



MacAuto Electric Machines and Vehicle Drive Systems Colloquium

19th September 2014

Supported by the IET Toronto Local Network and IEEE Hamilton Power Chapter



Technical presentations will start at 13:00 until 18:00, followed by an IEEE Distinguished Lecture Series Presentation at 18:30. The day will be finalised by a tour of the McMaster Automotive Resource Centre (MARC) facilities.

Technical Presentations

Time: 13:00 – 15:00

Venue: MARC Conference Room 107

“Thermal Analysis of Electric Motors and Generators – a Motor-CAD Software Seminar”

Speaker: Dr. David Staton

There are constant demands to develop higher powered, smaller, lighter and more efficient electric motors and generators. This inevitably leads to severe heat management issues. The ability to develop reliable thermal models that can be used to model the heat transfer and fluid flow in the electrical machine is becoming more important. Their use allows electric machine designers to optimise and investigate new cooling strategies and so gain confidence that their solution will not suffer from thermal problems. This tutorial will review the different methods available for thermal modelling of electric machines and give some practical examples of cooling system design.

Time: 15:15 – 15:45

Tea / Coffee break

Time: 15:45 – 16:30

Venue: MARC Conference Room 107

“Computationally Efficient Calculation of Losses in Brushless Permanent Magnet Machines”

Speaker: Prof. Phil H. Mellor

An integral part of the design of compact high performance electrical machines is an understanding of the magnitude and distribution of the losses. The presentation will review a range of methods available to accurately estimate the principal components of loss within PM electrical machines over typical operational envelopes, including field weakened operation. A

common approach is described where the loss variation with operating point is determined through simple mathematical relationships. The parameters of these loss functions are populated through a minimal number of bounded electromagnetic finite element analyses. The approach enables computationally efficient automated multi-physics design, with the developed expressions for loss forming the link between the electrical system, electromagnetic and the thermal domains. The accuracy of the approach will be demonstrated through test data obtained from high performance PM AC machine exemplars.

Time: 16:45 – 17:15

Venue: MARC Conference Room 107 or MARC 266

Title: “Electric vehicles, managing their huge appetite for energy”

Speaker: Dr. Pete James

As the number of Electric Vehicles increases, the energy demands of such vehicles becomes more of an issue. This presentation outlines the power requirements of electric vehicles and the issues of storage, supply and generation. The presentation will detail the energy requirements of an electric vehicle and the current methods of charging for such vehicles, it will also discuss the various battery packs currently being used and the requirements for maintaining a safe energy storage system. An overview of the active technology Lyra Electronics is developing to improve the battery cell balancing systems will also be presented along with a project outline of a high power DC-DC converter for rapid charging of battery packs and a novel solution to making this affordable.

Time: 17:30 – 18:00

Venue: MARC Conference Room 107 or MARC 266

Title: “Electric motorsport, challenges and achievements”

Speaker: Dr. Pete James

With the increasing uptake of electric vehicles by consumers motorsport event organisers are looking to exploit the new technology by creating and running electric races series. This presentation will describe the TTXGP electric motorbike championship from its conception in 2008 through to its running along side MotoGP in 2014. Focusing on the teams, their bikes and the race meetings it will outline the challenges and achievements of running an electric bike in a motorsport event. The presentation will also show the electric Le Mans car which Drayson Racing Technologies developed and went on to win the world land speed record for an electric car and outline the new Formula E world electric race series.

The Speakers

Dr. David Staton is the President of Motor Design, Ltd., UK, a software and consultancy company that he established in 1998 following previous work in the UK with the SPEED Laboratory at the University of Glasgow and Control Techniques Ltd., now part of Emerson Electric.

Dr. Staton has published more than one hundred papers. He has more than twenty five years of engineering experience and has provided design solutions and software for many leading manufacturers worldwide, as listed on the Company website www.motor-design.com.

The latest software from Motor Design, Ltd., is a unique template-driven program for coupled electromagnetic and thermal industrial design of electric motors and generators.



Prof. Phil H. Mellor received the B.Eng. and Ph.D degrees from the Department of Electrical Engineering, Liverpool University, Liverpool, U.K., in 1978 and 1981, respectively. He held academic posts at Liverpool University from 1986 to 1990 and at Sheffield University from 1990 to 2000. He is currently a Professor of electrical engineering in the Department of Electrical and Electronic Engineering, University of Bristol, Bristol, U.K.



Prof. Mellor's research interests include high-efficiency electric drives and actuation and generation systems for application in more electric aircraft and hybrid-electric vehicles.

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Dr Peter James is Technical Specialist and Director at Lyra Electronics Ltd., UK, specialising in electric and hybrid vehicles and green energy systems, for which he has worked for three years. Prior to Lyra Electronics he worked for Prodrive Ltd., UK, and Lucas Ltd., UK, in roles varying from Senior Engineer to Chief Engineer and Technical Specialist. During his career he has designed and developed 3 phase brushless motor drives, high and low power DC-DC converters, battery cell monitoring and balancing systems, power distribution module, control ECUs, and software for both embedded and desktop applications. He also writes low and high level Simulink software, simulates power electronics and hybrid and electric vehicle energy requirements and performs health and safety training for work on hybrid and electric vehicles.



Dr. James is also Chairman of the Automotive and Road Transport Systems Technical Professional Network (ARTS TPN) for the Institution of Engineering and Technology (IET) and was scrutineer and defined regulations for the TTXGP electric motorcycle championship. He is now scrutineer for the MotoE electric motorcycle championship.

ARTS TPN is the IET Automotive and Road Transport Systems Technical Professional Network. The Network organises technical events for industry. Hot topics at the moment are EV charging, autonomous (driverless) vehicles, vehicle-to-vehicle communications and road-to-vehicle communications.

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IEEE Distinguished Lecture Series

Time: Arrive at MARC, Conference Room 226, at 18:15, presentation starts at 18:30 for approximately 1hr with Q&A session. Presentation will be followed by tour of MARC facilities.

**Title: “Hybrid and Electric Vehicles in Europe
- Challenges and Practical Solutions for the Electric Machine Drive Systems”**

Speaker: Dr. Mircea Popescu

The lecture covers some of the latest developments in European HEV industry and includes state of the art topologies and emerging trends. Other timely topics such as heating and ventilation, manufacturing technologies like segmented stators for brushless PM machines and die-cast copper rotors for induction motors, the role of computer aided engineering in the industrial environment. Particular emphasis is placed on the possible shortage of NdFeB magnets and on potential alternatives for rare-earth free or magnet free solutions.

Various cooling systems for electric machines are illustrated in detail, with a focus on forced convection – air or liquid - methods. A high torque density value is achievable only if an efficient cooling is employed. The merits and problems for the existing cooling system are discussed. Topics such as the risk for PM demagnetization, the effect of switching frequency, supplementary AC losses and magnet losses are discussed.

A comparison between the permanent magnet motor solutions – interior and surface rotor mounted motors - with rare-earth magnetless solutions – induction motors and reluctance motors is presented.

The Speaker

Dr. Mircea Popescu (M’98 – SM’04) is the Engineering Director of Motor Design, Ltd., a software and consultancy company headquartered in the UK and with offices in the US, and has more than thirty years of engineering experience. Earlier in his career, he was with Helsinki University of Technology (now Aalto University) in Finland and with the SPEED Laboratory at the University of Glasgow. Dr. Popescu published more than one hundred papers and his publications have received three IEEE best paper awards.

His consultancy contributions for industry are incorporated in many state-of-the-art products. Current major projects include electrical machines and drives for hybrid/electrical vehicles, and formula-e racing cars. Dr. Popescu is the Chair of Electrical Machines Committee for IEEE Industry Application Society (IAS) and an IAS Distinguished Lecturer for 2014 and 2015.



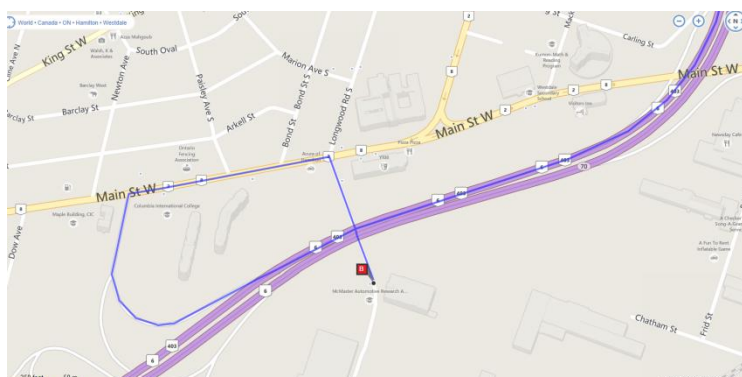
The Venue

Conference Rooms: MARC 107 and MARC 266

McMaster Automotive Resource Centre (MARC), McMaster University, Hamilton,
105-175 Longwood Road South, Hamilton, Ontario L8P 0A1:

<https://mcmasterinnovationpark.ca/mcmaster-university-automotive-resource-centre>

McMaster Automotive Resource Centre (MARC)



Attendance

Attendance is free, but please confirm in advance via email to Prof. Nigel Schofield at:
nigels@mcmaster.ca