for "high definition" television (using about 1000 lines instead of the current NTSC with 525 lines, and a wider picture), pointing out that the Japanese were already working on it: their MUSE system would have "Movie theatre quality" but would need an 8 MHz wide satellite channel. (Standard US TV uses 4.5 MHz video bandwidth).

Japan proposed a world standard of 1126 lines, 60 frames: there was US support, but Europe opposed it: it was defeated.

In 1987, the Japanese MUSE system was demonstrated to the US Congress, who supported it as a way to help US manufacturers, but it would have required additional spectrum: the FCC gave cursory heed, and still wanted to push land mobile. However, the House started an inquiry into HDTV and this pushed the FCC to set up its own committee (ACATS). After many meetings the FCC developed the requirements for proposed systems – twice the resolution of NTSC, could use a second channel, a working system must be demonstrated (no computer simulations!).

By the deadline of November, there were 14 proposals for systems or parts of systems. Six of them were accepted for further demonstrations. Expert viewers would rate the pictures. The Sarnoff-NBC-Thompson-Philips team, for instance, proposed a system in which the main channel was NTSC and a second channel carried side panels and increased the number of lines. The Japanese managed to squeeze their system into one channel. The others proposed digital systems which would not be compatible with NTSC but would use video compression to fit in a regular channel.

By 1991 it was time for a new round of more extensive tests, in a facility (the Advanced Television Test Center – ATTC) funded by the broadcasters and the cable industry. Among the problems with the various systems were poor picture quality and adjacent

channel problems. The results were reviewed in 1992 and only the four digital systems were left. The proponents were urged to form a Grand Alliance to combine the best features of the systems into one system. A stumbling block was whether to use progressive scan (as in a computer monitor) or interlaced scan (as in NTSC): in the end, it was decided to make it compatible with both. Retesting to start in 1993.

After much internal "discussion" the Dolby 5.1 system was adopted for sound. The Grand Alliance was told to adopt the MPEG-2 video compression system. [see Kadish and East: Satellite Communications Fundamentals chapter 17]. Using 256 QAM (quaternary amplitude modulation), HDTV fits into a single channel if the signal to noise ratio is not less than 28 dB, otherwise, it crashes.

Laboratory tests took place from October 1994 to July 1995, and field tests in August and September 1995. The tests went well: "the system works". Called the Advanced Television Standard by the FCC, it was adopted in May 1996.

At first, a broadcaster will continue NTSC programs with their regular NTSC channel and simulcast HDTV on a second channel. After 2009, the regular channel will be closed and turned over to the FCC, to be auctioned.

In the end, the broadcasters are spending billions of dollars and got neither more nor less channels than they started with. Satellite and cable companies are providing HDTV service now. In Canada, the CRTC position is to stay behind the US and learn from their mistakes.

Conestoga College Hosted IEEE Student Papers Night
Tom East

A good crowd turned out on the 15th of March for the annual Student papers night at the Doon Campus of Conestoga College. The entries from the college and from the Universities of Guelph and Waterloo were all in a single class for competition purposes.

The first place went to Iolanda Longo and Nathaniel Groendyk of Conestoga College for "Optical Modeling by Normalized Interpolation". The purpose of the equipment, which was actually present, is to capture the outline of an object in three dimensions and transfer it into a computer memory. The object is placed on a rotating platform and rotated slowly: after each complete revolution, the platform is raised by an actuator by, say, 0.1 mm. A laser distance measuring device is aimed at the side of the object. The measured distance, the angle of the rotation and the height of the platform are entered into a computer file each time, and a complete model calculated by interpolation.

Second place was awarded to Dan Brueckner, Dave Stevenson and Alicia Weber of Conestoga College for their "Blackberry Home Security Package". A RIM BlackBerry communicates using 56 bit encryption by Bluetooth at 2.45 GHz over a range of 10 – 100 m to a household control system, and can switch lights, door locks and so on. Alternatively, from a remote location, the BlackBerry commands can be relayed through a secure web site over the internet to the control system.

In third place was Ammar Alzaydi of the University of Waterloo for a paper on "EM Adaptive Mirrors for MEMS Scanning and Focusing Applications". The design of mirror has a Mylar reflecting surface 12 cm diameter, which is made to conform to a concave paraboloid by rapid rotation about its axis, and by electromagnetic forces around the edge. The research goal for this technique is to resolve the nucleus inside a cell.

The other three entries were:

"C4ExplodE High Resolution Display Technology" presented by Minel Glisic and Sinica Bjelica of Conestoga College. Large, high resolution Light Emitting Diode (LED) displays are extremely costly (typically $1,000 per square foot). The technique tested here on a small scale is to share LEDs between adjacent picture elements (pixels) so that when the number of pixels is increased by factor four, the number of LEDs only increases by one third.

"Real-time Automotive Self Diagnostic System" presented by University of Guelph students Christopher Passmore, Maria Mark, David Mancini and Garrett Reynolds. A motor vehicle fitted with sensors would report several conditions such as oil viscosity, tire pressure, and emissions. A capacitor alongside a brake pad would wear at the same rate as the pad, so a measure of its capacitance shows how much life is left in the pad. By observing the indications, maintenance is carried out promptly and the life of the vehicle extended.

"DigiPhase Acoustic Processor" by Stephen Connell, Derek Novakovich and Jonathan Musselman of Conestoga College. A monitoring microphone at the listener's position in front of a stereo system detects departures (such as room echoes) from the ideal signal in the stereo input, and feeds back corrections to the stereo.

Ionospheric Effects on HF Surface Wave RADAR
Tom East

On January 20th, Dr. Ryan Riddolls of the Department of National Defence of Canada addressed the problem facing the High Frequency Surface Wave Radars pioneered by Raytheon Canada. Two of these radars have been installed on the east coast to provide surveillance of the ocean out to the 200 mile limit and beyond. They use the HF band (3 – 30 MHz) so that the radiation follows the sea surface and detects ships. However, the radar also receives clutter from waves, icebergs and birds. Clutter can obscure targets to the point that they cannot be detected, and the radar contains advanced signal processing to minimize clutter.

What's more, HF transmissions are reflected by the ionosphere, which complicates the clutter problem. The F layer of the ionosphere reflects frequencies up to about 3 MHz at vertical incidence, and higher frequencies for inclined incidence, so clutter can be received by reflection as well as directly. In addition, fluctuation in the ionosphere can modify the reflected clutter. The ionosphere has been extensively measured by

radiosonde (since the 1920s), by the Canadian Alouette satellite from above (in the 1960s), and by the Arecibo radio telescope (the worlds largest dish) and others.

The main methods for reducing clutter are Doppler frequency discrimination and beam narrowing. Radar transmits a succession of pulses, and if a target has a radial velocity relative to the radar, successive echoes from it will vary in amplitude at a Doppler frequency. Thus, hopefully a target can be distinguished from clutter by its own radial velocity. However, the clutter signal can have frequency components of its own.

Narrowing the transmitted beam (which would usually be the same as the received beam) can be done by increasing the size of the antenna, which may require larger numbers of elements spread out over the ground, or many tall towers.

By means of many plots, such as range versus Doppler frequency, Dr.Riddolls showed various effects that the ionosphere has on clutter, and discussed the method of attack.

RIM Visit

IEEE-GOLD event
The presentation included an overview of RIM's history, why RIM is a leader in wireless communications, what the BlackBerry is, and what other products are in RIM's portfolio? The presentation also included information on the different co-op /internship job opportunities available at RIM.

Multi-Sensor Data Fusion

IEEE AESS Presentation by Prof. Varshney, Syracuse University, USA
This talk will present an overview of the exciting field of data and information fusion. It can be applied to many areas both in military as well as in nonmilitary applications. Some examples will be given for illustration. Distributed detection and decision fusion will be treated in some depth. The talk will end with a brief discussion on some of my ongoing research projects in the general areas of sensor networks and signal/image processing.

UWB for sensor networks: the 15.4a standard and beyond

IEEE Vehicular Technology Chapter Presentation by Dr. Andy Molisch
Ultra-wideband (UWB) communications is an extremely promising technology for sensor networks with low (<= 1 MBit/s) data rate. UWB offers high robustness to fading, low energy consumption, and the possibility for very precise geolocation. Recognizing these advantages, the IEEE has established a task group 802.15.4a that during the past 2 years developed a standard for such low-rate UWB devices. This standard, which covers both the PHY and the MAC layer, will be the main topic of this talk. It contains a number of scientific innovations that specifically exploit the sensor network applications. The physical layer is based on impulse radio, using bursts of impulses that allow coherent as well as noncoherent detection. Good spectral properties are obtained by polarization scrambling. Further options allow the use of chaotic waveforms or chirping. On the MAC side, pure ALOHA, or a special form of CSMA are used, and provisions are made for ranging that is resistant to spoofing or interception. The talk will wrap up with a description of possible applications and networking considerations.

Rectangular Dielectric Resonator Antennas
IEEE-MTT Presentation by K.W. Leung

Clock and Data Recovery Circuit Design for SERDES Applications
IEEE-SSC Presentation by Dr. Rezayee of Snowbush Microelectronics
This talk presents functional characteristics and design challenges associated with a serializer-deserializer (SERDES) system, as well as economical background for the fast growing SERDES industry. An approach to design clock and data recovery circuits (CRC's), that are the core base of a SERDES system is included, providing a brief summary of the design and the necessary verifications of a CDR building blocks. This talk also includes a brief summary of a 9-16 Gb/s clock and data recovery circuit that has been designed, and successfully tested in a standard CMOS 0.18um technology.

Iterative Coding and (Generalized) EXIT Functions
IEEE sponsored event by Ruediger Urbanke, EPFL, Switzerland

Abstract: We generalize the notion of EXIT functions, which were introduced by ten Brink. These generalized EXIT functions fulfill for transmission over a large class of channels an area theorem equivalent to the one fulfilled by EXIT functions when transmission takes place over the BEC. We then explore some of the consequences of this area theorem. In particular, we show that we can construct an upper bound on the MAP threshold for spares graph codes which we conjecture to be tight. We also extend the matching condition, well known in the case of transmission over the BEC, to the general case. These generalized EXIT functions can be seen as an extension of the elegant relationship between the derivative of the mutual information and the MSE, initially introduced by Guo, Shamai and Verdu in the context of Gaussian and Poisson channels.
http://www.cst.uwaterloo.ca/DSS/talks_2006.html#2006_feb_13

Nanotech devices to aid doctors
UW Daily Bulletin

An endoscope probe as big as the diameter of a toonie is a hard thing for a patient to swallow when doctors need to see the inside of the stomach -- but UW research is leading to a new device no bigger than a strand of spaghetti.

"It's a sad fact that often the equipment used by doctors and nurses is badly designed for their work," says a release written by Graeme Stemp-Morlock for the UW media relations office and issued last week. "Nanotechnology, however, offers a chance to redesign many instruments to achieve better results."

All of Yeow's work comes back to a desire to make functional devices that can be deployed in the real world. "In addition to working with models or software, I want to be able to hold and move the things I build."
http://biomems.uwaterloo.ca/

Sirific reveals first major product

Waterloo Tech Digest

Nearly six years after its launch, Sirific has unveiled its next- generation product -- described as the first single-chip CMOS RF transceiver for 3.5G cellphones using the HSDPA/WEDGE protocols. It will sell the product to handset manufacturers and hopes to be in production by the end of the year.

The chip, called the SW3200, supports five WCDMA bands, as well as EDGE, GPRS, and GSM bands. Sirific says it's far smaller than competing solutions.

New Advances in RAID Algorithms

ICR Seminar

Network Appliance is actively involved in research and advanced development in many aspects of storage, data management and information retrieval. This talk will present a brief overview of these activities, including parallel file systems, indexing, continuous data protection, and virtualization. One area where we have published results is in erasure coding algorithms for RAID systems. The Row-Diagonal parity algorithm is a two-erasure correcting algorithm that is provably optimal in disk space overhead, disk I/O, and computation complexity. It forms the basis of Network Appliance's RAID-DP (RAID-6) implementation, which protects against two disk failures with a very small performance penalty compared to RAID-4 or RAID-5. The talk will present this algorithm, along with some other new RAID ideas.

Software Security: Building Security in

ICR Seminar by Gary McGraw, CTO of Cigital, Inc.

Software security has come a long way, but we've really only just begun. I will present a coherent and detailed approach to getting past theory and putting software security into practice. By describing a manageably small set of touch points based around the software artifacts produced by every software development process, I avoid religious warfare over process and get on with the business of software security.
That means you can adopt the touch points without radically changing the way you build software. The touch points I will describe include:

- Code review using static analysis tools
- Architectural risk analysis and threat modeling
- Penetration testing
- Security testing
- Abuse case development
- Security requirements

Like the yin and the yang, software security requires a careful balance--attack and defense, exploiting and designing, breaking and building--inextricably mixed in a coherent package. Through a unification of proactive design and careful exploit-driven testing built on a foundation of risk management, you can properly address software-induced security risk. The touch points can and should be taught in every software course (even those courses that are presumably not about security).

NCR Produces Smaller Self-Checkout

Computing Canada

The NCR FastLane Mini is designed for space-constrained retail locations at a third the size of the express model. It allows shoppers to scan, bag and pay by themselves.

Personal Listening Device Debuts

KW Record

Sonami Communications is producing a product which directionally filters voices out of background noise. Designed for use in crowded areas such as restaurants, the system uses DSP technology and 2 microphones to calculate the origin of a noise and decrease the volume unless it is directly in front of the person.

Engineers and the World

Public Forum on Ontario's Energy Future

Tom East

On February 17th, a town-style meeting was held at the Delta Hotel (King St and Benton Hill, Kitchener) to discuss how to meet Ontario's future needs for energy, especially electricity. About 200 people watched a video by the Ontario Power Authority, containing pictures, wording, commentary and distracting music (perhaps to dull our critical faculty). This was followed by comments from the audience at two microphones, well controlled by the Chair, with only one minor outburst of heckling. Many of the speakers were experts in some aspects of the problem.

Fossil fuels (coal and natural gas) were defended because they are "clean" or can be made so: however, it was not clear whether there is any practical way of impounding the resulting carbon dioxide, a "greenhouse gas" (GHG). Natural gas is largely methane, over 20 times more powerful a GHG than CO_2, so leaks must be avoided. Coal is plentiful and relatively cheap: natural gas is becoming increasingly more costly. Either would be useful to meet peak demands.

Nuclear power has a bad name because of large cost overruns and poor reliability. In its defence, it was said that those problems apply to reactors built with 1960s technology: the last few Canadian CANDU reactors, supplied to China, South Korea and India, were "on schedule and on budget". Nuclear waste products have varying "half-lives", but the volume is modest compared with the garbage from cities. Capital cost is high, but running cost is low, making nuclear good for base load. Nuclear is haunted by the ghosts of Chernobyl and Three Mile Island

Renewables include hydro, wind and solar. The main hydro sources near cities are all in use: other possible sites could add about ten percent, but many are far from the load centres. There are many wind farms in Europe, and some are planned for Ontario, but why are the turbines being imported from Denmark when they could be made here? The

power is cheap, the equipment is reliable and there is great redundancy. A farmer in the audience said farmers "are lining up" to have turbines installed on their farms, as a source of income. Solar power is "about to take off" and its power is also cheap. But the sun doesn't shine nor the wind blow all the time, so to the power planner they are "unreliable". Storage is the problem: a country house with wind turbine and solar panel could be self sufficient, but only with a battery pack. On the large scale, pumping water into a reservoir on a hill top can store energy, and should be done at the few suitable sites.

Conservation (reduced consumption) could make a substantial difference. As an experiment, houses in Woodstock are equipped with "smart meters" which charge more per kilowatt-hour at times of peak load on the system, and less at off peak times: this has already persuaded people to change their consumption habits. Of course, charging the true cost of generation (which would increase the price quite a bit) would encourage people to use less.

The meeting started at 6.30 pm and ended at 10 pm but many did not stay that long.

Who Will Survive?

Tech Digest

LiveHive Systems has partnered with California-based Walton Communications to offer real-time wagering on events on the TV series Survivor. Walton operates the fan site Survivor.com, where registered visitors can now bet on who will win challenges, who will get voted off, and so on, using LiveHive technology. It's just for fun -- no money bets, but there are prizes for the winners.

Waterloo chapter of EWB is honoured

UW Daily Bulletin

Waterloo captured several awards at the recent Engineers Without Borders national conference in Ottawa. UW's Engineers Without Borders was named "Chapter of the Year," along with the University of Western Ontario, for its large volunteer involvement, expansive high-school outreach program and professional chapter structure.

UW's chapter sent 40 students to join more than 500 other young Canadians at the conference. The delegates learned about international development related issues and participated in interactive workshops. Engineers Without Borders is a leading international humanitarian organization dedicated to the fight against world poverty. Its goal is to develop technology -- innovative, appropriate, sustainable and locally available and generated -- to better the lives of people in developing communities across the globe.
http://uwaterloo.ewb.ca/

Hydrogen researcher urges diversity

UW media relations office

As the world hits peak oil production, there is keen interest in finding the next great fuel source. Many hope that hydrogen can be harnessed and that by the end of the 21st century we will all be driving hydrogen-powered cars.

Ironically, that's not the hope of Xianguo Li, a UW professor of mechanical engineering and a hydrogen fuel cell researcher. Though his research is focused on improving hydrogen fuel cells so they could be used in everybody's car, he doesn't want them to be the sole option. Instead, he espouses the notion of diversity. "The second law of thermodynamics, in essence, states that every energy process has an impact," said Li. "Biomass, solar, wind, hydrogen, if any of these took a dominant position in the market they would have major disadvantages."

Li cites London or Paris 100 years ago: everyone used carriages pulled by horses to get around, and that meant there were horse droppings everywhere. At a time of poor sanitation and street infrastructure, that led to a lot of disease, not to mention the smell. Then, a novel device known as the automobile came along. It ran on oil, which was in vast supply throughout the world, and the only thing it released was a little smoke that vanished into the air. Perfect solution, right? Only a few decades later we learned in a hard way --   like the Los Angeles smog -- that it was not perfect, after all.

Li believes the same would be true if hydrogen dominated the energy market. "Often, in history, we hail a new technology as a major step forward, only to realize its horrible side effects later, and we had to spend tremendous effort to eradicate those effects. It all comes back to the principle that you can't get something for nothing." Instead of one energy source dominating, Li believes the answer is energy diversity and that hydrogen fuel cells can play a large part, such as for automobiles in urban areas.

The mechanical engineering researcher has been working to make fuel cells less expensive, more reliable and more user friendly. "The real world is not kind to cars like labs are, so we have to design better and robust engines that can be easily made and maintained."

One of the ways that the life and reliability of hydrogen fuel cells could be improved is through optimizing how many fuel cells are in operation at any given moment. Not as much power is needed for idling at a red light as for cruising at 100km/h, so Li's research team is developing a technique that can determine how many cells need to be activated.

As hydrogen technology develops and gains acceptance, Li hopes that people will temper the desire to use it everywhere with the knowledge that all energy systems have negative impacts. "If we use any energy on a worldwide scale, there can be lots of problems, but if we use it on a small scale we should be okay."

Ontario Supports Local Green Energy
KW Record

The government will now support alternative energy production by providing a increased price for energy depending on how green it is. Also, selling the energy will be easier. These steps are expected to allow more small renewable energy sources to be developed.

Exploring Mars From Waterloo
KW Record
Geologist John Grant, took a Perimeter Institute audience on a trip to Mars. He was been connected to NASA since 2002 and described the difficulties and joys in remote exploration. The Rovers, with their Dalsa-built cameras, continue to feed data back as they explore the planet more.

U of Guelph Plants Seeds in Space
KW Record
Guelph biologist Mike Dixon is part of a team working on improving ways to grow plants in space. They have a unique research facility that allows them to study plants in low air pressure environments. They are also studying automated greenhouse maintenance by teaming with a U of Waterloo group. The goal is a rolled up inflatable greenhouse that could go to Mars. They are testing their ideas on Devon Island, a northern Canadian island with many similarities to Mars.

Waterloo Radar Part of Racing Yacht
KW Record
Radar developed for coastline security will be used in the Velux 5 Oceans solo race this fall. The technology will help skipper Derek Hatfield avoid collisions with debris and sea life during the 8 month race.

Engineering Humour
Heard by Tom East on CBC Radio
HOME (AND MARRIAGE) IMPROVEMENTS

A couple that hangs wallpaper together sticks together.