

# IEEE Northern Canada Section Newsletter 2023



Here are the events put on by the NCS and its Chapters and Affinity Groups in 2023.

**NCS** – Northern Canada Section

**IAS/PES** - Industry Applications Society and Power & Energy Society Joint Chapter

**PELS** – Power Electronics Chapter

**MTT-S/AP-S** - Microwave Theory and Technology Society and Antennas and Propagation Society Joint Chapter

**LM** – Life Members Affinity Group

**YP** – Young Professionals Affinity Group

**WIE** – Women in Engineering Affinity Group

**January 19** – NCS AGM and Elections.

**January 19** – PELS – Workshop on Technical Documentation using LaTeX.

LaTeX is a widely used tool for typesetting professional-looking documents. The focus of this workshop is to provide an introductory tutorial to the LaTeX tool for undergraduate students. Furthermore, this workshop is conducted in collaboration with the Electrical Engineering Club of the University of Alberta as a part of their module-based program called “Electrical Engineering Club Certificate of Design (EECERT)”. This program focused on teaching undergraduate students critical hardware and software skills that they may need in their careers and or co-op terms.

**January 19** – LM – Zoom presentation – Principles to Depolarize Energy Discussions.

How language can affect communications between individual or groups. Choice of words is important.

**February 6** – MTT-S/AP-S – Chapter AGM.

**February 16** – LM – Zoom presentation – Advantages of an Engineers Experience in being a City Councillor. The advantages having worked as an engineer can bring to the table when elected as a City Councillor.

**March 10** – PELS – Special Talk – ChatGPT and Academic Ethics: Navigating the Implications of Language Models.

AI-powered tools like ChatGPT have created a wide hype and raised serious concerns in the academic community, particularly around academic ethics. It is essential to ensure responsible implementation of these technologies, with careful consideration given to potential risks and rewards, and with ethical standards upheld during development and research. Join Dr. André dos Santos for a thought-provoking discussion on ChatGPT and Academic Ethics at the upcoming event. His insights and expertise will shed light on the ethical considerations that come with the use of language models and provide valuable guidance for navigating these implications in an academic context. *This description was generated aided by ChatGPT.*

**March 16** – LM – Zoom presentation – Challenges in Interconnecting Utility-size Solar Installations to the Grid. A review of the challenges in connecting three utility-sized solar installations to two different distribution companies.

**March 19** – NCS members served as invigilators at The Math Kangaroo Contest at Concordia University of Edmonton.

The first Canadian edition of the Math Kangaroo was in 2001, in Ottawa. An IB private bilingual school, Academie de la Capitale, had been hosting the Math Kangaroo in Ottawa and the region for five consecutive years, from 2001 to 2005. Since then, the contest becomes more and more popular among parents, teachers and students. In 2004 and 2005, groups of five Canadian students (winners of medals in their grades) travelled to Bulgaria in August, to participate in the Math Kangaroo International Summer Camps, together with best performers from Russia, Romania, France, Georgia, and Bulgaria.

In October 2006, Canada became a member of the International Association "Kangourou sans frontieres" (view a map of Math Kangaroo countries). Math Kangaroo in Canada representative Valeria Pandelieva joined the XIV General Assembly of the International Association "Kangaroo without Borders", which took place on October 11-15, 2006 in Barcelona, Catalonia.

The 2006 contest for the first time was organized in three Canadian cities: Ottawa, Toronto, and Edmonton. In 2007 three new centres offered the contest in Calgary, St. John's, and Montreal. The number of entries in Canada increased from 318 in 2006 to 1382 in 2011. In July 2007 a group of five winners and a supervisor from Canada traveled to Romania for a summer Math Kangaroo camp.



**April 27** – LM – Zoom presentation - Comparison of LRT to Other Forms of Urban Public Transit.

As a follow up to his February presentation on project management in municipal governance, City of Edmonton Councillor Tim Cartmell P.Eng will present factors both in favour of and against the development of LRT as opposed to other transit modes, and build specifically on past Edmonton City Council decision on LRT development. This presentation will combine the engineering perspective with the political perspective.

**May 18** – LM - Zoom presentation –Nanomedicine in Alberta.

The Department of Biomedical Engineering at the University of Alberta is a joint effort between the Faculty of Engineering and the Faculty of Medicine and Dentistry. The University is also the host site for the National Research Council's National Institute of Nanotechnology. Together these entities create a critical mass for research in nanomedicine.

Nanomedicine involves drug delivery using nanopolymers and aerosols to promote bone and tissue regeneration and the development of improved diagnostic tools including MEMS and NEMS. Wound healing and disease diagnosis are areas of active research.

Silver, and specifically silver ions  $Ag^+$ , are known to be beneficial in the treatment of wounds. In the mid 1990s, nanotechnology provided an opportunity to develop a new silver delivery system that released biologically active species other than  $Ag^+$ . Nanocrystalline silver releases multiple species into solution which have different biological properties than  $Ag^+$ . In vitro, in vivo and clinical studies have clearly demonstrated that this new form of silver has unique anti-inflammatory and anti microbial properties.

Nanotechnology can not only change the chemical properties of a material but also its optical properties. Current work using these modified optical properties is aimed at point of care diagnostics which require no amplification and can be read by eye. Such developments would make it possible to see molecules as small as 2nm on a surface.

**May 23** – PELS/YP– Technical Tour of Siemens Medium Voltage Variable Frequency Drives and Motors.

We are excited to announce a unique opportunity for a Technical Tour to Siemens Medium Voltage VFDs and Motors, organized by the IEEE NCS YP with IEEE NCS PELS Chapter, to get an exclusive look at Siemens' MV VFD and Motor lineup with contactors. This tour will provide some valuable insights into industrial MV equipment. This event will be offered both in-person and online, to accommodate all our members.

**June 15** – LM - Zoom presentation – Electrical Vehicle Overview.

As an EV owner and utility engineer with a career focus on electric vehicles, William York will be presenting on the environmental impacts of electrified transportation, the utility impacts as well as the personal testimony of his ownership experience.

An electric vehicle owner since 2018, William has travelled more than 90,000 pure electric kilometres.

**June 19** – MTT-S/AP-S – Digitalization and Intelligence: Unlocking the Innovation of Future Radios.

To overcome the ever-increasing design challenges of radio front end for wireless communications, extensive research efforts have been devoted to advance the RF transmitters in recent years at both industry and academia. This talk provides an introduction on the innovations leading to more advanced digital and intelligent RF transmitters. First, an overview and the technical challenges on designing and implementation of All-digital transmitter will be introduced covering both hardware and software aspects, including active devices, switching-mode PA operation, efficient and spurious-free power encoding of signals. Then advanced techniques with demonstrators of All-digital transmitter and All-digital phased array will be showcased. In addition, Machine learning and AI techniques applied to enhance the agility and performance (i.e. operating bandwidth, efficiency, linearity) of (digital) radio transmitter will be highlighted. Perspectives on the future directions of radio transmitter towards a greener and smarter wireless communication will be shared at the end.

**June 20** – PELS - 3rd Annual Celebration of PELS Day: “Energizing IEEE PELS Community”

To mark this special occasion, we are thrilled to announce that our chapter has organized a networking session followed by a delightful pizza lunch exclusively for IEEE NCS PELS members like you. The event

aims to provide a platform for our members to connect with one another and learn more about our chapter.

**July 23** – NCS/PELS/YP/LM/IAS/PES/WIE – IEEE Summer BBQ at Dawson Park in Edmonton.



**September 18** – MTT-S/AP-S – RF Plasma Circuits and Antennas.

Plasma technology is widely used in various applications such as lighting, semiconductor manufacturing, and food processing. Recently, there have been significant developments in using plasma technology in high-frequency electronics, ranging from RF to millimeter-wave bands. This talk aims to explore the latest advancements in this field and discuss the benefits, challenges, and application space of plasma-based devices in RF technology. We will first review the use of plasma as a tunable material for varactors, switches, and variable resistors. These devices are of particular interest in high-power applications, such as radar, radio transmission, and satellite communication, where signal control is required at the transmit side. In addition, these devices are useful for protecting sensitive circuits. Second, we will present recent solid-state plasma electronics for high-frequency applications. Furthermore, we will discuss the exciting potential to create widely tunable antenna elements for reconfigurable plasma antenna array systems.

**September 20** – LM – Methane Mitigation.

New Paradigm has been working on methane reduction projects since 1998 (just after the Kyoto protocol was reached in December 1991). The decision to focus on methane was because it was a “low-hanging fruit” for GHG reductions and “no regrets” as these reductions would also provide other benefits beyond GHG reductions. With oil and gas shareholder interest in achieving “net zero” targets in the last few years, there has been considerable progress in reducing emissions, both through improved regulations, volumetric reporting, incentives and collaborative actions by producers, suppliers, and governments. Results from the end of 2021 show a 44% reduction in methane emissions from 2014 levels in Alberta vs. a target of a 45% reduction by 2025. These emissions in Alberta are now ~15 MtCO<sub>2e</sub>/yr vs. almost 50 MtCO<sub>2e</sub>/yr in 2006.

This presentation will take a high-level look the wide range of methane sources of methane emissions from oil and gas operations and some of the challenges which have been or are being overcome to further reduce them.

**September 22** – PELS – Annual General Meeting

**October 4** – NCS/PELS/MTT-S/AP-S/IAS/PES – IEEE Day at University of Alberta.

IEEE Day commemorates the anniversary of the first time when IEEE members gathered to share their technical ideas, which took place in 1884. Worldwide celebrations demonstrate the ways thousands of IEEE members in local communities join together to collaborate on ideas that leverage technology for a better tomorrow. Now engraved in its essence, the IEEE Day’s theme is: “Leveraging Technology for a Better Tomorrow”. While the world benefits from what’s new, IEEE focuses on what’s next.

**October 13** – MTT-S/AP-S - Electrodynamics of Space-Filling Curves and Their Antenna and Metamaterial Applications.

The concept of space-filling curves has been a subject of study in the mathematics literature since the late part of 19th century. These curves are, in general, continuous mappings from a normalized one-dimensional interval  $[0,1]$  to a normalized two-dimensional region,  $[0,1] \times [0,1]$ , and for each case the curve passes through every point in the 2-D region in the limit of infinite iteration order. The most widely used of these curves is ones proposed by G. Peano and David Hilbert in 1890 and 1891, respectively.

From the electromagnetics, scattering, and antenna viewpoints the space-filling curves are very attractive since they offer a resonant structure that could have a very small footprint as one increases the step-order in iterative filling of a 2-D region. Space-filling curves, however, are a subset of much larger class of curves in Graph theory, called Grid-Graph Hamiltonian Paths (GG-HP) and Cycles (GG-HC).

In this lecture, the fundamental electrodynamics of Space-filling curves and Grid-Graph Hamiltonian Paths in terms of their scattering properties, polarizability, and multiband/wideband functionality, and their roles in development of low-profile, electrically small and reconfigurable antennas, metamaterials, and metasurfaces for antenna beam-shaping will be given. In particular, we describe use of the space-filling curve and Hamiltonian Path fractal elements in development of wideband but miniaturized top loaded monopoles, ultra-passive RFID tags, polarization insensitive high-impedance surfaces, electrically-thin microwave absorbers, SNG and DNG metamaterials, and metasurfaces with non-uniformly spaced inclusions for beam shaping of printed antennas. We will discuss salient features of these novel structures and will describe physical insights into the theoretical and measured results.

**October 13** – IAS/PES – Integration of Inverter-Based Resources (IBRS) in Weak Areas of the Power System.

Network transformation brings about new challenges in the operation and planning of the power system. One of these challenges is declining system strength across the grid as more conventional generations are being replaced by inverter-based resources (e.g. wind, solar, battery energy storage). This presentation covers the adverse impact of system strength shortfall on the operation and performance of IBRS. In addition, it reviews some of the corrective measures commonly used in industry to address such issues.

**October 19** – LM – Pathways Alliance – Pathways to Net Zero.

The Pathways Alliance is a collaboration of Canada's six largest oil sands producers which comprise 95 per cent of current oil sands production. In June 2021, they announced a comprehensive multi-phased plan to reduce current oil sands GHG emissions by about 22 million tonnes annually by 2030 on a path to net zero by 2050. The proposed foundational project is a carbon capture and storage (CCS) network and CO<sub>2</sub> pipeline to gather CO<sub>2</sub> from more than 20 facilities and transport it to a hub in the Cold Lake area for safe underground storage.

This presentation discusses Pathways' CCS which also enables other technologies including hydrogen, electrification, renewables, and direct air capture. The innovation arm of Pathways Alliance, COSIA (Canada's Oil Sands Innovation Alliance), is responsible for this technology development work.

**October 27** – YP/PELS/WIE/IAS/PES - CO<sub>2</sub> Emission Reduction Session.

CO<sub>2</sub> Emission Reduction by Steam and Gas Turbine Replacement with Electrical Motor and Variable Frequency drive. Introduction – Why this topic? Benefits of Replacing Turbines with Electric Drivers; Replacement Models; High Speed Motor and VFD Technology.

**November 9** – NCS – What do you want to know about ChatGPT: Basics, Experiences and Opportunities.

Since OpenAI launched ChatGPT, it grabs everyone's attention. ChatGPT is built on GPT which stands for Generative Pre-trained Transformer. This talk will explain what is GPT with the basics and also share

some experiences we have seen on the use of GPT/ChatGPT. At the end, the potential of using GPT/ChatGPT in education will be discussed.

**November 14** – IAS/PES – Electrical Design Considerations for EV Infrastructure.

In the rapidly evolving landscape of electric vehicles (EVs), ensuring a seamless and safe charging experience is paramount. "Electrical Design Considerations for EV Infrastructure" delves into the critical aspects of designing and implementing EV charging infrastructure, addressing the growing demand for sustainable transportation solutions. The presentation will highlight Charger Ratings and Topologies, shedding light on the various charging options available and their implications for design. Exploring the importance of Site Power Distribution Options, the presentation outlines strategies to optimize power delivery while considering practical constraints. Special attention is given to Designing Grid-to-Charger (G2C) Circuits, providing insights into the intricacies of electric grid integration. Join us in this enlightening presentation to explore the pivotal role of electrical design in shaping the future of EV charging.

**November 16** – LM- Zoom presentation - Fusion Energy, The Prize, Pathways, Progress & Prospects.

Fusion of nuclei, the source of energy in our sun and stars, can provide the clean, sustainable base load energy required to power our future in electricity, heat, and hydrogen for stationary and mobile applications. Harnessing fusion on earth requires heating fuel to ~100 million degrees and confining it (a difficult task) for sufficient time to realize practical energy gain. Progress in fusion science (achieving fuel confinement & "ignition") has moved to an engineering phase to demonstrate net energy production. There are a variety of technological approaches being pursued in academic, government and industry labs that offer promise; success will transform energy policy worldwide. This talk will highlight status, approaches & possible timelines for fusion energy demonstration. Recent success in achieving "ignition" will stimulate industrial development of enabling technologies to speed fusion energy development. Possible demonstration systems are likely to emerge in the 2030's but penetration as a major energy source for utilities & industry will likely take decades.

**November 16** – NCS – Section Elections.

**November 17** – PELS - Technical Talk: The Current Shaping Modular Multilevel DC-DC Converter: An Enabler Technology for Future DC Distribution Grids.

One of the next frontiers for DC grid technology will be the last mile of power delivery. For DC to be pervasive at distribution voltage levels, DC-DC converters for tapped power applications with low-cost and high-efficiency potential will be required. These converters would serve a similar function to secondary distribution transformers in AC grids. Recently a new class of converters has been introduced for this purpose, termed the current shaping modular multilevel converter (CS-MMC). The CS-MMC is a hybrid structure featuring a combined use of current source and voltage source modules, eliminating the need for internal string inductors. This particular structure enables high effective frequencies to be achieved, an important feature for achieving low-cost designs. In this presentation, an overview of the CS-MMC converter class will be presented along with some of the latest research findings on a new bidirectional current-fed multilevel topology with zero-current switching. A primary application for this topology is direct charging of an electric vehicle (EV) from a future medium-voltage DC distribution line.

**December 6** – IAS/PES – The Truth About Phasor Measurement.



If you look up "phasor measurement unit" on Wikipedia, you will learn a little about PMU that is right and a lot that is wrong. (To start with, phasors predate Steinmetz.) If you turn to the various papers and books that have been written on the topic, you will still not get the whole truth. Even the IEEE and IEC standards about PMUs have got significant parts wrong! If a PMU is built so as to fully comply with the standards, it will be an under-performing device that breaks the fundamental rules of measurement. The presenter, Dr. Harold Kirkham, is listed as a member of the working group that wrote the 2011 IEEE PMU standard. However, he was so upset by it that he is NOT listed as having voted for it! It has taken him a long time to figure out exactly what is right and what is wrong about the standard. This webinar will set the record straight and explain what is wrong with the current treatment of the subject.

**December 13** – IAS/PES – OPENPMU, PTP, and Time-Synchronized Sampled Values – The Data Hoarder's Approach.

"When you can measure what you are speaking about and express it in numbers, you know something about it." - Lord Kelvin.

Synchronized measurement technology, specifically the Phasor Measurement Unit (PMU), has provided tremendous insight into power system phenomena over the last few decades. However, the PMU is an instrument not well understood by many who utilize its measurements. The time-synchronized phasor, or synchrophasor, is a double-edged sword. On one hand, it has made it possible to apply classical methods of power system analysis to "real" data from actual systems. On the other hand, the synchrophasor eliminates all the nuances of the voltage or current waveform present in the sampled values from which it is estimated.

What if we keep all of the time-synchronized sampled value (TSSV) data and use that for our studies? Building machines capable of doing this is more than feasible. This talk will discuss the approaches and challenges that engineers pursuing this strategy face, particularly the not-so-small matter of the many terabytes of data such a system will create, with "needle in a haystack" levels of useful information. The talk will describe an effort on the island of Ireland to build a national system to record TSSV and also synchronize using PTP instead of GNSS and its "space-based" vulnerabilities.