Tuesday, December 10

Electronic Systems for Vehicle Propulsion

**Session Code:** ESVP1  
**Room TBD**  
**Session Time:** ALL DAY

The focus of this one day symposium is to address the trends, the challenges and the solutions of electronic systems controlling vehicle propulsion. Presentations will cover the controls of HEV, EV and FCEV Engines, Transmission & drivelines, xEV Applications and electrification. The emphasis of the presentations is on: electrification and the impacts of the various systems. Experts from OEM, Integrators, Tier suppliers and Academia will address issues critical to the automotive industry.

**Organizers -** Marc LeDuc, SAE International

**Time** | **Paper No.** | **Title**
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**Keynote:** Opportunities and Challenges of Hybrid Electric Vehicles: What is the "Right" Level of Electrification?

Driven by ever more demanding on-road customer expectations and legislative requirements, large car manufacturers face the challenge to improve fuel consumption and emissions of their products in a cost effective manner. The well of conventional internal combustion engine and transmission technology is drying up and it is getting increasingly expensive to draw from it. New powertrain functions are needed and some OEMs, including Ford, now serve an increasing customer base with a matured generation of Hybrid or Plug-In Hybrid products. In order to further democratize and expand the application of Hybrid technology in future cars, significant cost reductions are required. But these cost savings will come with trade-offs: engineering, planning and marketing professionals are thus faced with the issue of finding the sweet-spot of best attributes at minimal cost and investment. What role can premium Start-stop systems, mild/medium Hybrids and full Hybrids play? How do their subsystems interact? And does a low voltage Hybrid really provide good value for money? These and other important questions will be up for discussion in the presentation.

Daniel Kok, Ford Electric Vehicle

**China xEV Markets Trend with IFX Semiconductor System Solution Innovation**

Driven by the China National regulation of fuel consumption of year 2015/2020 of passenger vehicle and emission control policy, there are many different technology path step by step towards the pure EV implementation. Each progress of those technology is electronics oriented and all technology realization comes from the semiconductor innovation. From traditional powertrain EMS system, to electrification, start/stop and micro hybrid, mild hybrid to plugin, till pure EV are all derives from semiconductor innovation. As a global key player of automotive industry, Infineon has had a broad of product/system innovation solution to support the this diversified markets needs in terms of sensor, multicore MCU and drivers, bridge to fit for all different vehicle architecture and voltage range requirement.

Helen Xu, Infineon Integrated Circuit Co., Ltd.

**Battery Management System - Electric Architectures to Support the Increasing Hybridization of Vehicles**

TBD, Dr. Quanhui Zhang, Hella (confirmed)

**Advanced Modular Component Systems for EV Powertrains**

Alex Wang, Continental Automotive AsiaPacific Co., Ltd.
Panel: 48V Application

Acknowledged by most of the stakeholders, the propulsion systems will be hybridized. This panel will explore hybridization architectures, and develop the benefits and challenges. It will segment solution from low voltage 48V and high voltage solutions 200V to 1000V.

Moderators - Meng Liu, Infineon Technologies China Co., Ltd.
Panelists - David Cue, Johnson Controls; Zhenxing Fu, SAIC; Daniel Kok, Ford Motor Company; Zonghua Li, Chongqing Changan New Energy Auto Co., Ltd.;
Meng Liu, Infineon Technologies China Co., Ltd.

Research & Development of E-motor Control System

The design and development of E-motor controls present a variety of challenges, ranging from fast cycle times between 50 and 100 µs to critical safety, to the necessity of having to rely on less established tool chains in this relatively new business domain.

Zhihong Wu, Tongji Univ.

Electronic Controls for In-Wheel Motors

, Protean (CONFIRMED)

Open Inverter Platforms (including HIL)

Anton Angermaier, AVL

xEV Architecture Roadmap

With the environment protection becoming more and more important and the Energy-saving technology developing very rapidly in China, more strict regulations in China for fuel consumption and emission are published in recent years. Changan also focused on the technology industrialization in new energy area. This presentation first introduces the developing overall route and strategy of Changan, and then presents the changan HEV and EV system architecture, its advantage and disadvantage.

Zonghua Li, Chongqing Changan New Energy Auto Co., Ltd.

Panel: Paving the way to e-Mobility for China

China has worldwide the most aggressive target for fuel efficiency. Indeed, the average passenger car production of CO2 is today (2013) 180 gCO2/km and the target is 117g by 2020 and 95g by 2025.

Moderators - Patrick Leteinturier, Infineon Technologies AG
Panelists - Anton Angermaier, AVL; Vasco Schirmmacher, IAV Automotive Engineering Inc.; TBD, Protean (Invited);
Zhihong Wu, Tongji Univ.; Dong Xu, Protean Electric;
Patrick Leteinturier, Infineon Technologies AG

Wednesday, December 11

Electric Powertrain Technologies

Session Code: EPTS1

Room TBD

Session Time: ALL DAY

Time Paper No. Title

e-Powertrain Worldwide Landscape - Outlook 2020

Wolfgang Bernhart, Roland Berger Strategy Consultants
The International Technology and Industrial Development Trends of EV’s Drive Motor Systems

Jun Gong, Shanghai eDrive Co., Ltd.
**The Four Most Advanced Manufacture Process of e-Drive Devices**  
Zhishun Li, Synergistics

**Challenges and Requirements for High Volume Production of E-Motors for Automotive Propulsion**  
William Cai, Jing-Jin Electric Technologies

**Development of an Integrated High Efficiency Electric Powertrain Consisting of a Motor, Motor Controller and Reducer**  
Jaehong Kim, Posco

**BRS-Bosch New Boost and Recuperation System**  
Luming Liu, Bosch China Investment Co., Ltd.

**Developing an eMachine for a Range Extended Electric Vehicle**  
Eddie Wearing, Ricardo Inc.

**Examining the Difference in Energy Consumption Between a PMAC and an Induction Motor Over Various Drive Cycles**  
Jay Schultz, Parker Hannifin Corp.

**An Analysis of Copper Rotor Induction Motor Technology for EV's in China**  
Chen Xiaojiang, Hangsheng Electronics Co., Ltd.

**The State of Low-Speed Development and Production in China Today**  
Jackton Lu, Lujo (Weihai) EV R&D Co., Ltd.

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**Wednesday, December 11**

**High Efficiency Combustion Systems**

**Session Code:** HECS100

**Room TBD**

**Session Time:** ALL DAY

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**Keynote Speaker**

Dr. Smyth will provide his perspective on the future of these engines. How long will they be around? How much more efficient can they become? What is next?

Gary Smyth, General Motors Global R & D

**Friction Optimization to Reduce the Fuel Consumption of Internal Combustion Engines**

With more and more stringent legislation becoming effective, automotive OEMs are working on state-of-the-art technologies to meet the government requirements as well as customer expectations. In the past few years, tremendous effort has been applied on reducing engine frictions to lower the fuel consumption, both for the energy saving and environmental protection purposes. In this presentation, simulation and experimental studies are reported to show the effectiveness of each friction reduction technology on the fuel consumption. Also analyzed in this report is the cost sensitivity of each technology on the engine fuel consumption.

Yuan Shen, Zhejiang Geely Automobile Research Inst.
High Efficiency Concepts for Future SI Engines
The talk will discuss the state of the industry for advanced SI engines and then present SwRI’s solution for high efficiency engines. Cooled EGR plus boosting and an advanced ignition system can lead to considerable improvements in engine efficiency as well as emissions reductions. Some of the benefits and challenges of using cooled LPL EGR will be covered and SwRI’s concept for implementing cooled EGR for production discussed. Finally, the newest version of our cooled EGR technology, Dedicated EGR, will be discussed along with data showing how the concept works and the efficiency benefits possible.

Terry Alger, Southwest Research Institute

Design ICE for Hybrid Vehicles
The operating conditions of ICE on hybrid vehicles can be considerably different from those on traditional vehicles. This fact has motivated engine downsizing and use of the Atkinson cycle. Both of these changes have resulted in significant fuel savings. In this talk, we will discuss several other possible changes and present preliminary experimental and simulation results. We first run an LNF engine using its stock calibration, and then by analyzing its behavior on a simulated power-split hybrid vehicle, we design a set of experiments to study the effect of possible calibration changes to improve fuel economy and emissions, some of these calibration changes are implemented in our engine dyno lab and others, including the effect of change in combustion cycles are implemented in simulations.

Huei Peng, Univ. of Michigan - Ann Arbor

Turbo-Charge
Haiquan Han, BorgWarner China

High Performance Computing for Accelerating the Development of High Efficiency Engines
New fuel economy standards and emissions regulations are pushing the development of new engine technologies, sensors, and onboard computing on an unprecedented scale. These developments are leading to a paradigm shift in engine flexibility and enabling new approaches to high efficiency combustion. With this expanded flexibility, the challenge will now be the exponential increase in the design and calibration space and the need for the development of better simulations, optimization algorithms, and self-learning controls. This will include the development of more computationally efficient models and the use of heuristic optimizers to better manage the parameter space. The use of high performance computing systems will also be critical to accelerating this process and ensuring optimal design and calibration solutions for maximum efficiency and lowest possible emissions. This presentation also provides historical and future perspectives on the opportunities and challenges of this unparalleled technology growth for the next generation of high efficiency engines.

Robert M. Wagner, Oak Ridge National Laboratory
Hybrid Combustion Technology for LD Diesel Engines

- In order to achieve high efficiency and clean combustion of diesel engines, many advanced combustion concepts have been developed in recent years, such as homogeneous charge compression ignition (HCCI), premixed charge compression ignition (PCCI), Reactivity Charge Compression Ignition (RCCI) etc. These combustion modes can simultaneously reduce NOx and soot emissions with high efficiency. However, they also meet some challenges, such as, combustion control, ultra-high CO/UHC emissions and operation ranges etc. In this presentation, a hybrid combustion mode design has been proposed based on different operating conditions. Different combustion modes were investigated under the typical engine loads. The results showed that, compared to RCCI, the PCCI strategy could improve the CO/UHC emissions and BFSC, while the NOx and soot emissions are similar to those of RCCI at low load condition. At medium load condition, RCCI could meet the ultra-low NOx and soot emissions targets with improved BFSC. As the large load condition, to suppress the rapid rate of pressure rise of RCCI, the in-cylinder late-injection and QHCCI (Qusi-HCCI) of dual-fuel must be required. Additionally, by optimizing the turbochargers and EGR, the operation with high efficiency and low emissions (BSNOx<0.4g/kW.h) can be extended to 15.1bar BMEP. It showed that ultra-low NOx and soot emissions and high efficiency could be achieved with hybrid combustion mode, covering the full operation range of LD diesel engines.

Haifeng Liu, Tianjin Univ.

Minimize Total Operating Cost of a Tier 4 Non-road Engine

Non-road diesel engines above 56 kW that meet US EPA Tier 4 emissions uses select catalytic reduction (SCR) for NOx control. The SCR system, in addition to combustion optimization and EGR, offers opportunity to minimize total engine operating cost since fuel and urea have different market price in different regions of the world. This presentation discusses ways to optimize engine out NOx targeting through EGR adjustment and exhaust emissions through urea application.

Kevin Bailey, John Deere & Co.