IET Toronto Local Network

IEEE Hamilton Section

Technical presentation on:

Electric Energy Storage Systems for Electric Transportation – Recent Trends and Future Challenges

Supported by the IET Toronto Local Network and IEEE Hamilton Section

Date: 19th January 2015

Time: Arrive at 18:45, presentations starts at 19:00 for approx. 1 hour

Abstract:

In order to achieve stringent auto industry goals, the trend is moving towards transportation electrification, by introducing sustainable and non-polluting electric and plug-in hybrid electric vehicles (EVs/PHEVs). Hence, it has become imperative to find a solution, to manage energy production and usage accurately, especially within the context of future electric mass transit energy storage systems.

Enhancing the life of Lithium-ion battery packs has been the topic of much interest in the automotive industry. On-board cell-equalization problem of lithium-ion (Li-ion) batteries will be highlighted in this tutorial. This is a very important topic in the context of EV battery energy storage cost and life/state-of-charge, SOC/state-of-health, SOH monitoring. Li-ion batteries, although popularly proposed, have been highly uneconomic for EV energy storage, overshooting cost requirements by a large margin. They provide a good solution for EV and PHEV applications, but main issues include: cycle life, calendar life, energy density, power density, and lately, safety. These issues can be addressed successfully by using a simple practical approach: a power electronics cell voltage equalizer. The purpose of the second part of this tutorial is to demonstrate the role of power electronics intensive battery management solutions to reach the cost breakpoint of a PHEV/EV. The design and implementation of both inductor-based as well as switched capacitor DC/DC converters for Li-ion battery cell-equalization will be discussed. Finally, the design of a novel DC/DC resonant converter for voltage equalization of EV/PHEV Li-ion battery cells will also be presented.

This presentation will also look at storage issues related to future all-electric transit applications, such as transit buses, trucks, trains, and trams. The tutorial will present fast charging stations and smart on-board energy management for ultracapacitor (UC) powered electric traction. The presentation will depict the proposed possibility of completely eliminating the need for powering traction railway systems from overhead or side power conductor rails. The presentation will depict a new and innovative concept of powering city electric transit systems solely by the use of high power density UCs and promptly fast charging them off-board. The tutorial will also present a wireless DC fast charging system that can be installed only at major bus stops, tram stops, or train stations, to achieve charging of on-board UCs in < 2 minutes. The tutorial will present the sizing/layout of the UC bank (series/parallel modules) and its distinct DC/DC 2-quadrant converter (for regenerative

braking and acceleration), as well as the design the power electronic DC off-board fast charging infrastructure. The second part of this presentation will depict the design of the on-board DC/DC power electronic UC cell voltage management system. This smart and novel on-board DC/DC power electronic energy management converter will help equalize and balance the UC cell voltages.
It must be noted that this seminar will be particularly useful for engineers and managers with entry-level and medium-level knowledge of automotive power electronics and motor drives. The seminar would also be appropriate for engineers with entry-level knowledge of power electronics and motor drives applications towards energy storage systems, electric vehicles, and renewable energy systems.

The Speaker

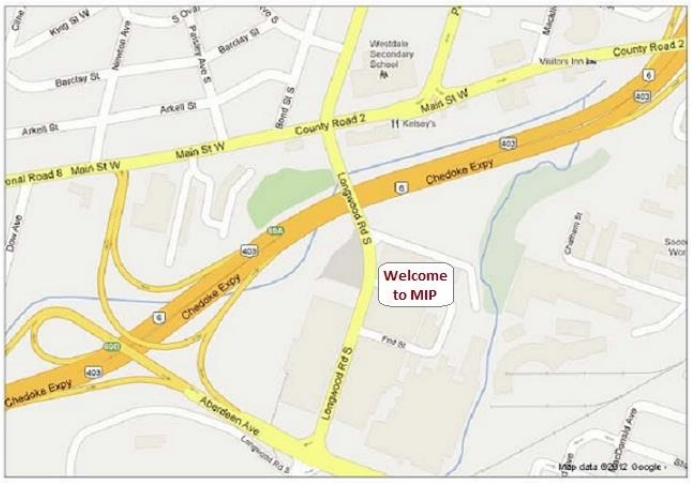
Sheldon S. Williamson (S'01–M'06–SM'13) received his Bachelor of Engineering (B.E.) degree in Electrical Engineering with high distinction from University of Mumbai, Mumbai, India, in 1999. He received the Master of Science (M.S.) degree in 2002, and the Doctor of Philosophy (Ph.D.) degree (with Honors) in 2006, both in Electrical Engineering, from the Illinois Institute of Technology, Chicago, IL, specializing in automotive power electronics and motor drives, at the Grainger Power Electronics and Motor Drives Laboratory. Dr. Williamson is an Associate Professor and NSERC Canada Research Chair in Transportation Electrification and Electric Energy Storage Systems, within the Department of Electrical, Computer, and Software Engineering, Faculty of Engineering and Applied Science, at the University of Ontario-Institute of Technology, Oshawa, Ontario. From 2006-2014, Dr. Williamson was with the Department of Electrical and Computer Engineering, at Concordia University, Montreal, Canada. His main research interests include the study and analysis of electric drive trains for electric, hybrid electric, plug-in hybrid electric, and fuel cell vehicles. His research interests also include modeling, analysis, design, and control of power electronic converters and motor drives for land, sea, air, and space vehicles, as well as the power electronic interface and control of renewable energy systems.
Dr. Williamson has offered numerous conference tutorials, lectures, and short courses in the areas of Automotive Power Electronics and Motor Drives. He is the principal author/co-author of over 150 journal and conference papers. He is also the author of 4 chapters in the book entitled, Vehicular Electric Power Systems (Marcel Dekker, 2003). He is also the author of 2 chapters in the book entitled, Energy Efficient Electric Motors (CRC Press, 2004). He also served as the Technical Program Chair for various conferences, including the Annual Conference of the IEEE Industrial Electronics Society (IEEE IECON 2012), the IEEE Vehicle Power and Propulsion Conference (2011), and the IEEE Canada Electrical Power and Energy Conference (2009). Dr. Williamson also served as the Project Coordination and Awards Chair at the 2007 IEEE Canada Electrical Power Conference, Montreal, Canada. He was the Conference Secretary for the 2005 IEEE Vehicle Power and Propulsion Conference, Chicago, Illinois. Dr. Williamson is also the beneficiary of numerous awards and recognitions. He was the recipient of the prestigious "Paper of the Year" award, for the year 2006, in the field of Automotive Power Electronics, from the IEEE Vehicular Technology Society (IEEE VTS). In addition, he also received the overall "Best Paper" award at the IEEE PELS and VTS Co-sponsored Vehicle Power and Propulsion Conference, in Sept. 2007. He was awarded the "Best Paper" award at the IEEE Canada Electrical Power and Energy Conference, in Halifax, Nova Scotia, Canada, in Aug. 2010. He was awarded the prestigious Sigma Xi/IIT Award for Excellence in University Research, for the academic year 2005-2006. In 2006, he also received the "Best Research Student" award, Ph.D. category, within the ECE Department, at the Illinois Institute of Technology, Chicago. Dr. Williamson is a Senior Member of the IEEE. He currently serves as a Distinguished Lecturer of the IEEE Vehicular Technology Society (VTS). He also serves as Associate Editor for the IEEE Transactions on Industrial Electronics, IEEE Transactions on Power Electronics, IEEE Transactions on Transportation Electrification, and the IEEE Journal of Emerging and Selected Topics in Power Electronics. He is a member of the IEEE PELS, IES, and VTS. He is also a Member of the IEEE Transportation Technologies Awards Committee.

The Venue

Meeting Agenda:
6:45 pm Refreshments & Networking
7:00 pm Technical Talk Presentation
8:00 pm Question & Answer Session
8:30 pm Refreshments and Networking

Meeting Room 1D
McMaster Innovation Park
175 Longwood Road
Hamilton, ON L8P 0A1

http://mcmasterinnovationpark.ca/directions-to-the-mip



Attendance

Attendance is free, refreshments available, free parking