**Tuesday, October 29**

**Transmission and Driveline (Part 1 of 2)**

**Session Code:** IIM303  
**Room Cornerstone I**  
**Session Time:** ALL DAY

This day will address the development of new transmission concepts, transmission enhancements and the advancement of the state of the art of transmission system design & integration. New transmissions, including 48V systems, and high voltage axles will be highlighted, along with controls and simulations.

**Chairpersons** -  
Pradeep Attibele, FCA US LLC; Azadeh Narimissa, General Motors; Hong Jiang, Ford Motor Company; Jim Borgerson, General Motors; Scott Halley, Lubrizol Corp.

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| 8:30 a.m.  | ORAL ONLY | **Keynote Presentation: Mobility and the Grid: A Vision for a Symbiotic Future**  
In the drive towards transportation electrification, researchers have investigated potential bottlenecks in the nation’s century-old power grid. The charting of the solution space, on the other hand, has barely begun. This talk will explore future hypothetical scenarios where EVs enhance the power grid and vice versa, from engineering, financial, and behavioral perspectives.  
Eric Hsieh, US Department of Energy |
| 9:30 a.m.  |           | **Networking Break in Exhibit**                                          |
| 10:00 a.m. | ORAL ONLY | **Ford 10R140 Heavy Duty Transmission**  
Ford Motor Company is introducing a new 10 speed rear wheel drive transmission for the 2020 model year Super Duty. This new transmission is designed specifically to address the challenging requirements of the over 8500 lbs pickup truck market. The new 10 speed transmission makes improvements in performance, efficiency, power take off capability, and smart electronic features compared to the prior model 6 speed transmission. The design team optimized the cross section to maintain the same axial length as the prior transmission, helping to reduce cost, weight, and impact to the vehicle package.  
Greg Stout, Ford Motor Co., Ltd. |
| 10:30 a.m. | ORAL ONLY | **New Allison 10 speed Transmission for Chevrolet & GMC**  
The new Allison 10 speed Transmission will be paired with the Duramax 6.6L engine in the new 2020 Chevrolet & GMC 2500/3500 HD trucks. General Motors and Allison Transmission engineers worked closely to develop the new 10 speed transmission to optimize system integration and reliability. The new transmission was analyzed and tested at both companies to ensure maximum reliability. In addition to more speeds, other features include higher torque capability, greater overall ratio coverage, smarter controls with wet initial characterization, better integration of transfer case mounting, lower pump losses, and an integrated PTO option. All of this comes in a similar space claim and mass as the previous 6 speed transmission.  
David C. Ames, General Motors |
11:00 a.m.  ORAL ONLY  
**Ford 10R80 MHT Transmission**

Increasing focus on fuel economy has driven the need for hybridization across multiple vehicle platforms at Ford. While powersplit hybrid architectures are well suited to front wheel drive applications, the lack of a mechanically connected reverse gear is an inhibitor to using these architectures in larger rear wheel drive vehicles that have significant towing capability. Ford needed a rear wheel drive hybrid architecture that could deliver improved fuel economy, provide a mechanical reverse gear for towing applications, and package into existing rear wheel drive architectures. In order to accomplish this a modular hybrid architecture that was an add on to the existing 10R80 transmission was adopted. This paper explores the development goals of the 10R80 MHT architecture and discusses the advantages achieved with this approach to rear wheel drive hybridization.

Gregory Gardner, Ford Motor Company

11:30 a.m.  Networking Lunch in Exhibit

1:00 p.m.  ORAL ONLY  
**Performance and Characteristics of the TREMEEC TR-9070 DCT 7-Speed Dual Clutch Transmission**

The new 2020 Ford Mustang Shelby GT500 is nothing short of amazing from front to rear â€“ to its aggressive front fascia to its venom-infused 760 horsepower supercharged 5.2L V8 under the hood.

Brad Denniss, Maarten Debrouwere, TREMEC

1:30 p.m.  ORAL ONLY  
**P2i, a Family of Modular, Scalable, and Integrated Hybrid Drive Modules**

Mark Buchanan, BorgWarner Inc.

2:00 p.m.  ORAL ONLY  
**New Generation Lubricants for Evolving Electrified Drivetrains**

Electrified transmissions are evolving to meet performance requirements while continuing to meet even more strict emissions requirements. Current lubricants may not provide adequate hardware protection for these new designs. It is anticipated that many future electrified vehicle transmissions will incorporate the electric motor within the unit housing. This will result in direct contact between the motor and the lubricating fluid and raises new concerns regarding the fluidâ€™s electrical conductivity, propensity to corrode cuprous materials, heat transfer & thermal stability, compatibility with plastics. This discussion will highlight a number of these challenges and opportunities for modern fluid protection for modern electrified transmissions.

Christopher Prengaman, Lubrizol Corp.

2:30 p.m.  Networking Break in Exhibit

3:00 p.m.  ORAL ONLY  
**Schaeffler P2 Systems and beyond - Enabling modularity for e-mobility solutions**

Schaeffler has worked together with Ford to successfully launch the Ford Explorer and Lincoln Aviator full and plug-in hybrids utilizing the Schaeffler P2 Modular Hybrid Transmission. Utilizing the modularity and systems design experience of the P2 and other mechatronic systems, Schaeffler will continue to build its portfolio to offer solutions to customers for their packaging and e-mobility challenges. This presentation will focus on Schaeffler's current and future portfolio of e-mobility systems that will enable OEMs to reach their increased fuel economy and performance targets.

Nick C. Johnson, Schaeffler Group USA Inc.
Tuesday, October 29

Market Analysis, Deployment Strategies & Impact of Automated Vehicles on MaaS

Session Code: IIM401
Room Legacy Ballroom I

Automated and autonomous vehicles promises to change the way we think of personal transportation. The session will provide a market analysis of future automated/autonomous vehicle development as well as offer some insights as to how these vehicles will be deployed from a personal, shared, and fleet owner viewpoints.

Chairpersons - Walid Aldeeb, Infineon Technologies AG

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<td>ORAL ONLY</td>
<td>Keynote Presentation: Advanced Driver Assistance Systems: The ADAS Road to AV Reality</td>
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<td>Kathy Winter, Intel</td>
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<td>Networking Break in Exhibit</td>
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<td>10:00 a.m.</td>
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<td>Keynote Presentation: Changing Mobility Landscape à¢â€“ Impacts of Autonomy, Mobility, &amp; Electrification</td>
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<td>Jono Anderson, KPMG LLP</td>
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Does DCT still have a chance in NA? As a P2 Hybrid it has!

In this presentation we will focus on the strong hybridization of a new type of mid-to-high torque DCT. Dual Clutch Technology has experienced a “rough ride” in NA market during the last decade. It is understood that conventional (non-hybrid) DCT does not fully match the functional driving expectations of NA drivers. Nonetheless, we want to show that a new kind of DCT technology constitutes a proper basis for hybrid drivetrain solutions in NA. More particularly we discuss a new FWD 7speed DCT concept with nearly 100kW electric motor and up to 420Nm system input torque. The new hybrid DCT, named DT2, uses both typical automatic transmission components such as wet clutches and planetary gearset with static clutch next to offset gearsets. The use of the static clutch enables an improvement in thermal dynamics and launching stability as well as a disruptive reduction in the amount of gearsets inside the main gear cluster.

Alexander Serrarens, Punch Powertrain Nederland BV

The Acceleration of Electrification (Increasing market share of electric vehicles across the globe)

This introspective of the transformation of the auto industries move towards low and no emission vehicles. Insights of the challenges faced by all OEMs. And, what FCA has already done, with a small glimpse of what is to come.

Bob Smyczynski, FCA US LLC
11:00 a.m. ORAL ONLY Automation in Light-Duty Vehicles: Market Analysis and Deployment Strategies
The market for automation in the light-duty vehicle sector is expected to be in the hundreds of billions of dollars by the middle of the next decade. How this sector grows is, however, still unknown. Some companies are approaching automation deployment by starting at lower SAE J3016 levels and proceeding to higher levels as the technology improves while others are starting at (or near) the top SAE J3016 levels to avoid human-machine interactions. This presentation illustrates the state of the market as well as potential paths for deployment and market growth.
Jeffrey Wishart, Exponent Inc.

11:30 a.m. Networking Lunch in Exhibit

1:00 p.m. ORAL ONLY The Road to Deployable Autonomy
The promise of the first true self-driving car hitting the streets is driving innovation throughout the automotive industry. But there are still large steps to take to turn today’s prototype vehicles along with their mandatory safety drivers into actual autonomous vehicles. This talk will examine some of the big challenges around the safe high-performance compute required, and outline solutions and technologies that can enable true deployment. Additional speaking points will include the different types of computing required, reducing SWaP-C (size, weight, power and cost), and achieving functional safety.
Paul Kopp, ARM

1:30 p.m. ORAL ONLY Mobility as a Service™User Experience and Vehicle Ownership Trends
In this presentation, we will explore some of the many factors that influence transportation choices among users, with a primary focus on millennials. We will also look at a case study on car-sharing services and analyze which specific user experience issues are affecting usage patterns. Finally, we will discuss how car-sharing, ride-hailing and other new types of mobility choices are impacting global vehicle ownership, and we will make some predictions on vehicle ownership trends moving forward.
Ben Lundin, Strategy Analytics Inc.

2:00 p.m. ORAL ONLY MOBILITY: Experiences per Mile
Rashmi Rao, Harman Automotive Inc.

Planned by ADAS to Automated Driving Organizing Committee / Innovations in Mobility Steering Committee

Tuesday, October 29

Smart Cities (Initiatives)

Session Code: IIM501

With congestion and travel safety worsening, new mobility options are needed to address these challenges. Presentations will include topics of connected and smart mobility initiatives addressing the future of transportation on a vehicle, city, and state level.

Chairpersons - Matthew Borst, SAE International

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<td>Mobility as a Service™User Experience and Vehicle Ownership Trends</td>
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<td>2:00 p.m.</td>
<td>ORAL ONLY</td>
<td>MOBILITY: Experiences per Mile</td>
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8:30 a.m.  **Keynote Presentation: Technology Trends in Moving People**  
As one of only six transit agencies that saw an increase in ridership in 2018, hear from Joanna M. Pinkerton, President/CEO of COTA as she shares how the public transit agency is using technology and public-private partnerships to respond to the growing mobility needs of the community.

Joanna M. Pinkerton, COTA

9:00 a.m.  **Keynote Presentation: Smart Mobility efforts in Sweden**  
Drive Sweden is a public-private partnership aiming at to design and pilot, future smart mobility services using connected, automated and shared vehicles. The program is sponsored by the Swedish government, and includes 100+ stakeholders from all segments collaborating in a cross-functional way. The presentation will be about Drive Sweden’s vision of a sustainable mobility and how we intend to get there.

Jan Hellåker, Lindholmen Science Park, Ltd.

9:30 a.m.  **Networking Break in Exhibit**

10:00 a.m.  **Intelligent Traffic Control with Connected and Automated Vehicles**  
Yiheng Feng, University of Michigan

11:00 a.m.  **Student & Young Professionals Technical Paper Competition Winner: An IMPC based Parking Assistance System with Interactive Searching Function (Presentation of SAE Paper 2019-01-2614)**  
This paper summarizes progress and outcome from our research projects on IMPC-based parking management system, including parking motion planning and control strategy, as well as a searching strategy for parking spot. IMPC here refers to interactive model predictive control regime, which is characterized in that multiple agents implementing separate MPC strategy are incorporating information about their state, objective, and constraints. To predict future parking parameters, we proposed a practical framework which integrates anticipatory techniques with a model predictive approach that robustly models the stochastic parking environment. The framework is able to take into account the interactions between vehicle subsystems, and can optimize trajectory under complex traffic patterns in real-world scenarios. Adaptive model predictive control is utilized to optimally minimize a cost function regarding performance, energy efficiency and drivability with regard to surrounding vehicle states. Dynamic programming was used to solve the control objective under multiple constraints, which yielded superior performance in comparison with convex programming. An original navigation system was developed for leading user to the parking spot in case of forgetting exact location, which is characterized in that swift location and path are generated by BLE-based sensor fusion. After successful parking action, the system beacons the parking location and transmits data to mobile equipment of user, which serves as goal of searching task. Simulation results show promising expected cost minimization in typical parking environments under consideration of fuel efficiency, parking time and distance to destination. Meanwhile, the state of art park spot search module is able to shorten the time for drivers to locate their vehicle with positioning error of less than 1.5 meter.

Qianyu Ouyang, FinitronX

11:30 a.m.  **Networking Lunch in Exhibit**
1:00 p.m.  ORAL ONLY  Moving Detroit

Detroit is now a city of “more” - more jobs, more restaurants, more recreational opportunities, and more friends to visit. Revitalization that started in Downtown is now spreading to neighborhoods across the city.

Transportation is the key to all Detroiter’s being able to access everything the City has to offer. In addition to improving what we already have, from our streets to our buses, and we are adding new options, from autonomous vehicles to microtransit, so people have real choices to get where they want to go.

Justin Snowden, City of Detroit

2:00 p.m.  ORAL ONLY  How to Build a Smart City: Exploring the IEEE Smart City Planning and Technology Standard P2784

Public agency leaders, whether city managers, public works directors, or elected officials, need to answer the critical question: â€œWhat do I actually do to define and build my Smart City?â€ This webinar addresses that broad question in a comprehensive manner with discussions of planning and stakeholder engagement, consensus-based user needs and measurable functional requirements. These concepts are then applied to define the vertical applications and technologies used in driving a successful Smart City project implementation forward. Topics to be discussed include environmental, economic, social, technological and political impacts as well as sustainability and economic vibrancy.

Learning objectives of the presentation:<br>
â€¢ Examine the human and societal user needs, applications and technologies that impact a Smart City<br>
â€¢ Discuss current opportunities and challenges faced by Smart City advocates, implementation specialists, the general public and other stakeholder communities. <br>
â€¢ Describe a number of important standards in the Smart City ecosystem, including the IEEE P2784 standard<br>
â€¢ Examine use of the IEEE P2784 Smart City Planning and Technology Guide in envisioning, deploying and managing your Smart City Project in order to deliver a comprehensive sustainable solution.

Who would benefit from attending:
Public Works technicians, Public Agency management staff, Smart City hardware and software development staff, Consulting engineers, Citizens and other stakeholders, City Managers and other city planning officials, Elected Officials

James Frazer, Arc Advisory Group

2:30 p.m.  Networking Break in Exhibit
Human Experience & Interface

Session Code: IIM413

Room Legacy Ballroom III

With any type of automation, the human experience is the key to its success. Industry experts and consumer advocates discuss the key issues, challenges, and solutions regarding human interaction with automated vehicles (L2+ and L4+) -- as passengers, pedestrians, and as drivers of other vehicles.

Chairpersons - Oliver Spiess, ZF

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<td>The ADAS Experience: Consumer Perceptions of Real-World Driving</td>
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<td>Networking Break in Exhibit</td>
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<tr>
<td>10:30 a.m.</td>
<td>ORAL ONLY</td>
<td>Humans and Systems Behaving in the Wild: An Opportunity to Re-Engineer the Relationship Between Humans and Automation?</td>
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Cities have been receiving most of the attention and accolades for their efforts in using technology to improve the transportation experience. Meanwhile, some states have been on the forefront of promoting these improvements on statewide scale. This session highlights the states' efforts to improve their transportation networks.

Moderators - Pete Bigelow, Automotive News

Panelists - Steven Bayless, ITS America; Collin Castle, Michigan Dept. of Transportation; Dominic Papa, Arizona Commerce Authority;

Planned by Smart Mobility and Infrastructure Organizers / Innovations in Mobility Steering Committee

Tuesday, October 29

Hybrid and Electric Powertrain

Panel Discussion: Smart State Initiatives

Realizing the promise of sophisticated automation systems will depend on the roles that are defined for humans and automated features -- and the understanding and communication between them. These concepts will be explored in a two-part presentation. (1) First, key findings from an on-going naturalistic and field observational trial will be presented (using video) to depict the way humans are currently behaving â€œin the wildâ€• with L2 systems - and (2) A new and different conceptualization of the relationship between human and vehicle may offer both the possibility of future improvements, and an important source of innovation.

Linda Sala Angell, Touchstone Evaluations Inc.; William Elm, Resilient Cognitive Solutions

Planned by ADAS to Automated Driving Organizing Committee / Innovations in Mobility Steering Committee
Keynote Presentation: Electrification is 'now'. So, what will you do?

All praises to Dr. Goodenough for being awarded the 2019 Nobel Prize for Chemistry for his research on Lithium Ion Batteries. He represents those who recognize a problem and works towards solutions. Over the past 30 years, technology advances in electronics, software, and batteries have revolutionized features and functions available to vehicle owners. This technology development has penetrated vehicle Infotainment, Braking, Steering, Driver Displays, Seating, Engines, Transmissions, and Batteries. Advanced batteries have enabled engines and transmissions to be used more efficiently as well as becoming a substitute for engines. All praise be to those who recognize a problem (reduction of emissions, drivability improvement, fuel economy improvement) and seeks solutions.

Denise Gray, LG Chem Michigan Inc. Tech. Center

Interconnected Issues in Battery Thermal Management, High Voltage Configurations, and Fast Charging

Transitioning to higher voltage battery systems may aid in addressing customer and technical concerns on range anxiety vs. fast charging of vehicles. Automotive OEMs target increasing electrified vehicle range (≥300 miles) and decreasing charge time (≥15 min). Trade-offs in system design present both opportunities and challenges with thermal management central to this potentially shifting electrification paradigm.

Brian Robert, Ford Motor Company

Overview of Adhesives, Sealants, and Heat Transfer Materials for Battery Systems: A New SAE International Committee

Adhesives, sealants, and heat transfer materials play a pivotal role in the assembly and performance of battery systems for mobility applications. Proper selection of materials from the cell to pack level is vital to achieving high-throughput manufacturing and safely managing mechanical, environmental, and thermal loads in the battery system. To accelerate the adoption of battery-propelled vehicles, the Society for Automotive Engineers International has formed a new committee focused on these materials. This presentation will introduce the role and responsibility of this committee as well as highlight the first in a series of efforts to educate and unify the global adoption of these materials.

Darren Hansen, Dow Chemical Company
11:00 a.m.   ORAL ONLY   Student & Young Professionals Technical Paper Competition Winner: Eco-Driving Strategies for Different Powertrain Types and Scenarios (Presentation of SAE Paper 2019-01-2608)

Connected automated vehicles (CAVs) are quickly becoming a reality, and their prospective ability to communicate with each other and the infrastructure around them has big potential impacts on future mobility systems. Perhaps one of the most important impacts could be on network wide energy consumption. A lot of research has already been performed on the topic of eco-driving and the potential fuel and energy consumption benefits for CAVs. However, most of the efforts to date have been solely based on simulation studies, and have only considered conventional vehicle powertrains. In this study, experimental data is presented for the potential eco-driving benefits of two specific intersection approach scenarios and four different powertrain types. The experimental results are compared to simulation data and show the variation of benefits for different powertrain types. In particular, energy consumption results show that hybrid and electric vehicles benefit more from intersection eco-approach strategies compared to conventional vehicles.

Simeon Iliev, Argonne National Laboratory

11:30 a.m.   Networking Lunch in Exhibit

1:00 p.m.   ORAL ONLY   Why Electric Vehicle Wireless Charging is Essential to the Future of Mobility

This presentation will address the critical role wireless charging technology plays in catalyzing EV adoption and enabling self-driving vehicles to reach full potential. Steveâ€™s session will explore how cordless options for EVs make powering-up even more convenient for drivers, while upholding the same efficiency and speed as conventional plug-in charging. With the explosive growth taking shape in mobility-as-a-service, attendees will walk away with an understanding of why wireless power is key to usher in a future of transportation that is electric, autonomous and shared.

Electric, shared and autonomous vehicles are the foundation for our mobility future. With countries like China, India and the U.K. moving to ban gas-guzzling vehicles in the next decade, and with autonomy around the corner, itâ€™s critical for the EV experience to be seamless and top-notch. This means taking the cords out of the equation.

Steve Ganem, WiTricity

1:30 p.m.   ORAL ONLY   Consequence-based Cybersecurity for High Power and Wireless Charging

As EV charge power rates and system complexities increase, cybersecurity is more critical than ever to ensure a safe and reliable charging infrastructure network. With an impact-based cybersecurity framework developed by INL, the highest impact threats and vulnerabilities are identified for high power DC charging (350kW) and high power wireless power transfer (>50 kW). This framework methodology allows research funding to be focused on the most critical vulnerabilities and threats. In the current project at INL, over 50 vulnerabilities and threats have been identified and prioritized. Hardware assessments are in progress, and mitigation solutions are being developed to secure the attack pathways for these prioritized potential events.

Tuesday, October 29

Internet of Things, Data Management, and Blockchain

Session Code:  IIM404

Room Legacy Ballroom V  Session Time:  ALL DAY

Attendees will hear how The Internet of Things and data management is a key enabler in the connectivity between ADS vehicles and other intelligent devices within the mobility ecosystems through new developments in cloud services, telematics, and over-the-air (OTA) software updates are impacting greater levels of automation in future vehicles. Lastly, speakers will discuss the integration of Blockchain, data management and automated vehicle technologies providing exciting solutions to some of the most pressing automotive issues.

2:00 p.m.  ORAL ONLY

Electric Vehicle Challenges with Circuit Protection as Voltages and Charging Rates Increase
The vehicle electrification era is here, bringing with it a wave of innovative technologies and exponential advancements. However, there are important safety implications to be considered as voltages and charging rates are increasing.

Brian J. McKay, Eaton

2:30 p.m.

Networking Break in Exhibit

3:00 p.m.  ORAL ONLY

Fuel Cell System Challenges for Heavy-Duty Vehicles
Fuel cells are a promising option for zero-emissions mobility for both light-duty and heavy-duty vehicles, but there are several challenges to their wider adoption. These challenges include system cost and on-vehicle fuel storage. For heavy-duty vehicles there are additional challenges regarding system durability, efficiency, and thermal management. In this presentation, AVL discusses the key challenges for heavy-duty fuel cell-electric vehicles.

John Kasab, AVL

3:30 p.m.  ORAL ONLY

Toyota Project PORTAL - ZERO emission Class 8 Truck Powertrain
To realize the goal defined in the Toyota Environmental Challenge 2050, to go beyond zero environmental impact and achieve a net positive impact, Toyota is committed to bring advanced technologies to the market across a wide breadth of applications. One of the critical areas needing a zero-emissions solution is the heavy duty transportation sector where alternative technologies have struggled to be competitive with conventional gasoline and diesel engines. Bringing a no compromise zero-emissions solution to drayage operations directly improves local and regional air quality at the ports and also along our freeways where many neighborhoods have struggled to have clean air. Project Portal combines Toyota’s 20 years of hydrogen and fuel cell development experience to study the feasibility of scaling light duty hardware from the Toyota Mirai into heavy duty applications and how fuel cell light duty and heavy duty vehicles will exist synergistically.

Takehito Yokoo, Toyota Motor North America Inc.

4:00 p.m.  ORAL ONLY

Innovations in Fuel Cell Stack and System Design
2019 marks Ballard Power Systems’ 40th anniversary, and finds the company as a world leader in fuel cell stack and system development for motive applications. With fuel cell systems moving beyond demonstrations and into real-world applications, stack and system requirements are getting more stringent, requiring ongoing development in power density and lifetime, with a need to operate in harsh environments and under a wider range of operating conditions.

This presentation will highlight Ballard’s latest developments in fuel cell technology for automotive, transit bus, truck, rail and marine applications to meet these market needs, and deploy fuel cell systems around the globe.

TJ Lawy, Ballard Power Systems Inc.
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<td><strong>Automotive - Driving the Future of Mobility</strong></td>
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<td>Raj Paul, Microsoft Corporation</td>
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<td>9:00 a.m.</td>
<td>ORAL ONLY</td>
<td><strong>The Role of Connected and Autonomous Vehicles in Smart Cities</strong></td>
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<td>Robert M. McQueen, Bob McQueen &amp; Associates</td>
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| 9:30 a.m.    |           | **Networking Break in Exhibit**                 |<a href="https://www.sae.org/servlets/techSession?REQUEST_TYPE=AUTHOR_BIO&saetkn=ERPTop4gdC&PROD_CD=19IIM-0035&PRESENTATION_TITLE=Learn+more+about+the+Panel+Participants&SCHED_NUM=">Learn more about the Panel Participants</a>
| 10:00 a.m.   | Panel     | **Panel Discussion: Internet of Things (IoT)**  |
|              |           | Moderators - Joe White, Reuters - Detroit       |
|              |           | Panelists - Chuck Brokish, Green Hills Software Inc.; Andreas Mai, ecomoworld; Bob McQueen, Bob McQueen and Associates; Radovan Miucic, Lear Corporation; |
| 11:30 a.m.   |           | **Networking Lunch in Exhibit**                 |
| 1:00 p.m.    | ORAL ONLY | **Blockchain 101: The Connected Ecosystem**     |
|              |           | By now, just about everyone is somewhat familiar with the potential of blockchain. In this segment, we explore some of the potential business models that blockchain enables, as well as the basic technology that supports a blockchain. We will also discuss the decisions a group of organizations would have to make in order to configure a blockchain for their particular needs. Daniel Conway, University of Arkansas |
| 1:30 p.m.    | ORAL ONLY | **Blockchain 201**                               |
|              |           | Not all blockchain networks are based on the same code, though many of them share the same ideas. In this presentation, the speaker will walk the group through some of the fundamental aspects of blockchains, comparing some of the technology options currently available today. Also covered are some use cases of blockchain technology, from reinventing internet service business models to baking more accountability, transparency, and automation into transactional processes in all aspects of industry. Charlie Dumont, EOS Detroit Inc. |
**Tuesday, October 29**

**Natural Gas**

**Session Code:**  IIM301

**Room Legacy Ballroom VI**

The Natural Gas symposium will convene leaders in the natural gas in transportation arena for an open discussion of challenges to accelerating the use of natural gas in transportation. Sessions will include dialogue regarding state-of-the-art natural gas engine system technologies, including high efficiency engines and exhaust aftertreatment advances and opportunities for enhanced on-board natural gas storage.

**Chairpersons:** Scott Curran, Oak Ridge National Laboratory; Benjamin Lawler, Clemson University; Ted Sears, National Renewable Energy Laboratory

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**2:00 p.m.**  
**ORAL ONLY**  
**The Vehicle as its Own Economic Agent**

The digital transformation of mobility and transportation has far reaching implications for consumers, industry and the public sector. Mobility is critical to economic and social development and must therefore be accessible and affordable to everyone. Driverless vehicles promise a leap in productivity, but at the same time threaten the industrial base and related jobs in view of digital business models, automation and new forms of ownership. At the same time, the digital transformation promises a future where mobility is not only sustainable and zero emission, but shared and available on demand in a highly customized fashion. Such personalization of mobility services rely on data and the ability to translate such data into products and services that consumers’ value. Data has become the ultimate control point and is at the center of emerging business models. What are the future business models in this emerging ecosystem of mobility?

Distributed Ledger Technology promises a future where personal identities and data can be protected. At the same time, identities and trust protocols enable a true P2P sharing economy without impacting privacy. It may enable data sharing across value chain participants in a way that puts consumers and commons in control of data and how it may be shared (and in exchange for what). Ultimately, the Distributed Ledgers promise to power not only humans, but autonomous fleets that create a self-governing marketplace of mobility and transportation services.

The vehicle will become its own economic agent.

Jochen (Joe) Renz, New Mobility Lab.

**2:30 p.m.**  
**Networking Break in Exhibit**

**3:00 p.m.**  
**Panel**

**Panel Discussion: Blockchain**

After listening to talks on Blockchain 101, 201 and a case study, come hear these experts address in more in-depth conversations the issues of Blockchain, data management and automated vehicle technologies that can provide exciting solutions to some of the most pressing automotive issues. Learn more about the Panel Participants

Moderators - Pramita Mitra, Ford Motor Company  
Panelists - Daniel Conway, University of Arkansas; Jochen Renz, New Mobility Lab.; Jovan Zagajac, Ford Motor Co.; Adam Zientarski, EOS Detroit Inc.
8:30 a.m.  ORAL ONLY  Keynote Presentation: Future Mobility and Natural Gas
Timothy Frazier, Cummins Inc.

9:30 a.m.  Networking Break in Exhibit

10:00 a.m.  ORAL ONLY  HPDI 2.0â„¢ High Efficiency Natural Gas System for Heavy Duty Trucks
Mark Dunn, Westport Fuel Systems

Reducing CO2 Emissions in Heavy-Duty Spark Ignited Engines using Alternative Fuels
Paul Wang, Caterpillar Inc.

10:30 a.m.  ORAL ONLY

11:00 a.m.  ORAL ONLY  Development of High Efficiency, Low NOx Natural Gas Engines
Michael Clifford Kocsis, Southwest Research Institute

11:30 a.m.  Networking Lunch in Exhibit
1:00 p.m.  ORAL ONLY  Natural Gas Engine and Aftertreatment Architecture Choices to Meet Future Emissions Regulations

There are very few fuels which offer as much potential as natural gas in achieving low NOx emissions along with the potential to meet and even exceed the lower CO2 standards that global emissions regulations are moving towards. This presentation will discuss future emissions regulations along with engine and aftertreatment architecture choices to meet the regulations in a cost competitive manner.

Saradhi Rengarajan, Cummins Inc.

1:30 p.m.  ORAL ONLY  Well-to-Wheels Analysis of Natural Gas as a Transportation Fuel

The U.S. has experienced boom in shale gas production. As a result, the U.S. now has a net surplus of natural gas. Potential use of natural gas in the transportation sector provides an economic advantage for those transportation subsectors where energy use is high. However, question remains if use of natural gas could result in increased greenhouse gas emissions on the well-to-wheels (WTW) basis. In this presentation, using the GREET life-cycle analysis model, we present the key factors determining relative WTW GHG emission results of natural gas vs. gasoline and diesel in different vehicle applications, and summarize WTW results of natural gas as a transportation fuel.

Michael Wang, Argonne National Laboratory

2:00 p.m.  ORAL ONLY  Renewable Natural Gas, Cleaner than Electric?

Renewable Natural Gas (RNG) has the potential to be a significant part of the transportation fueling system in the US while significantly reducing greenhouse gas emissions. The presentation will summarize the status, benefits, cost, and challenges with RNG.

Christopher Thomas, Gast Strategy Consulting LLC

2:30 p.m.  Networking Break in Exhibit

3:00 p.m.  ORAL ONLY  Keynote Presentation: DOE Natural Gas Vehicle R&D

Kevin Stork, US Dept. of Energy

3:30 p.m.  Panel  Panel Discussion

Moderators - Scott Curran, Oak Ridge National Laboratory
Panelists - Mark Dunn, Westport Fuel Systems; Saradhi Rengarajan, Cummins Inc.; Kevin Stork, US Dept. of Energy; Michael Wang, Argonne National Laboratory; Paul Wang, Caterpillar Inc.;

Planned by Natural Gas Organizers / Innovations in Mobility Steering Committee

Tuesday, October 29

Interior Occupant Protection for Automated Vehicles

As industry begins validation of level 4 and 5 automated systems and vehicles, a great many HMI and seating configurations have been shared in concept vehicles to inspire what is possible. But what is the reality for making sure an occupant in any seating position is safe? This symposium examines the critical work being done and the issues being raised to address occupant protection for both traditional as well as non-traditional vehicles (Low-Speed Neighborhood).

Chairpersons - Donald Parker, Exponent Inc.
Considerations for Collision Load Cases and Occupant Protection in Level 4 and 5 Autonomous Vehicles

Occupant protection considerations based upon decades of motor vehicle safety science are well developed and understood for conventional vehicles that rely on driver lookout, situational awareness, information capture, data processing, development of control intentions and finally, execution of control actions. Adaptation and application of Automated Driving Systems (ADS) at the SAE Level 3 and above are expected to positively affect the frequency, type, and severity of vehicle collisions; however, for continuing decades, Autonomous Vehicles at ADS Level 4 and 5 will share traffic-ways with vehicles piloted by human drivers. In general, ADS Level 4 and 5 vehicles will not be immune to impact events that are caused by caused by human operators in the collision partner vehicle. Therefore, safety engineers responsible for ADS Level 4 and 5 vehicles must deliberately consider the types and severity of collisions to which such vehicles may be subject, the potential for impact insult to occupants of the ADS vehicles, and the biomechanical tolerance limits for occupants of such vehicles who become subject to impact insult in such collisions.

Robert Lange, Exponent Inc.

Integrated Safety - Safety Concepts for Future Interiors

For future mobility solutions new interior concepts are already visible through innovative concept cars and ambitious interior stylings. The ambition is to provide additional value add to the consumers and to introduce new mobility concepts. The industry is active with detailing of plans for future vehicle architectures.

This paper provides views from a system supplier perspective on the development of occupant safety solutions for such new interiors. The paper discusses priorities for Integrated Safety technologies to enable additional safety use cases for such vehicles supporting new mobility concepts.

The paper introduces an approach for a stepped introduction of new occupant safety solutions based on an Integrated Safety -Baukasten consisting of proven Passive Safety technologies and new solutions to extend occupant seating position flexibility.

The paper discusses development challenges, opportunities and availability of technologies based on examples.

Frank Laakmann, Martin Seyffert, Lothar Zink, ZF Group

Networking Break in Exhibit

Safety with Automation

Innovative passive safety systems are an integral part of highly automated vehicle implementation. Highly automated vehicles will not be accident free. With new passenger compartment configurations proposed for HAVâ€”s the number of load cases to design for will be greater than today. These challenges come concurrent with the need to also improve protection to vulnerable occupants (elderly/obese) and rear seat passengers. Current restraint systems will need to be adjusted, if not reinvented to protect in some of these environments. Automated driving technology is here and will continue to grow. The industry must work together to bring the correct solutions to protect all occupants in all seating positions.

Douglas J. Stein, Autoliv ASP
Preparing for Automation Take-off: Place Your Seat in the Upright and Forward-Facing Position

The possibility of autonomous mobility, specifically Level 4 and 5 systems, have resulted in concepts that promise safe, comfortable, and entertainment-filled mobility in the next few years. The truth is the viability of a driverless future will depend on a better understanding of consumer needs, increased capability of hardware and software systems (while also reducing cost), regulatory changes at the state and federal level, and an understanding on how occupants will be protected in non-conventional seating configurations. The innovations that have been presented in recent years include rearward-facing and fully reclining seats. Some of these designs appear to conflict with the underpinning of occupant protection over the last 60 years which relies primarily on seatbelts to transmit forces via boney structures. New methods of distributing crash loads through new belt and inflatable systems will be needed. The purpose of this presentation is to look at injury distributions in real-world crashes and discuss the potential pitfalls of sleep compartment interior designs that will challenge occupant safety, studies of reported crash rates of autonomous vehicles, and penetration rates of existing vehicle technology.

Raul Arbelaez, Insurance Institute for Highway Safety

Biomechanics Considerations for Future Mobility - Resetting the Occupant Protection Paradigm

Automated vehicles are likely to bring new challenges in occupant restraint, such as widening the posture envelope and changing the types of crashes that may occur. As a field, however, it is pertinent to consider not just the challenges that automated vehicles may bring, but also how we can leverage this drive in new occupant protection research and safety system development to address problems that exist today. In this presentation we discuss several aspects of the contemporary automobile safety problem, and the potential for interplay with automated vehicle occupant safety research.

Jason Forman, Univ. of Virginia

Networking Lunch in Exhibit

Changes and Challenges for Occupant Protection in Future Vehicle Concepts

The promise of fully autonomous vehicles could enable very different concepts for vehicle designs in the future, particularly with respect to seating configurations. The absence of a driver, and driver controls, and vehicles aimed at mobility services, mean that such vehicles could also look and function quite differently. Challenges exist, however, regarding existing means of evaluating occupant protection, including the current crash protection FMVSS standards. This paper will discuss some of the challenges and opportunities from a safety perspective.

John Capp, General Motors

NHTSA’s Biomechanics and Crashworthiness Research for Automated Vehicles

The National Highway Traffic Safety Administration is investigating the development and/or refinement of tools for evaluating occupant response in alternative seating configurations that may be prevalent in automated vehicles. Most biomechanical response and injury causation studies have focused on nominal seat back angles. In automated vehicles, occupants may be more frequently seated in a reclined position and/or be rearward-facing relative to the direction of the crash. Understanding of human response in these conditions will allow assessment and refinement of anthropomorphic test devices (ATDs) and human body models (HBMs), which can then be used to develop occupant protection strategies.

Kevin Moorhouse, NHTSA
Additive Manufacturing in the Automotive Industry

**Additive Manufacturing** (AM) continues to be a rapidly evolving and growing technology, as it offers organizations many attractive benefits which include improved yields, greater design freedom, higher quality and throughput, while significantly reducing both operating and inventory costs. For this reason, AM is increasingly being adopted throughout the manufacturing industry to improve the design and manufacturability of both tooling and finished parts. It is imperative that government, industry, and academia continue to meet and collaborate to assure that AM reaches its fullest potential. This session will focus on AM within the automotive industry, as AM experts will provide invaluable insight on challenges, innovations and lessons learned in critical areas of AM such as, but not limited too; part design, modeling & simulation, feedstock materials, post-processing, automation and part-to-part variation.

**Chairpersons** - James McCabe, American National Standards Institute; Chandan Mozumder, General Motors

**Time** | **Paper No.** | **Title**
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2:00 p.m. | ORAL ONLY | Toyota’s Collaborative Safety Research Center (CSRC) and Enhancing Tools to Assess Crash Protection in Future Automated Vehicles

Toyota’s Collaborative Safety Research Center (CSRC) began in 2011 with a mission to enhance safety of vehicle occupants and pedestrians alike while making broader contributions to society overall. Since then the automotive/mobility industries have adapted to increase efforts to develop automated driving systems (ADS). The CSRC mission likewise has adapted to promote advanced research and technology to realize the safe integration of future mobility solutions for all. Work toward the CSRC mission has been completed through efforts of our university research partners and will be explored with emphasis on occupant protection in potentially novel interiors/activities enabled by future ADS.

Jason Hallman, Toyota Motor Corp.

2:30 p.m. | Networking Break in Exhibit

3:00 p.m. | Panel | Panel Discussion: Challenges of Non-Traditional (Low-speed Vehicle) Occupant Protection

With a fleet of low speed vehicles pilot programs being demonstrated within communities across the country what are the issues and challenges around occupant protection? Panelists will address how we drive focus on safety and improvement in non-traditional vehicles that may not be currently subject to FMVSS208.

Learn more about the Panel Participants

**Moderators** - Jason Forman, Univ. of Virginia

**Panelists** - Raul Arbelaez, Insurance Institute for Highway Safety; Richard Marks, EcoV Environmental Transportation Inc.; Melissa McAlpine, Polaris Inc.; Douglas J. Stein, Autoliv ASP;
8:30 a.m.  ORAL ONLY  
**Keynote Presentation: Drive to Production: The Expanding Role of Additive Manufacturing in the Automotive Industry**

The automotive industry is in the midst of a transformation that will drive more change over the next 5 years than the last 100 years combined. A new automotive world of electrified vehicles and autonomous vehicles with no steering wheels or pedals will only be enabled by challenging the status quo and thinking very differently about how automobiles are designed and manufactured. Additive manufacturing will be one of the key technologies to support the transformation and help deliver this new and exciting future. Not only will 3D printing continue to support the vehicle development process through quick and efficient prototype parts, but end use serial production is within sight. Additively manufactured production parts can enable unique, fully optimized, component designs that will deliver performance and capability to customers that could not be realized with traditional manufacturing methods. The opportunities are endless as the technology continues to grow and develop.

Kevin Quinn, General Motors

9:30 a.m.  
**Networking Break in Exhibit**

10:00 a.m.  ORAL ONLY  
**Hot Isostatic Pressing (HIP) and Heat Treatment for Additive Manufacturing**

Additive manufacturing offers fantastic possibilities to produce components with complex geometries but for most additive manufacturing technologies there will be some internal defects in the as-printed condition such as gas porosity, lack-of-fusion defects, microcracks and residual sintering porosity that can negatively influence the material properties. Hot Isostatic Pressing (HIP) uses a high isostatic pressure and elevated temperature to eliminate the internal defects in the material to improve material properties such as fatigue, creep, ductility and fracture toughness which will be important for automotive applications. This presentation will cover HIP and heat treatment for different AM technologies and materials.

Magnus Ahlfors, Quintus Technologies LLC

10:30 a.m.  ORAL ONLY  
**Modeling, Simulation, and Data Analytics for Metal Additive Manufacturing**

Metal additive manufacturing offers opportunities for designing and fabricating geometrically complex structural and functional components. However, the thermal characteristics of AM produce heterogeneous and non-equilibrium material microstructures. These aspects of AM may be harnessed to develop unique materials with exception properties, but dynamic process interactions can also produce unintended defects and localized variations in structure and properties. When applied appropriately, modeling and data analytics tools can be used to exploit the opportunities of AM. This presentation will describe existing computational approaches and how these tools offer a pathway for certification and qualification of next generation components.

Alex Plotkowski, Oak Ridge National Laboratory

11:00 a.m.  
**Open Discussion**

The open discussion is a facilitated dialogue between session speakers and attendees regarding a number of critical issues pertaining to additive manufacturing itself or the implementation and application of the technology in automotive manufacturing.

11:30 a.m.  
**Networking Lunch in Exhibit**
1:00 p.m.  ORAL ONLY  Build it Better: Additive Manufacturing Post Processing
Additive manufacturing has become ubiquitous in the automotive industry - advancements in the technology open up new application opportunities nearly every day. But if we want to do more with the machines and materials we available today, what options are there? In this session we'll discuss approachable methods to make current 3D printed polymer and metal parts more functional and ready for broader applications.

Tyler Reid, GoEngineer

1:30 p.m.  ORAL ONLY  Future Factories Drive Deep Customization
Future Factories will be physical, virtual and digital. Automotive and transportation mobility design, manufacturing and production technologies are rapidly evolving on many fronts. Future cities will be dominated by connected, electrified and automated vehicles. Our cars will be faster, smarter and cooler - and so too will our future factories. This session will focus on the role of innovative manufacturing technologies including the internet-of-things, additive manufacturing, generative design, augmented and virtual reality (AR/VR) platforms, digital twins and smart sensors to improve vehicle production capability, deep customization and radical creativity to meet changing customer requirements and increased personalization at affordable costs.

John Waraniak, Specialty Equipment Market Association

2:00 p.m.  ORAL ONLY  Virtual Design, Development, and Validation for Additive Manufacturing: Current Challenges and Technology Gaps
Design for Additive Manufacturing (DfAM) can enable optimization and manufacturing of complex geometries to meet mass/performance goals while reducing assembly complexity and development time. 3D-printing an existing design has no advantage for mass or cost, and DfAM could be so complex that traditional design process does not work. Virtual Design, Development, and Validation (VDDV) provides a way to take advantage of design and manufacturing freedom. Virtual optimization and process simulation tools should be used effectively to generate best design for meeting the performance requirements with minimum mass and cost. This talk will give a brief introduction of VDDV process for Additive Manufacturing and emphasize CAE’s critical role. The DfAM process flow will be discussed and show where different tools fit in or development is needed. Automotive OEM parts design for light-weighting and performance comes with own unique challenges, which most of the existing tools are inadequate to address in their current form. Couple of DfAM examples will be presented and the current challenges & technology gaps in executing design optimization and process simulation for AM will be discussed.

Chandan Mozumder, General Motors

2:30 p.m.  Networking Break in Exhibit

3:00 p.m.  Panel  Panel Discussion: Standards
<a href="https://www.sae.org/servlets/techSession?REQUEST_TYPE=AUTHOR_BIO&saetkn=ERPTop4gdC&PROD_CD=19IIM-0210&PRES&ENTATION_TITLE=Learn+more+about+the+Panel+Participants&SC_HED_NUM=">Learn more about the Panel Participants</a>

Moderators -  John Wilczynski, National Center for Defense

Panelists -  Dave Abbott, GE Aviation; Shane Collins, Additive Industries; Jessica Coughlin, American Welding Society D20 Committee on Additive Manufacturing; Kathryn Hyam, American Society of Mechanical Engineers (ASME); James McCabe, American National Standards Institute; Lisa Spellman, Medical Imaging Technology Alliance;
Transmission and Driveline (Part 2 of 2)

Session Code: IIM303

Room Cornerstone I  Session Time: ALL DAY

This day will address the development of new transmission concepts, transmission enhancements and the advancement of the state of the art of transmission system design & integration. New transmissions, including 48V systems, and high voltage axles will be highlighted, along with controls and simulations.

Chairpersons - Hong Jiang, Ford Motor Company; Hussein Dourra, Magna Global IT Canada; Rob Mangan, Link Engineering Company

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<td>Panel</td>
<td>Panel Discussion: Electrification</td>
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<td>&lt;a href=&quot;https://www.sae.org/servlets/techSession?REQUEST_TYPE=AUTHOR_BIO &amp;saetkn=ERPTop4gdC&amp;PROD_CD=19IIM-0064&amp;PRESENTATION_TITLE=Learn+more+about+the+Panel+Participants&amp;SCHED_NUM=&quot;&gt;Learn more about the Panel Participants&lt;/a&gt;</td>
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<td>Networking Break in Exhibit</td>
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<td>10:00 a.m.</td>
<td>Vehicle Dynamics Modeling Estimation and Control - A Mechatronics Approach</td>
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<td>Advanced engineering staff within Dana's USA and European-based teams have undertaken the task of developing a vehicle dynamics suite for state estimation and feedback handling control for torque vectoring applications. The main objective of this work is to produce software components comprised of easy-to-tune, customizable and robust control/estimation algorithms. This presentation gives an overview of the underlying modeling strategy, development tools and validation effort taken in this process with emphasis on the lateral vehicle dynamics. Specifically, side-slip angle estimation utilizing extended Kalman filtering will be discussed in detail with experimental results from Dana's demo-vehicles showing achieved accuracy and robustness.</td>
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<td>Ahmed El-Shaer, Dana</td>
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10:30 a.m.  ORAL ONLY  

Advanced Wet Clutch Test Methodology for Upfront Controllability Assessment

Propulsion system performance is built upon complex interactions among various components. Key components and assemblies are evaluated on a test bench at the early phase of development before the entire system becomes available. Component characterization data and test results are also utilized in system simulations for upfront assessment of design, control and performance. However, some components behave differently on a bench as compared to system environment. This presentation focuses on wet clutch characterization, specifically for capturing hydrodynamic behaviors. An advanced test methodology is demonstrated to replicate realistic conditions during gear shifting and engine restart, highlighting the advantages over the standard SAE#2 procedure for clutch controllability assessment. A realistic clutch transfer function is constructed based on advanced bench testing for use in enhanced system simulations.

Matthew Wendel, F.C.C. CO., LTD.; Hiral Haria, Ford Motor Company; Nikolaos Katopodes, University of Michigan

11:00 a.m.  ORAL ONLY  

Dynamic Characterization and Modeling of Wet Clutch Actuator for High-Fidelity Propulsion System Simulations

Innovations in mobility benefit from state-of-the-art CAE tools for simulating complex system interactions. However impressive they may appear, predictability of such system simulations still depends on the quality of the component models. This presentation focuses on dynamic characterization and modeling of a wet clutch actuator. The effect of seal friction is examined during stroking and de-stroking. It is found that the seal friction is not only dependent on the direction of piston motion, but is also highly non-linear and discontinuous under certain conditions. It introduces a significant error in clutch apply force calculation unless it is explicitly and correctly accounted for. A new clutch actuator model is proposed including a seal friction representation based on empirical observation of its complex behaviors. It is shown that including the seal model in the clutch actuator is critical for improving the predictability of propulsion system simulations.

Hiral Haria, Ford Motor Company; Matthew Wendel, F.C.C. CO., LTD.; Nikolaos Katopodes, University of Michigan

11:30 a.m.  

Networking Lunch in Exhibit

1:00 p.m.  ORAL ONLY  

Model-Based Adaptive Estimation of Transfer Case Clutch Touch-Point

Transfer case is widely used in four-wheel and other multiple-axle vehicles. It transfers torque through a clutch from the transmission to the front and/or rear axles and synchronizes the front and rear wheel speed. The clutch output torque can be assumed to be proportional to the controlled actuation displacement minus the touch-point distance. Since the touch-point distance changes due to manufacturing part-to-part variation, clutch wear, and temperature change, there is a need to estimate the touch point in real-time for accurately controlling the transfer case output torque. This presentation describes a control-oriented transfer case model and a model-based adaptive estimation of transfer case clutch touch-point distance for real-time applications.

Guoming (George) Zhu, Michigan State University
1:30 p.m.  ORAL ONLY  Trade-off Analysis and Systematic Optimization of Heavy-Duty Diesel Hybrid Powertrain

In recent years significant progress has been made in developing hybrid and battery electric vehicles for passenger car and light-duty applications. In the light-duty segment, vehicle manufacturers have been working to develop diesel hybrid powertrains to meet future fuel economy targets. The trend of hybridization is also under investigation for heavy-duty applications. The US Supertruck program is a good example of heavy-duty on-highway vehicle manufacturers working to maximize vehicle performance with application of hybrid powertrain components. Most of the early studies have shown, that significant fuel economy benefits are possible with specific vehicle applications using diesel hybrid powertrains. Although there is good knowledge on the level of electrification and its benefits for passenger car and light-duty applications, there is limited data in this regards for heavy-duty applications. Also, the resultant impact on PM emissions with hybridization of diesel powertrain has not been previously reported.

Mufaddel Dahodwala, Satyum Joshi, Erik W. Koehler, Michael Franke, FEV North America Inc.

2:00 p.m.  ORAL ONLY  Experimental and Computational Studies of the No-Load Churning Loss of a Truck Axle

Oil churning losses in a heavy-duty truck axle were measured and compared to CFD model predictions. Loss measurements on the carrier assembly were made with and without the ring gear and carrier. These results were combined with a carrier bearing loss prediction to isolate the churning losses. Favorable agreement was found between the experimental data and CFD model predictions at highway speed, with standard lubrication, fill level, and operating temperature.

John Bair, Western Michigan University; Claudia M. Fajardo, Western Michigan Univ.

2:30 p.m.  Networking Break in Exhibit

3:00 p.m.  ORAL ONLY  System Level Cost Optimisation of BEV Powertrain Components and Architecture

YASA discusses a new tool to optimise the motor, inverter, gearbox and vehicle architecture to achieve given vehicle performance metrics (0-60mph acceleration, range, top speed) at the lowest BOM cost. The tool has been used with OEMs to jointly develop optimal powertrain solutions that offer larger BEV ranges at a lower cost to the end user. It is demonstrated how the tool has been used at YASA to influence its new EDU (Electric Drive Unit) products and prioritise the R&D roadmap for future improvements.

Ajay Lukha, Yasa, Ltd.

3:30 p.m.  ORAL ONLY  Schaeffler PowerWheel: Key to New Mobility Concepts

Schaefflerâ€™s electric wheel hub drive has shifted the paradigm for vehicle design â€” literally. By integrating electric motor, transmission and brake into the wheel, it opens up more usable space â€” and more possibilities for vehicle concepts of the future.

Sebastian Wielgos, Schaeffler AG
Wednesday, October 30

Wireless Communications and HD Mapping

**Session Code:** IIM407  
**Room Legacy Ballroom I**  
**Session Time:** ALL DAY

This session begins with experts addressing the question - 5G? V2X? Edge Computing? Where will it end for enabled digital services and connectivity and where should we be investing our time and resources and into which technology? It concludes with experts talking about HD mapping as a critical function for ensuring automated vehicles (L2+ and L4+) are able to effectively navigate their environments by avoiding obstructions, obstacles, road closures, and traffic to ensure safe and reliable transportation.

**Chairpersons** - Chad Zagorski, General Motors

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<td>8:30 a.m.</td>
<td>ORAL ONLY</td>
<td><strong>Dynamic Edge: Why Big Data and Automated Systems Won’t be Successful Without it</strong></td>
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<td>Connectivity across the transportation ecosystem has progressed rapidly with a large percentage being connected by LTE or other network technologies by the end of 2020. Transportation includes all areas of human and cargo mobility including integration with smart cities, logistics, large scale data analytics, vehicle manufacturers and the surrounding ecosystem. While consumer applications are mainly press releases and not sizable and scalable businesses; vertical-specific commercial opportunities are compelling. And the future opportunity is especially exciting as connectivity options - such as 5G and DSRC - and on-vehicle compute advance.</td>
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<td><strong>Bill Leisenring, Aptiv Connected Services</strong></td>
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<td>9:00 a.m.</td>
<td>ORAL ONLY</td>
<td><strong>Big Data Signal Processing</strong></td>
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<td><strong>Joseph Campbell, Michael Frans, T-Systems North America Inc.</strong></td>
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<td>9:30 a.m.</td>
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<td><strong>Networking Break in Exhibit</strong></td>
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<td>10:00 a.m.</td>
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<td><strong>V2X: From here to 5G</strong></td>
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<td>Rapid advancements in cellular technologies is encouraging the automotive industry to look for new ways of enhancing Advanced Driver Assistance Systems (ADAS). Cellular connectivity as an essential part of Connected and Autonomous vehicles will enhance ADAS performance and achieve fully automated vehicle functions such as remote driving. The connectivity solution for most radio technologies covers vehicle-to-vehicle (V2V), vehicle-to-infrastructure (V2I), vehicle-to-network (V2N) and vehicle-to-pedestrian (V2P)...a.k.a V2X (Vehicle to Everything Communication). V2X will provide us with many benefits such as crash-free driving, travel time reduction, fuel saving, and so on. In this presentation, we are going to talk about number of activities done by 5GAA and its members like Savari to pave the path from here towards 5G.</td>
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<td><strong>Ravi Puvvala, Savari Networks</strong></td>
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10:30 a.m.  ORAL ONLY  ITS America Perspective on 5G
ITS America is an association dedicated to the deployment of new technology to
make transportation safer, greener and smarter. For the session, ITS America will
present its perspective on connected and automated vehicles and smart
infrastructure technology broadly -- describing challenges and opportunities in
5G.

Steven Bayless, ITS America

11:00 a.m.  ORAL ONLY  5G Sensor Sharing for Connected and Automated Vehicles
Situational awareness at every car on the road is critical to improve safety in
vehicles with advanced driver assistance systems or fully automated driving. The
information that provides this situational awareness comes mainly from the
onboard automotive sensors. Most sensors though have a limited field-of-view,
rendering them less useful in traffic or at complicated intersections, which is
exactly where situational awareness is most useful. Future Vehicle-to-vehicle
(V2V) and vehicle-to-infrastructure (V2I) connectivity will permit vehicles to relay
their positions and velocities to each other with millisecond latency, enabling tight
coordinated platooning and efficient intersection management. More ambitiously,
broadband V2V and V2I enabled by 5G wireless networks will permit vehicles to
share unprocessed or lightly-processed sensor data. Ad hoc networks of vehicles
and infrastructure will then function as a single sensing organism.

Ehsan Moradi-Pari, Honda R & D Americas Inc.

11:30 a.m.  Networking Lunch in Exhibit

1:00 p.m.  ORAL ONLY  Advancing Automated Driving with HD Maps
Traditional sensors such as Camera, Radar and LIDAR have greatly increased
the perception capabilities of automated vehicles - but without high-definition
(HD) maps, those vehicles cannot accurately understand their position on the
road and plan their path for the road ahead.  
In this presentation, Praveen Chandrasekar, TomTom's Regional Senior Product
Manager for Autonomous Driving, will discuss how HD maps, working with the
different sensors in the vehicle, can enable high accuracy localization,
environment perception and path planning. Join in to learn how TomTom utilizes
a variety of sources and innovative streaming technology to keep their HD maps
updated.  
Attendees will walk away with an understanding of the importance of combining
sensor observations with streaming HD maps to create a robust autonomous
driving experience that will ultimately lead to a safer world, free of congestion and
emissions.

Praveen Chandrasekar, TomTom

1:30 p.m.  ORAL ONLY  Digital Maps: Types and Needs
Since the early 1990's, digital maps have been a reality in the automotive world.
Early maps started out as very basic maps of road networks with a focus on road
connectivity and addressing scheme. Digital maps have since greatly evolved to
contain more data, higher accuracies and fewer errors. Today’s digital maps are
divided into different categories from navigation, to ADAS, to autonomous
depending on the need, but the reality is, these digital maps often blur the lines
between these areas. This presentation will examine each map type and its
corresponding ability.

David Craig, General Motors LLC
2:00 p.m. ORAL ONLY

Real-World Map Data: Simulation and Editing

HD Map data is critical for the development and validation of AV algorithms, but there is a wide gap between typical HD Map content and practical usage in simulation. We present an approach to convert a wide range of HD Map formats to common scenario representations, including generation of visual scene content. Our approach provides the ability to freely edit and expand upon the HD Map and environment data. We also showcase an approach for scenario creation and co-simulation with existing simulators.

Alex Goldberg, VectorZero

2:30 p.m.

Networking Break in Exhibit

3:00 p.m. ORAL ONLY

Precise worldwide ultra HD Map Data Collection as basis for Vehicle Test Drives as well as for virtual Testing and Simulation

Precise ultra HD Map data is the basis for test drives as well as for virtual testing and simulation. Test drives for autonomous driving development or ADAS sensor validation use HD reference maps as ground truth to validate sensor measurements and AI results. Precise ultra HD Map data additionally serves as indispensable basis for virtual testing and simulation for the same purposes. Artificially designed digital roads may help simulations case by case, but for various applications the precise digitalization and digital as-built representation of real-world roads is needed. The typical requirement is, that the roads used for virtual testing and simulation are regarded as digital twin of the real-world roads, which is prerequisite to gain comparable testing results in reality and in the virtual environment. 

The technical solution for digitizing test tracks, race tracks and public roads with sufficient accuracy and resolution is high-end mobile surveying using high-resolution scanners and multiple cameras. 3D Mapping has invented the necessary technology since more than 20 years and today deploys van-based survey systems worldwide.

Markus Grünke, 3D Mapping Solutions GmbH

3:30 p.m. ORAL ONLY

HD Maps: How High is High-Def? How Real is Real-Time

The term "HD Maps" has been helpful in defining a new category this past decade, but there is still a lot of inconsistency in how developers, suppliers and other stakeholders define key characteristics of these maps. In this talk, we will examine how CARLENA builds and maintains HD map data for OEM use cases (e.g. Toyota), mobility-as-a-service deployments (e.g. Voyage) and the broader AV developer ecosystem (e.g. Baidu Apollo). In doing so, we will share insights on what the industry considers baseline table-stakes, emerging norms and upper bounds in areas like fidelity and freshness to warrant the distinction of "HD."

Ro Gupta, Carmera
Wednesday, October 30

Urban Mobility (Applications)

Rapid urbanization is challenging urban transportation networks. Emerging mobility options, such as shared mobility, micromobility, and urban air mobility are being proposed to address some of these issues.

**Chairpersons** - Andrej Ivanco, Allison Transmission Inc.

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<th>Time</th>
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| 8:30 a.m. | ORAL ONLY | **Keynote Presentation: Efficient Mobility Systems Program: DOE’s Research on SMART Mobility**
The U.S. Department of Energy's Vehicle Technologies Office (VTO) supports early-stage research and development of efficient, cost-effective, and sustainable powertrain, vehicle, and transportation technologies that enable individuals and businesses to save money and use less energy. Through its Energy Efficient Mobility Systems (EEMS) Program, VTO conducts transportation system research at the vehicle, traveler, and system levels, and identifies opportunities to use emerging technologies such as automation and connectivity to improve the mobility of people and goods by making transportation safer, more efficient, and more affordable.

The EEMS Program, through its SMART Mobility Laboratory Consortium, has created sophisticated mobility modeling and simulation tools, developed control algorithms to reduce fuel consumption and improve traffic flow, performed analyses to evaluate the energy and mobility benefits of future transportation scenarios, and studied the important role of traveler decision-making in the transportation system. David Anderson, VTO’s EEMS Program Manager, will discuss why this research area is a priority to the Energy Department, and highlight recent technical results from the first phase of the SMART Mobility initiative.

David Anderson, Department of Energy

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| 9:00 a.m. | ORAL ONLY | **Keynote Presentation: Leveraging AV Shuttle Buses for Better Urbanism and Vice Versa**
Ellen Dunham-Jones, Georgia Tech. Univ.
9:30 a.m.  
Networking Break in Exhibit

10:00 a.m.  
Panel  
Panel Discussion: Micromobility Deployment  
Micromobility is a promising solution for trips that are too far to walk yet too close to drive. It includes a variety of vehicles ranging from e-skateboards to e-scooters. Disruptions to the status quo are often accompanied by opportunities and challenges. This session brings together regulators, operators, and manufacturers to discuss innovative ideas on how micromobility can be best integrated into our mobility systems to better serve everyday urban travelers.  
<a href="https://www.sae.org/servlets/techSession?REQUEST_TYPE=AUTHOR_BIO&saetkn=ERPTop4gdC&PROD_CD=19IIM-0093&PRESENTATION_TITLE=Learn+more+about+the+Panel+Participants&SCHEV_NUM=">Learn more about the Panel Participants</a>

Moderators -  
Christopher Cherry, University of Tennessee

Panelists -  
Annie Chang, SAE International; Komal Doshi, Ann Arbor Spark; Anthony Ho, Segway Inc.; Nico Probst, Lime; Marla Diane Westervelt, BIRD;  

11:30 a.m.  
Networking Lunch in Exhibit

1:00 p.m.  
Panel  
Panel Discussion: New Concepts for City-Based Mobility  
With the advent of on-demand mobility solutions like Uber and Lyft, cities have struggled to adjust to shifts in new transportation preferences. There is no single solution to alleviate city congestion, air pollution, and safety with a growing urban population. Cities need help developing new methods to approach these issues and meet the mobility needs for our future. This session will discuss alternatives to traditional vehicle ownership models as well as associated regulations, standards, and business models for city-wide transportation.  
<a href="https://www.sae.org/servlets/techSession?REQUEST_TYPE=AUTHOR_BIO&saetkn=ERPTop4gdC&PROD_CD=19IIM-0040&PRESENTATION_TITLE=Learn+more+about+the+Panel+Participants&SCHEV_NUM=">Learn more about the Panel Participants</a>

Moderators -  
Andrej Ivanco, Allison Transmission Inc.

Panelists -  
Philip George, Schaeffler Group USA Inc.; Greg McGuire, University of Michigan; Monique Stinson, Argonne National Laboratory; Brian Suckow, Ridecell;  

2:30 p.m.  
Networking Break in Exhibit
Panel Discussion: Air Mobility

Since the Jetson's introduced us to personal "flying" transportation, we have been promised that this technology is coming soon. It seems that now the convergence of technologies—artificial intelligence, battery power/energy density, distributed electric architectures, and lightweight, high-strength materials—is enabling this new reality. More than 120 new aircraft designs have taken shape in the past 5 years, from roadable aircraft (flying cars) to air taxis, specialty vehicle to recreational vehicles, and single passenger hover-bikes to 9 passenger air buses. This session address the question, "What does the immediate future hold for these new aviation markets?"


Planned by Smart Mobility and Infrastructure Organizers / Innovations in Mobility Steering Committee
Relative velocity motion model based Estimation filter for Noise Cancellation and Obstacle tracking using Radar sensor for Environment perception in autonomous vehicles

As far as self driving cars are concerned, it is necessary to have information about the behavior of surrounding objects for proper path planning and smooth maneuvering of ego vehicle. In Autonomous driving, Radar system is used for sensing the position and relative velocity of any moving objects. Apart from above info, we have chosen to process radar data for determining the various properties such as orientation, absolute velocity, path history and predicting the future behavior of obstacle. But Radar data is often spoiled by the atmospheric noises, reflections and interferences. Conventional methods relies on thresholding or low pass filtering for noise filtering which proved to be erroneous.

Tracking based on constant motion models fails to adapt the non linear behavior of obstacles. This paper describes in detail, a real time approach for filtering raw Radar data from noises, obtaining stable and accurate properties of the obstacles, by means of Extended Kalman filtering and tracking. We have proposed relative velocity motion model for EKF tracking which proves to have better performance over conventional motion model based tracking as they adapts the dynamicity of moving obstacles more readily, at the same time EKF smoothens the behavior. The validation of the proposed method is performed in the Carla simulation environment by modelling the Radar data with the available information from Carla Simulator. The results, after testing in real prototype vehicle, are presented. They are tested in junction, approaching (obstacles approaching ego vehicle) and departing scenarios. The performance is best when there is enough relative movement between ego vehicle and rabbit vehicle. The approach proposed for obstacle attribute calculation can be used for other sensor data processing also where object position is available. The concepts can be applied to improve the performance of driver assistance systems also.

Revathi T. S, Automotive Research & Testing Center; Nijesh Sadanandan, Automotive Electronic Control Software
Silicon Photonics FMCW LIDAR Technologies for Automotive Applications

Integration is key to reducing the cost and footprint of LIDAR and enabling its widespread deployment in many market segments, including automotive. This talk will discuss the application of silicon photonics technology to LIDAR using the frequency modulated continuous wave (FMCW) approach, beginning with an overview of current FMCW LIDAR solution providers and a comparison of FMCW LIDAR to other LIDAR types. Silicon photonics is a proven platform with mature components originally developed for telecom/datacom applications (lasers, detectors, optical couplers, and others), that are now being directly applied to the integration of the photonic functions required for coherent LIDAR. Newer components such as optical phased arrays (OPAs) are under development that will further enhance this functionality and replace current bulky and unreliable mechanical systems. The flexibility of silicon photonics enables a modular approach where the transmission and detection operations, as well as the scanning optics can be separated if required. Thus, performance and cost can be optimized for each application with this modular approach. This talk will include results from recent tests of silicon photonic based FMCW LIDAR systems and discuss potential future developments, together with an assessment of the limitations and challenges associated with the FMCW approach. The talk will also include discussion on the current challenges with the silicon photonics approach, and specifically how these apply to automotive LIDAR applications.

Ralf Muenster, SiLC Technologies

Networking Break in Exhibit

Managing the System-level evolution of ADAS systems to Autonomous Systems

The architecture of the electronic control units (ECUs) used to implement advanced driver assistance systems (ADAS) in vehicles is changing.

ADAS applications use many types of sensors, including cameras, medium and long-range radar, ultrasonic, and LIDAR. Data from these sensors is used to enable ADAS functions such as parking assistance, automatic emergency breaking, pedestrian detection, surround view, and even drowsiness and gaze detection.

Current ADAS architectures distribute sensors and their related processors throughout the vehicle. How this is changing, as automotive system architects integrate multiple applications into ADAS ECUs that serve multiple functions and what efficiencies can be gained, will be discussed in further detail.

Tom Toma, Veoneer
10:30 a.m.  ORAL ONLY  Integrating LIDAR into the Automotive ADAS roadmap

Car crashes kill 1.3M annually, 93% of these are human error. Forward collisions account for over 76% of crashes in the USA, with an average cost per crash of ~$45,000. With the increasing addition of ADAS functionalities through NCAP and IIHS, these 2016 numbers are expected to reduce. Improvements in features such as automatic emergency braking, lane keeping assist, blind spot detection, cross traffic alert, etc. will make vehicles safer. These safety technologies currently rely primarily on radar and camera for detection of free space and objects. When we study the test protocols for these ratings, we can notice that their application in real life conditions is limited by the shortfalls of camera and radar. Accurate free space detection at engine on with long range and resolution is a key strength for lidar. In this presentation, Velodyne will present some of our findings on the potential market for lidar in ADAS and how we can make the system more robust and available with the addition of lidar to the sensor suite.

Rajeev Thakur, Velodyne LiDAR

11:00 a.m.  ORAL ONLY  Bringing Intelligence to the Edge

The automotive industry has been transitioning from passive safety to active safety systems, with an eye towards systems intended for higher levels of autonomy. This translates into high quantities of data feeds, which mandate new requirements for compute capability and power consumption. Fortunately, the capability and reliability of sensors have increased dramatically. In this session, AEye senior director of LiDAR product architecture Ove Salomonsson discusses how advanced, LiDAR-enabled sensor systems can reduce data streams without having to make compromises on the resolution and field of view requirements mandated by early enough detection and classification. He will discuss the architecture of these systems, and how camera deficiencies can be covered by LiDAR, especially if the LiDAR is cued by those deficiencies. He will also expand upon how these systems are able to filter out the most important aspects of a given scene, enabling the vehicle’s perception system to target only the salient 5% of data needed to build the environment model and safely navigate roadways.

Ove Salomonsson, AEye Inc.

11:30 a.m.  Networking Lunch in Exhibit
From early vehicle commercialization in the 1920s to DARPA in the early 2000s, the path to autonomous vehicles has been long and windy. The market has set its sights on a future of self-driving cars, but today’s technology still falls short of those expectations. LiDAR is the key to making self-driving cars a reality. Getting the eyes right on driverless cars is tantamount to creating a safe, truly autonomous driving experience. Developing systems to meet the complex and constantly changing needs of fully autonomous vehicles requires new approaches and high performance to reach unprecedented levels of 3-D visualization. To ensure a safe autonomous driving future, the industry needs to address the limitations of the current technology and literally see around corners. The best autonomous vehicle programs today are only improving performance by 50% each year. At that rate, unless there is a dramatic improvement in the technology, self-driving won’t be better than humans until 2040. However, automakers are already pushing to a 2021-2022 timeline for commercial autonomous vehicles, and these OEMs need a significant lead time (traditionally 7-year design cycles) to test, design, build and integrate these sensors into their platforms. In this presentation, Luminar CTO and co-founder Jason Eichenholz will discuss the requirements for a fully autonomous vehicle, the state of the market today, and what we need to get there. The talk will also address key technological assumptions made by current LiDAR platforms, OEM requirements for LiDAR sensors and system engineering challenges in designing a cost effective LiDAR system.

Jason Eichenholz, Luminar Technologies

<p>Beside electro-mobility, automation of driving is one of the main topics on the research and development agenda of the automotive industry. On the one hand, automotive OEMS are working to achieve the step to level 3 automation of driving in general public traffic. On the other hand, shuttle service providers are working on even higher levels of automation for limited use cases.</p>

Available LiDAR technology is based on mechanical scanning. This sets limits to the robustness, durability, size and cost of such sensors. Therefore, there is a demand for solid-state LiDAR technology. Many established and start-up companies came up with a broad range of solutions. Most of them are either MEMS scanning LiDARs or flash LiDARs. Both technologies have their advantages and their limitations. Ibeo will present its approach of actually combining the advantages of scanning with those of solid-state flash LiDAR.

Paula Jones, Ibeo Automotive USA Inc.

Automated driving is widely viewed as a critical component in addressing the mobility challenges that cities and countries are facing worldwide.

Pierre Olivier, Eng., Leddartech Inc.

Networking Break in Exhibit
Deployment of Smart Manufacturing Technologies Throughout the Automotive Value Chain

**Session Code:** IIM102

**Room Legacy Ballroom IV**

IIoT, Additive Manufacturing (AM), Digital Thread, Extended Reality (XR), Machine Learning, Artificial Intelligence (AI), Blockchain and Robotics are many of the key technologies which are revolutionizing manufacturing. A thorough understanding of these technologies and a sound deployment strategy is essential to maximize the many benefits that these powerful tools have to offer. This session will explore “Smart Factory” deployment and integration strategies currently being utilized; productivity improvements being realized, and lessons learned throughout the automotive value chain. In addition, industry experts will provide their perspective on the future direction and expected developments in this manufacturing revolution.

**Chairpersons** - Monika Minarcin, Accenture; Adrian Jennings, Ubisense Inc.

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| 8:30 a.m.    | ORAL ONLY        | *Panel Discussion: Automated Vehicle Sensor Technology*  
**Moderators** - Rini Sherony, Toyota Motor North America Inc.  
**Panelists** - Jason Eichenholz, Luminar; Paula Jones, Ibeo Automotive USA Inc.; Ralf Muenster, SiLC Technologies; Pierre Olivier, Leddartech Inc.  |
| 9:30 a.m.    |                  | *Keynote Presentation: Journey to Digital Operations*  
Ford Motor Company is leveraging its Advanced Manufacturing Organization to accelerate the transformation of its manufacturing operations from a series of connected equipment across operations to a completely digital and integrated system of processes that are tied to the connected vehicles that are produced and to the product development tools that are used to conceive the products through the creation of an enterprise Digital Twin.  
Michael Mikula, Ford Motor Co., Ltd.  |
| 10:00 a.m.   | ORAL ONLY        | *Vehicle Digital Twin + Digital Thread + Blockchain = Road to Profit*  
What is a digital twin? Can it be used outside of design and manufacturing?  
What is a digital thread? How are these two technologies related and enable OEMs to connect to auto industry ecosystem? Why do we even need them and what are the limitations of each?  
What is a blockchain? Can it be used to overcome the roadblocks on the transformation journey ahead? Join us as we answer all these questions and uncover how a blockchain-backed vehicle digital twin and thread can help overcome these hazards and drive your digital strategy to a profitable road ahead!  
Joshua Cartellone, Richard T. Meszaros, Accenture  |
| 11:00 a.m.   | ORAL ONLY        | *Crafting a Digital Thread for the Intelligent Factory*  
Karthik Gopalakrishnan, Robert Bosch LLC  |
**11:30 a.m.**  
**ORAL ONLY**  
*Industry 4.0*

Industry 4.0 refers to the concept of factories in which machines are augmented with network connectivity and sensors, connected to a system that can visualize the entire production line and formulate decisions through an algorithmic analysis on its own.

In summary, Industry 4.0 describes the trend towards automation and data exchange in manufacturing technologies and processes which include digital systems, the internet of things (IoT), industrial internet of things (IIoT), cloud computing, cognitive computing and artificial intelligence.

David Hanby, ABB Robotics Inc.

**11:30 a.m.**  
**Networking Lunch in Exhibit**

**1:00 p.m.**  
**ORAL ONLY**  
*The Siemens Digitalization Journey – Creating and Leveraging the Digital Twin of Production*

To keep up with changing consumer desires, Automotive OEM’s and suppliers are feeling the pressure to expand their current product portfolios. These changes have also become a catalyst for new players to enter this space and subsequently disrupt the traditional OEM and supplier landscape. One thing is for sure, whether you are an established OEM, Supplier or Startup, priority is being placed on efficient and flexible production systems. During this presentation Siemens will explain how an End-to-End Digitalization approach to Manufacturing Engineering and the development of a Digital Twin for Production can help manufacturers engineer, launch, maintain and optimize the complex manufacturing systems of the future.

Todd Bengtsson, Siemens PLM Software

**1:30 p.m.**  
**ORAL ONLY**  
*Supporting Intelligent Supply Chain and Manufacturing Technologies*

This presentation will show how Microsoft supports intelligent supply chain and manufacturing technologies. Microsoft is helping companies realize the end state of a closed loop manufacturing and supply chain platform. We are bringing the non-homogeneous digital world of controllers, machines, business systems, IT systems and OT systems together with a common data model in a single platform of intelligence that supersedes all systems. It enables digital feedback loops through business systems, customers, lines of business and products. With a single platform of intelligence, the ability to go from concept to prototype to production to scale is enabled with great visibility to the entire process and how execution happens against the digital plans. Artificial Intelligence helps solve factory problems, optimize supply chains, and improve the customer experience. Machine Learning improves the operational cycles of machines, improve demand planning exercises and set maximized pricing. And Cognitive services bridges the world of communication to actions. It empowers employees to focus on their value added tasks versus the administrative noise. We will go through real world examples of these digital factory and supply chain transformations and the real impact that is realized today and what will be in the future.

Darren Coil, Microsoft Corporation

**2:00 p.m.**  
**ORAL ONLY**  
*People Aren’t Things: Extending IoT to Manual Processes*

IoT focuses on connectivity between “things” devices, machines, tools etc., but in automotive assembly many processes are still overwhelmingly planned, supervised and executed by people. In this presentation Adrian Jennings describes how the standard notion of the IoT “Digital Twin” has limited value in these applications, leaving large parts of critical processes completely opaque and unconnected. Using real-world case studies as examples, Mr. Jennings will explain technologies that are extending the Digital Twin to encompass manual assembly activities and how significant value is being created as a result.

Adrian Jennings, Ubisense Inc.
Artificial Intelligence and Machine Learning Impacts on ADAS and AV Advancements

Session Code: IIM405

Room Legacy Ballroom V

As AI and ML expands its development into mobility, the impact will be felt throughout vehicle’s development, design and deployment regarding ADAS, Connectivity, and enhanced user experience technology. Come hear experts address the current state of AI/ML and future research and developments of this technology as it relates to increasing vehicle automation.

Chairpersons - Oliver Spiess, ZF; Phares A. Noel, Oakland Univ.

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<tr>
<td>8:30 a.m.</td>
<td>ORAL ONLY</td>
<td>Impact of AI in Automotive Mobility</td>
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<td>Incorporation of AI into vehicles brings several major challenges that will require us to adapt existing engineering processes. Current processes tend to treat artificial intelligence models as just another piece of software, but AI models are fundamentally different from traditional software and existing methods are insufficient for dealing with these differences. This presentation will discuss the challenges in delivering AI-based systems while maintaining compliance with automotive engineering standards such as ISO 26262 and ASPICE.</td>
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<td>Sky Matthews, IBM Watson Solutions</td>
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Networking Break in Exhibit

3:00 p.m.  ORAL ONLY  Can a Successful Manufacturing Organization Drive Innovation?

Perhaps it is, if not one of the most effective means to lead it

An unprecedented business case enables the study of just how the starting point can be the same, however the differences can be drastically seen on how each of the production centers at first leverages their competitive edges; one being low cost advantage, and the other, the first world advantage. Incredibly eventually both started moving into the same likeness in culture. In fact perhaps it has nothing to do with low cost or first world centers but the driver for competitiveness has been human creativity all along, or as we call it, Innovation â€“ and it is with this culture for which will bear the age of the intelligent factories

Jeffrey Liaw, Martinrea

Moderators - Monika Minarcin, Accenture
Panelists - Ted Brown, Totally Automated Systems; Darren Coil, Microsoft Corporation; Adrian Jennings, Ubisense Inc.; Jeffrey Liaw, Martinrea;
Towards Kinematic Reconstruction of Roadway Scenes from Single-Camera Input

Creating simulation environments takes ample well-annotated data. The recent trend moving toward machine learning-based construction and use of simulations has increased the need for such data. However, acquiring such well-annotated data is a challenge, especially in the case of rare traffic events like crashes. Surprisingly, web-uploaded open-source videos acquired from simple devices like dash cameras already contain ample examples. Yet, their 3d kinematic and dynamic parameters are not known. In this talk, I will describe our recent efforts in inferring such parameters for third-person view dash-camera acquired video. Our works implement human-in-the-loop deep network architectures to reconstruct vehicle pose from a single viewpoint and to request input from a human to help with this process.

Jason J. Corso, University of Michigan

Networking Break in Exhibit

Using Intelligent Sensing to Achieve Accurate, Fast Perception

Most LiDARs use a fixed scanning pattern to sense surroundings and create a 3D point cloud. This pattern tries to strike a balance between the 3 Rs - range, resolution and refresh rate.

From a self-driving car's perspective, the closest objects in its direction of motion are far more important than the farther objects, while less important objects may become very important in just a few milliseconds.

This presentation will look at Intelligent sensing, with its fourth R (Region of Interest), and how the ability to foveate on one more more objects increases the accuracy and speed of perception algorithms.

Ove Salomonsson, AEye Inc.

See What You Get - Independent Performance Evaluation of Neural Networks for Real-Time Perception

The real-time performance of perception systems was identified as major challenge to automate driving. For the right selection of SoCs an early performance evaluation is required.

Computer vision represents the idea of giving machines the capacity to make meaning out of images frames, and for decades it consisted mostly of laborious and complex techniques that provided poor performance, which prevented them from making their way into "real-world" applications. With the advent of the Deep Convolutional Neural Networks (DCNN), computer vision systems have reached levels of accuracy that allowed them to grain ground into several industries such as Manufacturing (automated quality inspection and risk surveillance) and Automotive (autonomous driving and driver assistance systems), for example. A major challenge, however, resides in deploying computer vision systems that can perform in real-time in environments (such as driverless cars) that impose a series of constraints in terms of energy supply, weight and space. Techniques such as reduced precision and batching can be used employed in order to obtain successive improvements. The different implementations provide a wide range of achieved throughput, power consumption and energy efficiency. E.g. with the configuration used the best performance was achieved at 47.7 fps with a resolution of 1080x720. The several obtained results demonstrate the scalability potential of the system with respect to different configurations. And even more important it shows the physical limits or performance and power consumption ratio.

See also SAE 2019-01-1045

Fabian Koark, Invensity Inc.
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<tr>
<td>11:00 a.m.</td>
<td>ORAL ONLY</td>
<td><strong>Is Artificial Intelligence Certifiable for Deployment in Autonomous Driving</strong>&lt;br&gt;The approval and certification of safety critical systems stick to very strict and restrictive rules. Unambiguous requirements, consistent traceability and a strict review process of functions, systems, hardware and software contribute among others to provide safety arguments for official certification by authorities. Learning based artificial intelligence, like machine learning, do have a completely different approach then requirement-based software, even if the learning mechanism is freezeed for operation. These algorithms pass on explicit requirements, since their function is established on data-driven training. The algorithm quality (like performance, robustness and comprehensibility) and the thereon based safety, depends mostly on the model and especially on the used data and their quality. It is a major challenge for approval and certification to deal with such case. Should the safety argument be proved by the quality of the data? Is it possible to define a certain level of data quality for training data? Can we find meaningful metrics of data quality? Are these feasible for complex use cases such autonomous driving in urban environment? Is this trustworthy and good enough to provide a certificate of road worthiness? How should standards be modified to cope with this case? Should regulation allow for learning while operation? The presentation will address these questions and provide an overview on the current status of regulation, of art and of science. Additionally, some approaches are proposed that promise to provide adequate answers on how AI Algorithms can be approved and certified in the future.</td>
<td>Houssem Abdellatif, TÜV SÜD; Stefan Merkl, TÜV SÜD Americas</td>
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<td>11:30 a.m.</td>
<td>Networking Lunch in Exhibit</td>
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<td>1:00 p.m.</td>
<td>ORAL ONLY</td>
<td><strong>The Case for Transparent AI</strong>&lt;br&gt;Replacing a human driver is an extraordinarily complex task. While machine learning (ML) and its' subset, deep learning (DL) are fueling breakthroughs in everything from consumer mobile applications to image and gesture recognition, significant challenges remain. The majority of artificial intelligence (AI) learning applications within the Connected Automated Vehicle (CAV) and related ecosystem space are opaque - genuine &quot;black boxes.&quot; Transparency is the ability to have access to the logic behind a decision made by a machine learning system. This is a requirement to establishing trust in high risk and high cost applications such as CAVs. This presentation will outline how Transparent AI based on Knowledge Representation and Reasoning (KRR) and learning creates a &quot;holistic AI&quot; approach based on an actual implementation.</td>
<td>Monika Minarcin, Accenture</td>
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<td>1:30 p.m.</td>
<td>ORAL ONLY</td>
<td><strong>Machine Learning at Scale for Autonomous Driving</strong>&lt;br&gt;Building ML systems for a self-driving vehicle faces unique challenges in terms of data, scale, and robustness: they must handle not just everyday driving, but also be capable and reliable enough to handle rare, once in a million mile situations on the road. In this talk, we share how we’re thinking about the state of ML / AI in handling the long-tail, what it means for ML at scale, and our ingredients for building the machine learning factory for self driving.</td>
<td>Michael James, Waymo</td>
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<td>2:00 p.m.</td>
<td>ORAL ONLY</td>
<td><strong>Approaches to Machine Learning and AI in Automotive and the Critical Attributes of Enabling Solutions</strong>&lt;br&gt;Machine Learning and AI technologies hold great promise for enabling Automotive use cases and building compelling vehicle, phone and cloud solutions. The presentation will cover the value add of these technologies, clustered by the types of problems to be addressed and the applicable techniques within these clusters as well as the key constraints and required features of enabling solutions (both technical and organizational).</td>
<td>Jim Brown, CloudMade</td>
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Planned by ADAS to Automated Driving Organizing Committee / Innovations in Mobility Steering Committee

**Net-Zero Carbon Fuels Technology (Part 1 of 2)**

**Session Code:** IIM307  
**Session Time:** ALL DAY

This meeting will provide a forum to discuss emerging net-zero carbon fuels technologies and the potential for a sustainable transportation future. The scope will include electro-fuels, bio-fuels, and other fuel technologies with the potential for net-zero life-cycle carbon emissions in applications spanning all transportation sectors - on/off-road, aviation, marine, and rail. Sessions will address fuel production technologies, combustion and emissions performance, and life-cycle/techno-economic analyses of net-zero carbon systems, with the goal of understanding near- and long-term pathways to implementation, and potential impacts on transportation and the U.S. energy infrastructure.

**Chairpersons** -  
Claus Daniel, Oak Ridge National Laboratory; John Farrell, National Renewable Energy Laboratory; Michelle Kidder, Robert Wagner, Oak Ridge National Laboratory

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| 8:30 a.m.  | ORAL ONLY          | Keynote Presentation: The Route of Sustainable Fuels as the Basis for Zero Emission Mobility - is there a chance for Hydrogen and eFuels?  
*In this Keynote the options for future Energy Carrier (â€”Fuelsâ€™) will be evaluated â€” as part of the Transition in Transport towards Zero Emission Transport.*  
Wolfgang Warnecke, Shell Global Solutions |
| 9:30 a.m.  | Networking Break in Exhibit |                                                                      |
| 10:00 a.m. | ORAL ONLY          | Net-Zero-Carbon Fuels  
Major reductions in the carbon footprint of the transportation sector will require broad-based implementation of net-zero-carbon fuels â€“ electricity, hydrogen, and liquids. To drive this implementation, research is needed to develop cost-effective technologies that synergistically integrate all potential energy sources and all elements of the transportation sector. Key to large-scale integration of renewable, zero-carbon electricity â€“ solar and wind â€“ will be the development of cost-effective long-term energy storage and distribution systems enabled by advances in carbon capture, electrolysis, and liquid synthesis. To gain a foothold in the global market, these technologies will, in turn, need to be embedded within economically optimized energy ecosystems.  
Paul Najt, USCAR |
10:30 a.m.  ORAL ONLY  


While electric vehicles are expected to make big strides in the coming decades, liquid fuels will remain a key part of our transportation reality for the foreseeable future. To meet the need for sustainable, domestically sourced fuel, the U.S. Department of Energyâ€™s (DOE) Bioenergy Technologies Office (BETO) supports research and development to enable a robust biofuels industry. Advanced biofuels, strategies that integrate advancements in engine design and fuel technology, and improved processes, including increased CO2 utilization, can all offer significant life-cycle emissions benefits. This talk will cover advancements in biofuel technologies and efforts across DOE to develop integrated strategies to drive down emissions across the transportation sector.

Alicia Lindauer, US Department of Energy

11:00 a.m.  ORAL ONLY  

**Innovation and Emerging Technology Perspectives in Hydrogen and Fuel cells at the U.S. Department of Energy**

Today the technology around generating efficient and sustainable energy is rapidly evolving and hydrogen and fuel cells are emerging, versatile examples within a portfolio of options. Dr. Sunita Satyapal will provide an overview of the U.S. Department of Energy’s (DOE) activities within the Office of Energy Efficiency and Renewable Energy (EERE) focusing on hydrogen and fuel cell technologies. This is an exciting time in the fuel cell industry with several thousand commercial fuel cell vehicles now sold or leased, hundreds of fueling stations worldwide, and more than a quarter of a million stationary fuel cells providing clean, reliable power. DOE’s Fuel Cell Technologies Office (FCTO) addresses key technical barriers faced by hydrogen and fuel cells through a comprehensive portfolio of early-stage research and development (R&D) with the potential to meet technical and cost targets that enable competitiveness with incumbent technologies in the market.  

The presentation will cover DOE’s H2@Scale initiative which will enable innovations to generate cost-competitive hydrogen as an energy carrier, coupling renewables, as well as nuclear, fossil fuels, and the grid, to enhance the economics of both baseload power plants and intermittent solar and wind, enhancing resiliency and avoiding curtailment. Hydrogen can be stored, distributed and used as a fuel or feedstock in transportation, stationary or multiple industrial sectors, while creating additional revenue streams. Topics will include activities to enable the production of synthetic fuels through carbon dioxide plus hydrogen pathways. The presentation will also provide fuel cell, hydrogen production, storage & delivery, as well as safety, codes and standards R&D activities that FCTO is funding to enable the H2@Scale initiative.

Max Lyubovsky, US Department of Energy

11:30 a.m.  

**Networking Lunch in Exhibit**

1:00 p.m.  ORAL ONLY  

**An Introduction to the Joint Center for Artificial Photosynthesis**

The Joint Center for Artificial Photosynthesis (JCAP) was established in 2010 as part of a U.S. Department of Energy effort to confront the technical challenges associated with developing solar fuels. In service of this goal, JCAP efforts have been organized into four research thrusts. In thrusts 1 and 2, investigations span the discovery and characterization of new electrocatalysts and photoelectrocatalysts for CO2 reduction. The respective research foci of thrusts 3 and 4 involve materials integration and device-level prototyping, with an ultimate goal of developing practical methods of incorporating materials for solar capture and CO2 conversion into fully-integrated PEC devices. In this talk, an overview of the work conducted and progress made in these areas, will be discussed.

Peter Agbo, Lawrence Berkeley National Laboratory
Currently 80% of the global primary energy consumption comes from fossil fuels, of which the transportation sector consumes approximately one-third of this. As a consequence, transportation is also the second largest carbon dioxide (CO2) producer at 29%, and is the fastest growing source of the world greenhouse gas emissions. Decarbonizing transportation requires a shift from conventional fuels (diesel and gas) to advanced environmentally-friendly options. However, the needs for each sector in transport is unique, which makes addressing short to long term solutions difficult for developing net zero carbon fuels from different resources such as CO2 or biomass, thus will require a combination of advanced material, infrastructure and process design. Most notably, current technology is limited and costly to supply synthetic fuels that are drop in from biofuels and e-fuels, for medium to heavy duty, marine, and aviation. Synthetic fuels and the ability to use renewable resources is an ideal pathway to sustainability and reduced emissions, but the challenges such as suitable catalysts, fuel yields, selectivity and scalability are among some of the limiting factors. Curbing fossil fuel dependence to mitigate emissions from carbon dioxide, has opened up new areas that bring challenges for both science and engineering development, however it also provides a unique opportunity to develop sustainable energy solutions. With carbon capture and sequestration becoming a key element in worldwide efforts to control emissions, large amounts of CO2 will become available as a feedstock for innovative conversion for synthetic fuels. An overview of the current scientific challenges and the urgent agenda for materials research and development for CO2 conversion to hydrocarbon fuels will be discussed.

Michelle Kidder, Oak Ridge National Laboratory

Retail is where innovation in transportation energy intersects with the consumer. If the consumer cannot access energy for their vehicle, transitioning to a new transportation system will be impossible. The fuel retailing industry operates more than 150,000 outlets selling a low margin, high volume product through infrastructure that is complex, expensive and heavily regulated to protect the environment and consumers. This session will provide an overview of the current fuel retailing market and evaluate some of the changes that might be required to introduce a new transportation energy product throughout the nation.

John Eichberger, The Fuels Institute

Networking Break in Exhibit
Feasibility Study of Utilizing Electricity to Produce Intermediates from CO\(_2\)<sub>2</sub>

The increasing availability of renewable electricity at costs competitive with electricity from natural gas and the associated need for energy storage due to off-peak and time-varying production is driving the United States towards a tipping point in the way that we produce and consume energy and products. However, there are several emerging technologies in this area (especially at low technology readiness level) ranging from reductive and oxidative approaches using inorganic catalysts with proton or anion exchange membranes to biological approaches whereby microorganisms directly utilize energy from electricity to produce fuels. These emerging technologies combined with cost-competitive renewable electricity generation and advances in material science warrant further investigation of the potential for electricity to be integrated with conversion of CO\(_2\), biomass, or waste resources to advance production of fuels and chemicals. This paper is aimed at evaluating the potential for cost reduction and efficiency improvements by utilizing electricity and plan to (1) understand the fundamental technical and economic feasibility of utilizing electricity for CO\(_2\) conversion strategies, and (2) assess integration of these technologies through mass/energy balance calculations and economic evaluations. Our approach to this feasibility study leverages NRELâ€™s existing core capability and expertise in analysis, builds off of prior survey work at NREL that explored CO\(_2\)-to-chemicals pathways, comprises literature review and engagement with technical experts in the field, and is divided into two main tasks to assess both technical feasibility and economic feasibility. Our analysis identified the top technical barriers for synthesis of accessible C1-C3 intermediates, outlined R&D activities and resources needed to overcome each barrier, and categorized the time horizon for overcoming these barriers as near-, intermediate-, and long-term.

Ling Tao, National Renewable Energy Laboratory

Well-to-Wheels GHG Emissions of Transportation Fuels

Regulations at the federal and state levels are in place to encourage research, development, and deployment of fuels with significantly lower GHG emissions to help reduce transportation GHG emissions. Existing regulations include the U.S. EPA's Renewable Fuel Standard and California's Low Carbon Fuel Standard. These regulations require that GHG emissions for various fuels are determined on the well-to-wheels (WTW) basis. Consequently, fuels with very low WTW GHG emissions have been introduced and are being researched. Such fuels include biogas from various waste feedstocks, biofuels from different feedstocks, and electro-fuels from renewable hydrogen and CO\(_2\) waste streams. Argonne National Laboratory has been developing the Greenhouse gases, Regulated Emissions, and Energy use in Transportation (GREET) model to evaluate WTW GHG emissions of a variety of transportation fuels. This presentation will cover WTW GHG emissions of gaseous and liquid fuels with different feedstocks and conversion processes simulated with the GREET model.

Michael Wang, Argonne National Laboratory

Panel Discussion: Net-Zero Carbon Fuels Technology

**Moderators** - Robert Wagner, Oak Ridge National Laboratory; Michelle Kidder, Oak Ridge National Laboratory; Ling Tao, National Renewable Energy Laboratory; Michael Wang, Argonne National Laboratory;
Connected and Automated Vehicles (CAVs) are primed to create disruptive changes in the future of transportation. Yet realizing a fully-evolved CAV ecosystem has hit the fundamental challenges for verification and validation in terms of: (i) uncertainty induced by mixed-traffic and human-variability; and (ii) need for hundreds-of-millions of miles of testing (simulated as well as real-world). It is in this milieu that we propose to further discussions and disseminate information around the emerging R&D, standardization, deployment and policy issues surrounding global deployments of CAVs (by including the critical academic, industry and professional society stakeholders).

Chairpersons - Patti Kreh, SAE International

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<th>Time</th>
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<td>1:00 p.m.</td>
<td>Panel</td>
<td>Panel Discussion: Simulation</td>
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Automated driving is a software challenge of unrivaled complexity that has reinvented software testing best practices, particularly regarding what it means to provide continuous testing coverage at scale. Daily simulation using millions of highly parameterized edge cases is replacing more traditional specification-based testing approaches. While simulation is intended to play a key role in the development and validation of autonomous vehicles, it has come to mean different things to different organizations. No clear consensus exists regarding the roles of simulation vs. closed track testing vs. live-traffic driving. While the 37 NHTSA pre-crash typologies offer some insights into the scenarios to be tested, to date no clear consensus or standard has emerged on how those scenarios should be described (fidelity). Misquoting George Box: “All simulations are wrong; but some are useful” this session seeks to promote discussions on the emerging trends in fidelity and scale of simulation testing and the ever-critical level of correspondence between the simulation and real-world results.

Learn more about the Panel Participants

Moderators - Jeffery Blackburn, Dataspeed Inc.

Panelists - Tony Gioutsos, Siemens Corp.; Mahendra Muli, dSPACE Inc.; Pavan Vempaty, Dataspeed Inc.;

2:30 p.m. Networking Break in Exhibit
The growth of test-centers has emerged from the need for vehicles to be immersed in the desired environment to enable testing of automation algorithms. Several purpose-built AV test centers have emerged intended to replicate conditions found in highway driving, urban test areas, and specialized areas for rough road, wet road, or off-road testing, and safe interaction with other vehicles (towed targets) and pedestrians (animated mannequins). However, in helping narrow the scope - from "desired-features" to "necessary-features" - no clear standards regarding what should be done in closed track testing vs. street driving vs. simulation. The difficulty of insuring repeatability of tests (e.g. even from run to run) let alone within multiple instances of the same scenario (e.g. left-turn across traffic). In this session, leading experts from the test-centers will discuss approaches to develop meaningful performance metrics despite the immense variability and interplay between the real-world artifacts (e.g. track surfaces, markings, and soft targets) and digital elements (e.g. software code under test; velocity, volume, veracity and variety of acquired data). 

Planned by Validation, Certification, and Testing Committee / Innovations in Mobility Steering Committee

**Panel Discussion: Test-Centers**

The growth of test-centers has emerged from the need for vehicles to be immersed in the desired environment to enable testing of automation algorithms. Several purpose-built AV test centers have emerged intended to replicate conditions found in highway driving, urban test areas, and specialized areas for rough road, wet road, or off-road testing, and safe interaction with other vehicles (towed targets) and pedestrians (animated mannequins). However, in helping narrow the scope - from "desired-features" to "necessary-features" - no clear standards regarding what should be done in closed track testing vs. street driving vs. simulation. The difficulty of insuring repeatability of tests (e.g. even from run to run) let alone within multiple instances of the same scenario (e.g. left-turn across traffic). In this session, leading experts from the test-centers will discuss approaches to develop meaningful performance metrics despite the immense variability and interplay between the real-world artifacts (e.g. track surfaces, markings, and soft targets) and digital elements (e.g. software code under test; velocity, volume, veracity and variety of acquired data). 

Panelists - Alexander Lybarger, Transportation Research Center Inc.; Huei Peng, Univ. of Michigan-Ann Arbor; Eric Rask, Argonne National Laboratory; Rahul Razdan, Florida Polytechnic Univ.; Rajeev Thakur, Velodyne LiDAR;

Moderators - Edward Straub, SAE International

Mobility Service Providers seek to provide transportation services that meet customers' needs for comfort, reliability, safety, and connectivity. Future Mobility will be defined by unique powertrains, technologies and architectures that ensure these attributes are met - but there are materials challenges in these designs. Fleet owners must offer products and solutions that also deliver a profitable business model. This presentation will explore insights from a long-term assessment of Future Automotive Trends, and why steel applications continue to make sense.

George W. Coates, WorldAutoSteel

Wednesday, October 30

**Material Needs of New Generation Vehicles**

**Session Code:** IIM201

**Room Legacy Ballroom VIII**

The new generation of vehicles (i.e. Autonomous & New Energy Vehicles) currently being manufactured and designed as well as those that are expected to exist in the future possess a myriad of material challenges and requirements. Many of the same technological advancements which are making these new generation of vehicles a reality is being employed by material designers and manufacturers to develop new alloys, manufacturing process and testing techniques to meet the material needs of these vehicles. This session will provide useful insight into many of the high priority challenges that the materials community is currently addressing related to new generation vehicles while also looking into the near and long-term future to assess and predict the industry's future requirements.

**Chairpersons -** Qian Zou, Oakland University; Jian Tao, FCA US LLC

**Keynote Presentation: Steel's Place in Future Mobility**

Mobility Service Providers seek to provide transportation services that meet customers’ needs for comfort, reliability, safety, and connectivity. Future Mobility will be defined by unique powertrains, technologies and architectures that ensure these attributes are met - but there are materials challenges in these designs. Fleet owners must offer products and solutions that also deliver a profitable business model. This presentation will explore insights from a long-term assessment of Future Automotive Trends, and why steel applications continue to make sense.

George W. Coates, WorldAutoSteel
9:00 a.m. ORAL ONLY Keynote Presentation: Collaborating for Future Steel Vehicles
The steel and automotive industries have a long history of collaborating for new technologies. A collaborative project introduced nearly a decade ago, the FutureSteelVehicle, produced results that have been continuously adopted by automakers, as early as the 2015 model year and is now seen on future vehicle architectures. The project showcased state-of-the-future design innovations detailing steel’s versatility and strength. Key results are being implemented for future mobility applications, as new vehicle architectures are showcasing the expanding portfolio of advanced high-strength steels (AHSS) - including third generation AHSS - while illuminating the many steel component production technologies that enable different manufacturing strategies.
Jody N. Hall, American Iron and Steel Institute

9:30 a.m. Networking Break in Exhibit

10:00 a.m. ORAL ONLY Electrical Steels for E-Mobility: Where From and Where To
Electrical steels remain the engineering material of choice for nearly all energy conversion applications. This is especially true with the motors being designed for e-mobility traction applications. Because of their unique performance requirements of these motors a new class of specialized non-oriented electrical steels has been developed with further specialization tailored for application in different motor styles. A brief background into non-oriented electrical steels is provided to establish context for describing the evolution of these e-mobility traction steels, their unique properties, and application trends. Finally, a summary of the current market dynamics and development trends will be highlighted.
Erik J. Hilinski, Tempel Steel Co.

10:30 a.m. ORAL ONLY Structural and thermal material and design considerations for a 48V battery pack
This presentation will cover battery key performance of thermal and functionality after a crush event, material selection approach - encapsulant, and material study and characteristics.
Serin Shen, A123 Systems Inc.

11:00 a.m. ORAL ONLY Sheet Aluminum Solutions for Battery Enclosures
Aluminum sheet provides a more cost-effective solution for battery enclosures in high production volume battery electric vehicles. Novelis has developed a sheet aluminum battery enclosure solution as part of its Alumineering® collection of generic sheet aluminum solutions for light vehicle body structures and closures. Using Novelis' latest Advanz® high strength and highly formable aluminum grades, this design provides a light weight, lower cost solution compared to aluminum extrusion-intensive battery enclosures in high volume electric vehicle applications, and substantial weight reduction at attractive light weighting cost compared to state-of-the-art advanced high strength steel-intensive battery enclosures. The presentation will provide details of pertinent design, performance, cost, and weight elements of the Novelis Alumineering® sheet aluminum battery enclosure solution.
Blake Zuidema, Novelis North America

11:30 a.m. Networking Lunch in Exhibit
1:00 p.m.  ORAL ONLY  Keynote Presentation: Evolving Trends in Automotive Plastics and Composites

The presentation will highlight evolving global trends and challenges for engineering plastics in automotive including the potential effects of increasing electrification, autonomous vehicle capability and changing ownership models on material needs and requirements. Dr. Helms will also examine the past several years of the SPE Automotive Division Innovation Awards program extracting key innovation trends as seen through over 300 innovation awards nominations across 9 categories including those in the latest awards program category, additive manufacturing.

Jeffrey Helms, Celanese Corp.

1:30 p.m.  ORAL ONLY  Material Trends in Future Mobility

This presentation will share trends and innovations in automotive materials, including the impact of increased electrification and the shift toward autonomy. The presentation will also share insights on how advanced polymers/plastics, including new materials, will enable future mobility.


Brian Krull, Magna Exteriors and Interiors Corp.

2:00 p.m.  ORAL ONLY  Advancements in Composite Resin Systems for Electric and Autonomous Vehicle Applications

For over half a century, the automotive industry has used composite materials on exterior and semi-structural applications for their inherent benefits in mass-reduction, tooling investment-reduction, corrosion-resistance, and styling flexibility. As the transportation industry is now rapidly changing, composite material technologies must also change to meet new challenges for material properties, durability, and value. INEOS Composites has developed a next-generation series of cost-effective thermoset resin systems to provide solutions to these challenges. This presentation will summarize these advancements and review the potential benefits for EV/AV applications such as battery enclosures, exterior panels, body structures, communication/infotainment supports, and stowage systems.

Thomas J. Skelskey, Erin Findley, Dan Dowdall, Ashland LLC

2:30 p.m.  Networking Break in Exhibit
The third day of programming will open with a future of mobility panel followed by a compliment of AWD-related sessions with coverage on electric and electric axle drive systems.

**Panel Discussion: Impact of Future Vehicle Architecture and Duty-Cycle on Material Requirements**

A group of industry experts will be on-hand to address the anticipated material needs associated with forthcoming New Energy and Autonomous Vehicles that will transform lives. Fundamental changes to vehicle propulsion systems will necessitate and allow dramatic vehicle architectural adaptations. These adaptations will necessitate a deeper understanding of both people and technology, and, correspondingly, functional and non-functional material requirements will evolve. Furthermore, in contrast to traditional human-controlled vehicles, certain autonomous vehicles are expected to drive more than 1000 miles per day on various road surfaces; thus, vehicle components will be subjected to very different duty-cycles compared to traditional vehicles. It is therefore important to understand these differences such that our collective experience and resources used in developing traditional vehicles is transitioned smoothly to autonomous vehicles and their components.  

<https://www.sae.org/servlets/techSession?REQUEST_TYPE=AUTHOR_BIO&saetkn=ERPTop4gdC&PROD_CD=19IIM-0209&PRESENTATION_TITLE=Learn+more+about+the+Panel+Participants&SCHEDE_NUM=>Learn more about the Panel Participants

**Moderators** - Brandon Hance, United States Steel Corp.  
**Panelists** - Jon Aldred, HBM Prenscia; Robert Hathaway, Oshkosh Corp.; Jeffrey Helms, Celanese Corp.; Gavin Song, Ford Motor Company;  

**Panelists -** Berthold Martin, FCA US LLC; Steven Wesolowski, Dana; Ryan Kadlec, Magna Powertrain USA Inc.; Azadeh Narimissa, General Motors

**Time**  |  **Paper No.**  |  **Title**
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8:30 a.m. | ORAL ONLY | Keynote Presentation: The Energy Implications of Mobility Research  
Focused research in mobility and transportation technologies have had a substantial positive impact on oil importation, fuel consumption and mobility energy use in the US. Open questions still remain related to the best application of new mobility technologies and the proper selection of powertrain and driveline alternatives. Federally funded Research into probable mobility scenarios give insight into the optimal technology selections.  
Don Hillebrand, Argonne National Laboratory  
9:30 a.m. |  | Networking Break in Exhibit
10:00 a.m.  ORAL ONLY  

**Drivetrain design of an AWD, Class 3, pure electric Sport Utility Truck**

The Bollinger B1 and B2 are two on and off road capable, fully electric, AWD trucks set to begin mass production in Q3 2020. Both vehicles are equipped with dual permanent magnet motors, two speed electric transaxles and in-wheel gear reduction hubs. This provides the greatest combination of on road efficiency and off road capability. These Class 3 vehicles face significant challenges, as they demand both the maneuverability of a traditional center differential, with the ultimate tractive effort of a locked transfer case, all without any physical connection between the front and rear wheels. The controls strategies used to achieve balance between on and off road performance will be discussed. Of the electric AWD vehicles currently available, none command serious off road capability, payload capacities equal to the vehicle unladen weight or heavy towing requirements. Unique cargo carrying features drive strict packaging constraints for the under floor mounted powertrain. Additionally, a center mounted battery pack eliminates the ability to mechanically link the drive axles. Achieving the performance goals with limited available hardware and strict packaging constraints necessitated designing and manufacturing custom two speed transaxles and geared hubs. The process for addressing these challenges as well as the selection of drivetrain layout, traction motors and gear ratios will be discussed.

Charles Winegar, Bollinger Motors

10:30 a.m. ORAL ONLY  

**An Innovative Approach to a Coaxial Planetary P4 eAxle**

GKN as tier one system supplier developed a new rear axle e-drive module for a global hybrid vehicle application which will launch this year. The system combines a semi-integrated transmission utilizing a coaxial planetary gear set and an AC induction eMotor. The planetary transmission arrangement utilizes a passive lubrication concept and stepped planets to achieve the required reduction ratio. The system does not require a disconnect function as the electric drive module is able to operate up to the maximum vehicle speed when the vehicle is driven by the internal combustion engine. As a P4 system, this electric drive unit provides all wheel drive functionality to the vehicle. This, combined with an optimized system efficiency and performance while minimizing complexity, sets new standards regarding customer benefit and differentiates it from existing units on the market. Cross-functional systems engineering capabilities such as simulation, verification and validation in combination with GKN's in-house validation support for all system elements were the enabler to identify and realize solutions to the many technical challenges encountered during the development of this system. The presentation will show the system and highlight some of the key aspects of the development.

Joe Palazzolo, GKN Driveline North America Inc.
Recent vehicle introductions of AWD battery electric performance SUV’s, such as the Jaguar I-PACE and Tesla Model X, have demonstrated the use of electric drive units (EDUs) for both the front and rear axles using permanent magnet motors on each axle. An alternative architecture is to employ a mix of eMotor types between the front and rear EDUs such that the front axle contains a permanent magnet motor while the rear EDU uses an induction motor. A control method will be shown that optimizes the overall vehicle efficiency by utilizing the best attributes of each eMotor type while driving thru standard drive cycles. A customized Matlab/Simulink vehicle simulation model will run various drive cycles and compute system efficiency and energy consumption. Comparisons will be made between the standard architecture of permanent magnet motors in both front and rear EDUs and with the mixed eMotor architecture using the optimization algorithm. The impacts to the overall vehicle efficiency and potential system costs will be analyzed for both architectures. Conclusions and recommendations will be provided regarding the application of dual PM and mixed motor EDU solutions in P4 battery electric systems.

David Crecelius, AAM - American Axle & Manufacturing
Two-Speed EDU Development for Battery Electric Vehicles

The transportation industry continues to develop new powertrain and vehicle technologies aimed at reducing overall vehicle-level fuel consumption. Specifically, the use of electrified propulsion systems is expected to play an increasingly important role in helping OEMs meet fleet CO2 reduction targets for 2025 and beyond. This will also include a strong growth in the demand for electric drive units (EDU). To be successful in the market, new EDU concepts require intelligent solutions that are customized to specific market needs. In order to find the best possible solution, the characteristics of different applications such as small/large passenger cars, light/medium/heavy duty trucks, and offhighway equipment have to be considered carefully. While single-speed EDUs currently represent the state-of-the-art and are usually sufficient for many light-duty BEV applications, two-speed EDUs can increase both electric drive range and top speed capability while maintaining good drive-away performance. The number of ratios can also have a significant impact on function, complexity, and therefore cost of the vehicle, which makes it important to find the best solution for a given application in the concept phase.

Multi-speed EDUs in battery electric vehicles require power-shift capability to enable smooth acceleration without torque interruption. Further, the number of gear ratios has a direct impact on system performance and required e-Motor size. In particular, multi-speed solutions can be beneficial in vehicles with relatively high wheel torque and low power requirement such as delivery trucks that face the challenge of both sufficient launch torque and a reasonable maximum achievable speed on the highway. This presentation will begin with a market view of electrified transmission systems. Specifically, the transmission challenges and requirements for EDU applications will be discussed. Simulation results showing advantages of two-speed EDUs on a light commercial vehicle with respect to energy consumption and drivability will be presented. The presentation will provide details on two-speed EDU concepts, including a layshaft-based design as well as a new compact planetary-based architecture.

Brian Campbell, FEV North America Inc.; Thomas Wellmann, FEV Inc.; Gereon Hellenbroich, FEV Group GmbH
The automotive industry continues to develop new powertrain and vehicle technologies aimed at reducing overall vehicle-level fuel consumption. Specifically, the use of electrified propulsion systems is expected to play an increasingly important role in helping OEM's meet fleet CO2 reduction targets for 2025 and beyond. This will also include a strong growth in the demand for electric drive units (EDU). The change from conventional vehicles to vehicles propelled by EDU leads to a reduction in overall vehicle exterior and interior noise levels, especially during lowspeed vehicle operation. Despite the overall noise levels being low, the NVH behavior of such vehicles can be objectionable due to the presence of tonal noise coming from electric machines and geartrain components. In order to ensure customer acceptance of electrically propelled vehicles, it is imperative that these NVH challenges are understood and solved. This publication discusses various aspects of the EDU NVH development process. This will include a discussion of the NVH target cascading methodologies for EDUs, followed by a description of the EDU development and NVH integration process. Utilizing examples, specific aspects of EDU design to assure acceptable NVH behavior from the EDU will be discussed. The use of advanced simulation techniques for electric machine noise as well as geartrain-related noise will be demonstrated using examples. Finally, aspects of EDU "source" noise/vibration measurements and integration into the vehicle to ensure refined vehicle-level NVH behavior will be illustrated using examples from relevant case studies.

Thomas Wellmann, FEV North America, Inc.; Kiran Govindswamy, FEV North America Inc.; Christoph Steffens, Peter Janssen, FEV Europe GmbH

Various transmission systems with permanent magnet synchronous machine (PSM) and asynchronous machine (ASM) combined with offset-, layshaft-, and planetary- layouts are in GKN's portfolio. The multifactorial parameter analysis on a component and sub-assembly level, combined with systematic analysis of concept on system level, enables a rating of the performance including improvements for fatigue, efficiency, and NVH. This methodology will be demonstrated by means of a transmission design, and experiences in electrification of drivetrain will be highlighted. The applied method offers an effective, focused set of generic work and validation of ongoing electrification for real applications in the shortest possible time.

Molly Renshaw, GKN Driveline

Networking Break in Exhibit
Thursday, October 31

Critical Legal, Regulatory, Insurance & Consumer Metrics for AV

Session Code: IIM411  Room Legacy Ballroom I

This session begins with a series of short discussions and a panel on the legal interpretation of transportation regulations and liability legislation for automated vehicle developers, suppliers, insurers, and consumers. This is followed by critical discussions on transportation regulations, insurance and consumer metrics that are influencing how automated vehicles are developed and deployed into the public. Speakers will discuss current work to ensure safe, efficient and reliable automated vehicle operations.

Chairpersons - Fabian Koark, Invensity Inc.; Donald Parker, Exponent Inc.

Time  Paper No.  Title

3:00 p.m.  ORAL ONLY  Development of a Front Axle Spin Loss and Efficiency Test Procedure

In this presentation, front axle spin loss and efficiency test procedure development is explained. Measurement of Front Axle Disconnect benefits are integrated with the spin loss procedure; temperature control and measurement methods were developed to more accurately simulate EPA vehicle fuel economy and greenhouse gas operating conditions, including cold CO2. The method can also be applied to other vehicle test protocols like CR, US06, WLTC, and China 6. A “float to equilibrium temperature” approach was used for obtaining the axle efficiency and spin loss data. The test strategy of “float to equilibrium temperature” vs. “fixed sump temperature” was compared. An accelerated break-in procedure using a comparable energy approach has been developed; the duration of break-in is significantly reduced while achieving the same break-in effect as non-accelerated break-in procedures.

Siqin Wei, FCA US LLC

3:30 p.m.  ORAL ONLY  High Performance Dual Motor e-Axle

Electric vehicles make up a small percentage of the overall sales volumes today in the US market. The trend to be a “green consumer” is gaining momentum but not at a pace which will increase the sales of electric cars sharply. As automotive engineers we must bring solutions that attract buyers to electric vehicles through efficiency, performance and cost optimization that are more competitive than traditional vehicle offerings. In this presentation we will explore a High-Performance Dual Motor E-Axle specifically suited to the task of attracting customers to electric vehicles.

Harish Mathiazhagan, AVL North America Inc.

4:00 p.m.  ORAL ONLY  SAE Drivetrain Standards Committee Update

The Drivetrain Standards committee reports to the Powertrain Systems Group of the Motor Vehicle council. The committee is responsible for development and maintenance of SAE standards, Recommended Practices, and Information Reports related to drivetrain components and drivetrain systems, excluding powerplant and transmission. This presentation will cover the recent activities of the committee, current work in progress and needed support for the future.

Eric R. Frenz, Magna Powertrain USA Inc.; Michael Kocevar, JTEKT Corp.

4:30 p.m.  ORAL ONLY  Update from Automatic Transmission and Transaxle Committee

Ibrahim A. Khalil, Filtran LLC

Planned by All Wheel Drive Committee / Innovations in Mobility Steering Committee
8:30 a.m. Panel Discussion: ADAS, Automated and Legal Interpretation

Each Panelist will give a 10 minute point of view perspective on the topic of ADAS, Automated and Legal Interpretation

**Moderators** - Marc LeDuc, SAE International

**Panelists** - Thomas P. Branigan, Bowman & Brooke; Raj Choudhary, Independent Consultant; Jennifer Dukarski, Butzel Long; Emily Frascaroli, Ford Motor Company;

9:30 a.m. Networking Break in Exhibit

10:00 a.m. Panel

Panel Discussion: ADAS, Automated and Legal Interpretation (continued)

This panel will focus on legal interpretation of transportation regulations and liability legislation for ADAS and automated vehicles. It is designed to share opinions critical to AV developers, suppliers, insurers, and consumers. <a href="https://www.sae.org/servlets/techSession?REQUEST_TYPE=AUTHOR_BIO&saetkn=ERPTop4gdC&PROD_CD=19IIM-0026&PRESENTATION_TITLE=Learn+more+about+the+Panel+Participants&SCHEDD_NUM=">Learn more about the Panel Participants</a>

**Moderators** - Marc LeDuc, SAE International

**Panelists** - Thomas P. Branigan, Bowman & Brooke; Raj Choudhary, Independent Consultant; Jennifer Dukarski, Butzel Long; Emily Frascaroli, Ford Motor Company;

11:30 a.m. Networking Lunch in Exhibit

1:00 p.m. ORAL ONLY Legislation & Policy Enabling the Testing and Deployment of Automated Vehicles

Join Aaron Foster, Solutions Engineer at NAVYA, Inc for a presentation on the current state of AV legislation in the United States. Topics will include an overview of US DOT's guidance on AV development and deployment, key government agencies, safety standards that apply differently to different vehicle types, the difference between a foreign made and domestically made vehicle, how to overcome public doubts and fears surrounding AVs, how to influence policy makers, and more.

Aaron Foster, Navya Inc.

1:30 p.m. ORAL ONLY Uberâ€™s Perspective on Regulation and Automated Vehicles

Steve Kenner, Uber ATG

2:00 p.m. ORAL ONLY On Road Testing; Some Missing Regulatory Pieces

The legislatures in twenty-nine states and the District of Columbia have enacted legislation and the governors of eleven states have issued executive orders related to AV's. Many of these regulations concern on road testing of vehicles. No state requires vehicles being tested meet any type of minimal AV performance standards and only California requires any type of public disclosure related to vehicle performance. Given the highly publicized fatal Uber and Tesla crashes, perhaps it's time to require prototype AV's pass some basic performance tests, and require entities wishing to test on public roads, to provide some standardized information disclosure related to vehicle performance.

Jeffery Blackburn, Dataspeed Inc.

2:30 p.m. Networking Break in Exhibit
The changing transportation preferences and technologies are driving innovations in infrastructure development. Discussions will center around the macro mobility ecosystem, its infrastructure, and the network communications necessary to support these changes.

Anne O'Neil, Anne O'Neil Consultants LLC

Thursday, October 31

Next Generation Infrastructure

Session Code: IIM507
Room Legacy Ballroom II

Chairpersons - Anne O'Neil, Anne O'Neil Consultants LLC

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<tr>
<th>Time</th>
<th>Paper No.</th>
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<tr>
<td>8:30 a.m.</td>
<td>ORAL ONLY</td>
<td><strong>Keynote Presentation: Emerging Mobility Solutions - What Lies Ahead?</strong></td>
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<td>Jim Barbaresco, HNTB Corp.</td>
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<td>9:00 a.m.</td>
<td>ORAL ONLY</td>
<td><strong>Keynote Presentation: Smart Cities, Mobility, and Human Behavior - Seamless integration?</strong></td>
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<td>Carla Bailo, Center For Automotive Research</td>
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New vehicles are being equipped with Advanced Driver Assistance Systems (ADAS) designed to mitigate or prevent crashes. The Highway Loss Data Institute has used insurance loss data to document the real-world effects of ADAS on crashes for over a decade. This work has identified what ADAS work, which ones do not work as expected, and, in partnership with the Insurance Institute for Highway Safety, how to make ADAS work better. This presentation will overview Institute research on ADAS, areas for improvement, and what we can expect as these technologies evolve to automate some or all of the driving task.

David Kidd, Insurance Institute for Highway Safety

Networking Break in Exhibit
10:00 a.m.  Panel  
Panel Discussion: The Macro Mobility Ecosystem

This session looks at the broader, macro-level picture for enabling and planning of an ecosystem of diverse mobility options that cater to broadest cross-section of public users possible. Land use priorities and planning become a significant factor in re-constructing our transportation network as we aim to create an intentionally integrated future. This session aims to bring in the necessary planners and contributors together that can solve problems beyond just the vehicle that impact the entire mobility ecosystem, even discussing the issue of whether data and technology serve as a bridge to enabling an integrated, accessible reality for all.

<a href="https://www.sae.org/servlets/techSession?REQUEST_TYPE=AUTHOR_BIO &saetkn=ERPTop4gdC&PROD_CD=19IIM-0243&Presentation_Title=Learn+more+about+the+Panel+Participants&SESSION_NUM=">Learn more about the Panel Participants</a>

Moderators - Mark de la Vergne, City of Detroit  
Panelists - Valerie Brugeman, Daimler Corp.; Jeff Jones, Ford Smart Mobility; Stanislav Sobolevsky, New York University; Jason Zogg, Ford Mobility;

11:30 a.m.  
Networking Lunch in Exhibit

1:00 p.m.  Panel  
Panel Discussion: Next Generation Infrastructure

The growing prevalence of electrified and connected vehicles as well as pressure to increase transportation safety is providing the necessity for significant infrastructure development. New technologies enabling network and vehicle communications promise greater opportunities for improved safety, efficiency, and utilization. However, there will also be greater demand on the country’s power grid and utility network. This session will address the balance between these new developments and the challenges that provides to the power system.

<a href="https://www.sae.org/servlets/techSession?REQUEST_TYPE=AUTHOR_BIO &saetkn=ERPTop4gdC&PROD_CD=19IIM-0225&Presentation_Title=Learn+more+about+the+Panel+Participants&SESSION_NUM=">Learn more about the Panel Participants</a>

Moderators - Anne O’Neil, Anne O’Neil Consultants LLC  
Panelists - Rex Alexander, Vertical Flight Society; Mark Berndt, AEP OHIO; TJ Costello, Cisco Systems Inc.; Barry Einsig, CAVita; Kristina Mlakar, CUTRIC; Jason Zogg, Ford Motor Co.;
Thursday, October 31

Engine and Materials Convergence

Research and development of advanced materials in engine designs is essential for lowering costs, increasing the recyclability of parts, and maximizing the fuel economy benefits. This symposium will specifically examine material selection for coatings, aftertreatment components, and boosted and downsized engines.

Chairpersons - Graham Conway, Southwest Research Institute; James Haynes, Oak Ridge National Laboratory; Mark Hoffman, Auburn Univ.; Michael Kocsis, Christopher Suhocki, Southwest Research Institute

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<tr>
<th>Time</th>
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| 8:30 a.m.| ORAL ONLY | Keynote: Materials Challenges and Opportunities in 21st Century Heavy Duty Engines
Stephen Ciatti, PACCAR Technical Center |
| 9:00 a.m.| ORAL ONLY | Keynote Presentation: The Convergence of Material Science and Advanced Engines
Jerry L. Gibbs, US Government |
| 9:30 a.m.|           | Networking Break in Exhibit |
| 10:00 a.m.| ORAL ONLY | Thermal barrier coatings - just a bunch of hot air?
Ashwin Salvi, Achates Power Inc. |
10:30 a.m.  ORAL ONLY  Design & Implementation of In-Cylinder Temperature-Swing Coatings

In the pursuit of higher efficiency engines, the reduction of heat losses in-cylinder can be quite appealing. Historically, these attempts have been hampered by other unintended loss mechanisms, material processing limitations and durability concerns. However, new materials, techniques, and a better understanding of the requirements of a temperature-swing coating for use in SI and CI engines has enabled advances in this field. Low heat capacity and low thermal conductivity engineered coatings are being designed and tested on various engine components to achieve cost-effective efficiency improvements for any internal combustion engine.

Peter Andruskiewicz, General Motors Global R & D

11:00 a.m.  ORAL ONLY  Designing Thin "Temperature Swing" Coatings to Improve the Thermal and Combustion Efficiencies of Kinetically Controlled Combustion

The kinetically-driven nature of gasoline compression ignition (GCI) means that changes in wall temperature directly affect the rate and completeness of combustion. The application of thin Thermal Barrier Coatings (TBCs) to the combustion chamber enhances the wall temperature dynamics, strategically reducing combustion heat transfer and avoiding intake charge heating. Durable, low conductivity TBCs were created using low-to-moderate pore fractions and structured porosity. These coatings experimentally exhibited gains in GCI combustion and indicated thermal efficiencies of up to 1.5% and 5.9% respectively. Additionally, fuel interactions with the TBC surface roughness and open porosity were investigated and quantified.

Thomas Powell, Oak Ridge National Laboratory

11:30 a.m.  Networking Lunch in Exhibit

1:00 p.m.  ORAL ONLY  Deposit Reduction in SCR Aftertreatment Systems by Chemical Modification of Urea-Water Solution

As diesel engine efficiency increases and NOX regulation limits decrease, more emphasis is placed on mitigation of NOX emissions at low exhaust gas temperatures. In order to accomplish low-temperature NOX reduction, urea-water solution (UWS) must be dosed at conditions amenable to significant accumulation of deposits within the aftertreatment system. Two known methods of attenuating deposit accumulation include: incorporation of a heterogenous hydrolysis catalyst downstream of the UWS injector, and addition of surfactant directly to the fluid. The presented research combines ideas from the two methodologies and demonstrates the reduction in deposit mass that can be achieved from incorporation of both a surfactant and homogeneous hydrolysis catalyst directly into the UWS.

Ryan Hartley, Southwest Research Institute

1:30 p.m.  ORAL ONLY  System Level Approaches for Future Light and Heavy Duty Diesel Regulations

As governments and regulatory agencies continue discussions over the next phase of diesel emissions stringency, vehicle manufacturers have already initiated development for the next generation of emissions abatement technology. While ongoing efforts are focused on low temperature catalyst technology and durability, aftertreatment control strategies are also evolving to minimize the fuel consumption impact. In the light duty segment, vehicle hybridization has created opportunities to advance emissions reduction performance utilizing higher voltage systems. This discussion will highlight the systems level approach and associated solutions to achieve emissions reduction for light and heavy duty diesel applications.

Bryan A. Zavala, Southwest Research Institute
Extended Reality (XR) which comprises Augmented Reality (AR), Virtual Reality (VR) and Mixed Reality (MR) enables users to accomplish important functions such as product and process design and training at a fraction of the cost with even greater success than traditional methods when employed properly. These benefits directly correlate to increased quality and efficiency. These impressive capabilities make XR an invaluable tool for manufacturers across all industries. This session will focus on XR within the automotive industry, as XR experts will provide an understanding of its current state of adoption and utilization as well as their perspective on its future direction using business cases and lessons learned.

David Pollock, Mirari

Planned by Engine and Materials Convergence Organizers / Innovations in Mobility Steering Committee

Thursday, October 31

The Current and Future State of XR in the Automotive Industry

Session Code: IIM103

Room Legacy Ballroom IV

2:00 p.m. ORAL ONLY Gasoline Particulate Filter Development and System Integration

Gasoline particulate filters have been successfully commercialized for applications in the European and Chinese markets to meet the particulate number standards. New development areas for the next generation of GPF products will be discussed in this presentation. The main focuses have been on the improvement of the primary performance characteristics and the reduction in the filter pressure drop while achieving fresh high filtration efficiencies up to 95%. Approaches to integration of the GPF into the exhaust aftertreatment system will also be reviewed.

Louise Arnold, Johnson Matthey Inc.

2:30 p.m. Networking Break in Exhibit

3:00 p.m. ORAL ONLY Engine Block/Head and Exhaust Manifold of Eco-boost Engine

Mei Li, Ford Motor Company

3:30 p.m. ORAL ONLY Modern Valvetrains: Deploying High-performance Materials in High-volume Components

Challenges facing the OEM supply chain combine the need to keep costs competitive while addressing the increasing demands of the modern high-performance combustion cycle. Engine valves are a component that must perform a critical role in achieving efficiency targets while being exposed to a uniquely complex and increasingly more challenging dynamic high-temperature environment. A delicate balance exists between market competitiveness and technology development that addresses the next generation of valve materials in optimized combustion engine architectures.

Mark Carroll, Federal-Mogul Corp.

4:00 p.m. ORAL ONLY Development of Lightweight Engine for Heavy Duty Applications

Cummins Inc. had worked with many government funding agents in the past in developing lightweight diesel engines for military and commercial applications. By replacing cast iron cylinder head and block with an aluminum alloy, a 25% weight saving was achieved without sacrificing the horsepower. Significant amount of work was spent in evaluating right alloy and manufacturing process for the applications. Extensive analysis work, component testing, and engine testing were conducted to validate the designs. This talk will review the story about the historic Cummins aluminum engine, and how the materials and manufacturing lessons learned enabled the more recent ISV5.0 engines.

Yong-Ching Chen, Cummins Inc.
8:30 a.m.  ORAL ONLY  Keynote Presentation: Digital Experience - Exploring Real-time and XR Throughout the Product Lifecycle
This presentation will share effective applications of real-time technology and XR (EXtended Reality, AR, VR, MR) from product development to the customer experience.

Greg Melling, Unity Technologies

9:30 a.m.  Networking Break in Exhibit

10:00 a.m.  ORAL ONLY  Assisted Reality Solutions for Industry 4.0 â€“ It can never be an Island
Michael Frans, T-Systems North America Inc.

10:30 a.m.  ORAL ONLY  Bosch Technical Training Supported by Augmented Reality
Learn how Bosch is using Augmented Reality to improve training for service technicians. This presentation will provide an overview of the Bosch Common Augmented Reality platform (CAP) that is used to create and deliver training content to Microsoft HoloLens, Windows Tablet, iOS and Android devices along with specific examples where Augmented Reality has been utilized in a training environment to improve student engagement and knowledge retention.

Phil LaFond, Bosch Automotive Service Solutions LLC

11:00 a.m.  ORAL ONLY  Open Discussion
The open discussion is a facilitated dialogue between session speakers and attendees regarding a number of critical issues pertaining to extended reality itself or the implementation and application of the technology in automotive manufacturing.

11:30 a.m.  Networking Lunch in Exhibit

1:00 p.m.  ORAL ONLY  Real World Examples of MR in Production Facilities
We will explore how the professional world has brought the concepts of augmented reality, mixed reality and virtual reality to life and in daily practice. From the design and PLM process using MR to help visualize and interact with design before even prototyping is done. To the factory floor where expertise assistance is a touch away with MR providing collaborative experiences to reduce the necessity of experts on site all the time. And the future looking use cases of MR and VR to help redesign factories before they are built or even optimize those that are in existence already. We will discuss real world examples of MR in production facilities today and how they are empowering employees to achieve more.

Darren Coil, Microsoft Corporation

1:30 p.m.  ORAL ONLY  Unique Challenges with Next Generation EV’s and Autonomous Vehicles
We will present an overview of the compelling capabilities of remote training as opposed to localized training for dealing with new challenges in regards to instructing individuals in safety practices that are unique to the next generation EV’s and autonomous vehicles. MR and VR allow for literally in-depth training with an unprecedented ability to convey a higher level of comprehension and retention than traditional methodologies. A live demonstration of a remote instructional scenario will be provided for a handful of conference attendees in full VR regalia with a large live video feed simultaneously providing an eagle eyes view of the virtual environment for dealing with hazardous scenarios that would otherwise be dangerous for student subjects. Attendees will interact in real time with other live individuals in a remote location in full VR immersion.

Philip Little, SYNTHACON; Erica Schaffel, Marco Maceri, PIXO VR
Cybersecurity

Session Code: IIM415
Room Legacy Ballroom V

Cyber attacks and breaches become a greater threat as vehicle connectivity and the levels of vehicle automation increase. Industry experts from the Auto ISAC, automotive OEMs, suppliers, infrastructure, and security firms share the latest cybersecurity measures, standards, and regulations being discussed, developed, and deployed to ensure safe and secure transportation.

Chairpersons - Oliver Spiess, ZF

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<tr>
<td>2:00 p.m.</td>
<td>ORAL ONLY</td>
<td><strong>Spatial Computing in the Automotive Enterprise: How Extended Reality Is Transforming The Way We Work</strong></td>
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<td>Come learn how spatial computing is helping businesses to: improve the way they design and develop their products; train employees more effectively and offer guided work instructions; enable collaborative experiences in 3D - even where workers are distributed globally.</td>
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<td>2:30 p.m.</td>
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<td><strong>Networking Break in Exhibit</strong></td>
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<td>3:00 p.m.</td>
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<td><strong>Industry 4.0 - Smart Manufacturing and Smarter Business - The Automotive Industry through the Lens of XR</strong></td>
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<td>Brad Waid, Educator, Emerging Technology Leader, Global Influencer</td>
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<td>3:30 p.m.</td>
<td>Panel</td>
<td><strong>Panel Discussion: XR in the Automotive Industry</strong></td>
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<td><strong>Moderators</strong> - Elizabeth S. Baron, Silverdraft Supercomputing, LLC</td>
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<td><strong>Panelists</strong> - Darren Coil, Microsoft Corporation; David Golembiewski, Magic Leap Co.; Randy Nunez, Ford Motor Co., Ltd.; Brad Waid, Educator, Emerging Technology Leader, Global Influencer;</td>
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Planned by Extended Reality Committee / Innovations in Mobility Steering Committee

Thursday, October 31

Cybersecurity

Session Code: IIM415
Room Legacy Ballroom V

Cyber attacks and breaches become a greater threat as vehicle connectivity and the levels of vehicle automation increase. Industry experts from the Auto ISAC, automotive OEMs, suppliers, infrastructure, and security firms share the latest cybersecurity measures, standards, and regulations being discussed, developed, and deployed to ensure safe and secure transportation.

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<td>8:30 a.m.</td>
<td>ORAL ONLY</td>
<td><strong>A Measured Approach to Increasing Complexity</strong></td>
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<td>The automotive industry is experiencing a major transformation with technological changes and business shifts happening at breakneck speed. Shifting business dynamics and technology enhancements come with potential risk of cybersecurity attacks that could impact the individual, the company, the brand, and the entire automotive industry. Many know the challenges that already threaten the security of todayâ€™s connected vehicle, but whatâ€™s next and are we ready? For each new frontier for the automotive industry, such as electric vehicles, smart infrastructure, and autonomous vehicles, it is necessary to collaborate, build alliances, and share information and perspectives in order to ensure the safe and harmonious integration between vehicles and other systems. The Auto-ISAC provides the opportunity for the automotive industry to collaborate on these issues.</td>
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<td>Faye Francy, Auto-ISAC</td>
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Vehicle-level Cybersecurity Considerations for the Increasingly Connected, Automated, and AI-informed Mobility Environment

Rapid advances with respect to connectivity and automation within the mobility sector coupled with the expansion and adoption of machine learning techniques across an ever increasing range of disciplines has led to a significant expansion in the types, opportunities, scale, and degree of sophistication that should be considered for vehicle and mobility-system cybersecurity evaluation. While technology-specific attack opportunities and vulnerabilities begin to emerge across the technology spectrum from basic automation features such as Adaptive Cruise Control and Lane-following to fully automated vehicles dispatched by a centralized controller, it is equally important consider the ease of implementation, possible system responses, and existing robustness to these emerging attacks when prioritizing the severity and risks associated with these new issues relative to existing cybersecurity concerns. Additionally, machine-learning techniques, specifically deep-learning approaches, appear to offer opportunities not only to better exploit certain vulnerabilities, but also to defend against these attacks in a more robust fashion. This presentation seeks to discuss on-going multi-disciplinary research examining emerging cybersecurity concepts, trends, and opportunities within the mobility space, with a specific focus on highlighted vehicle-level concepts and considerations. This work also seeks to highlight how cybersecurity risks may also impact the implementation of other connected/automated vehicle concepts including methods to improve vehicle efficiency via connectivity and automation.

Eric Rask, Argonne National Laboratory

From Start-up to a Tier-1, a Journey in Automotive Cybersecurity

The challenges of cybersecurity are new to the automotive domain, and are more and more necessary with the introduction of vehicle connectivity and advanced features. In a domain pushed by IT industry standards and best practices, which are not exactly tailored to automotive needs, start-ups and other technology innovation companies are suggesting solutions and then forced to quickly adapt to the unique industry challenges. In this presentation we will explore the cybersecurity challenges in modern mobility, possible solutions and the start-up gone Tier-1 perspective.

Liron Kaneti, Dustin Mysen, Argus Cyber Security, Ltd.

A Security-aware Container-based Architecture for Connected Vehicles

Cyber-attack is a growing concern in connected vehicles because of the possibility of accessing, changing, or destroying sensitive information. On the other hand, many existing security protocols are infeasible to apply because of high resource consumption. Containers are a method of providing added security through virtualisation. Advantages of containers include increasing utilisation of bare-metal resources, and adding security isolation properties to various types of systems. These advantages make containers well-suited for the connected vehicle software. This presentation describes a specific consideration in the development of a container architecture pattern for embedded systems, aimed at enforcing multiple modes of application functionality.

Akramul Azim, Ontario Tech. University
11:00 a.m.      ORAL ONLY  Intelligent Intrusion Detection System for Autonomous Vehicles

The use of autonomous vehicles (AVs) is a promising technology in Intelligent Transportation Systems (ITSs) to improve safety and driving efficiency. Vehicle-to-everything (V2X) technology enables communication among vehicles and other infrastructures. However, AVs and Internet of Vehicles (IoV) are vulnerable to different types of cyber-attacks such as denial of service (DoS), spoofing, sniffing, fuzzy and brute-force attacks. In this talk, we will discuss these attacks in more details and propose an intelligent intrusion detection system that uses tree-structure machine learning models to provide protection for both the intra-vehicle and external communications. The preliminary results from the implementation of the proposed intrusion detection system on standard data sets indicate that the system has the ability to identify various cyber-attacks in the AV networks. On the other hand, the proposed ensemble learning and feature selection approaches enable the proposed system to achieve high detection rate and low computational cost simultaneously. Furthermore, this talk presents some of the optimization techniques currently being investigated to tune the hyper-parameters of the proposed machine learning algorithms. This includes techniques such as Bayesian optimization, genetic algorithms (GA), and particle swarm optimization (PSO) techniques.

Abdallah Shami, Western Univ.

11:30 a.m.  Networking Lunch in Exhibit

1:00 p.m.  Panel  Panel Discussion: Cybersecurity for ADAS to Automated Vehicles

The potential for Cyberattacks become a greater threat as vehicle connectivity and the levels of vehicle automation increase. Our panelist of experts from the Auto ISAC, automotive OEMs, suppliers, infrastructure, and security firms share their perspective on latest cybersecurity measures, standards, and regulations being discussed, developed, and deployed to ensure safe and secure transportation.

Moderators - Andre Weimerskirch, Lear Corporation
Panelists - Lisa Boran, Ford Motor Company; Faye Francy, Auto-ISAC; Brian Murray, ZF Group;

Planned by ADAS to Automated Driving Organizing Committee / Innovations in Mobility Steering Committee

Thursday, October 31

Net-Zero Carbon Fuels Technology (Part 2 of 2)

Session Code: IIM307

Session Time: ALL DAY

This meeting will provide a forum to discuss emerging net-zero carbon fuels technologies and the potential for a sustainable transportation future. The scope will include electro-fuels, bio-fuels, and other fuel technologies with the potential for net-zero life-cycle carbon emissions in applications spanning all transportation sectors - on/off-road, aviation, marine, and rail. Sessions will address fuel production technologies, combustion and emissions performance, and life-cycle/techno-economic analyses of net-zero carbon systems, with the goal of understanding near- and long-term pathways to implementation, and potential impacts on transportation and the U.S. energy infrastructure.

Chairpersons - John Farrell, National Renewable Energy Laboratory; Michelle Kidder, Robert Wagner, Oak Ridge National Laboratory

Time  Paper No.  Title
8:30 a.m.   ORAL ONLY   **Keynote Presentation: Opportunities to Improve Efficiency in Transportation through Advanced Technology**

Various projections suggest the worldwide demand for transport fuels will significantly increase in the coming decades. Governments worldwide are simultaneously exerting pressure to reduce the environmental impact of the transportation sector. With such challenges, the energy and auto industries are looking for technological solutions to meet both regulators and customer demands.

Multiple technologies and options are available to improve the efficiency of the transportation fleet. Improvements to fuel production can be found in upstream practices and crude choices along with refinery operations. Vehicle technologies beyond electrification are an attractive economic option to meet future regulations. Advanced combustion regimes can bring together the oil and auto industries to co-design fuels and engines to achieve lower life-cycle greenhouse gas (GHG) emissions. Advanced lubricants have the potential to provide among the highest value in fuel economy improvements. Connected and Automated Vehicles (CAVs) may radically disrupt the current on-road transportation fleet and could either reduce or increase future fuel demand and efficiency.

The presentation will discuss several technology options for future transportation needs including: crude oil production, refinery configurations, vehicle fuel and engine opportunities, and on-board carbon capture.

Steven Przesmitzki, Aramco Research Center

9:30 a.m.   ORAL ONLY   **Networking Break in Exhibit**

10:00 a.m.   ORAL ONLY   **Sustainable Aviation Fuel**

Unlike light duty and medium duty vehicles there is little opportunity to electrify commercial aircraft. However, it is possible to produce “net-zero carbon fuel” by using waste carbon – industrial gasses rich in CO or wet sludges from waste water and manures – coupled with clean electrons in new processes. This talk will detail work within the Bioproducts Institute, a joint venture between Pacific Northwest National Laboratory and Washington State University. The talk will cover the critical fuel properties of jet fuel, chemical families to achieve those fuel properties, and conversion processes that can transform carbon waste into sustainable aviation fuel.

John Holladay, Pacific Northwest National Laboratory

10:30 a.m.   ORAL ONLY   **Perspectives on Achieving Net-Zero-Carbon Fuels for the Marine Sector**

This presentation will introduce and review that strategies being considered for achieving carbon neutrality and zero emissions in marine vessels. The marine sector has unique challenges and opportunities as it moves towards more energy efficient operation and reduced emissions. An introduction and background are important to understand the complexity and economics that drive marine transport. Case studies and ongoing research efforts will be highlighted and special emphasis will be placed on the cargo vessels used to move goods worldwide.

Michael Kass, Oakridge National Laboratory; Thomas N. Thompson, Us Maritime Administration (MARAD)

11:00 a.m.   Panel   **Panel Discussion: Net-Zero Carbon Fuels Technology**

**Moderators** - John Farrell, National Renewable Energy Laboratory
**Panelists** - Johnathan Holladay, Pacific Northwest National Laboratory; Michael Kass, Oak Ridge National Laboratory; Steven Przesmitzki, Aramco Research Center;
11:30 a.m. Networking Lunch in Exhibit

1:00 p.m. ORAL ONLY Keynote Presentation: DOE Co-Optimization of Engines and Fuels
Kevin Stork, US Dept. of Energy

1:30 p.m. ORAL ONLY Top 10 Bio-derived Blendstocks to Improve Turbocharged Gasoline Engine Efficiency
More efficient engines enabled by better fuels derived from biomass could increase the fuel economy of the light duty fleet by 10% over current technology and planned developments, with lower life-cycle greenhouse gas emissions. This presentation describes the identification of biofuel candidates, via a tiered selection process, with the potential to increase the efficiency of turbocharged engines on the basis of advantageous fuel properties. Analysis of potential environmental impacts of the biofuel candidates and future research needs will be described.
Daniel J. Gaspar, Pacific Northwest National Laboratory

2:00 p.m. ORAL ONLY Performance-Advantaged Ether Diesel Bioblendstocks by a priori Design
To address the growing demand for diesel fuel, biofuels provide a means to meet this energy need with renewable carbon. This talk will highlight recent efforts to develop a transformative approach for producing ether diesel bioblendstocks with reduced sooting and improved performance, while accounting for biofuel conversion economics and associated greenhouse gas emissions. We apply emerging fuel property prediction tools to aid in selecting target diesel molecules and conversion pathways, and we validate promising bioblendstocks by addressing the considerations of health and safety, fuel performance, infrastructure compatibility, and techno-economic and life-cycle analysis.
Derek Vardon, National Renewable Energy Laboratory

2:30 p.m. Networking Break in Exhibit

3:00 p.m. ORAL ONLY Effects of Fuel Composition on Emissions and Emissions Control Catalyst Performance
Significant reductions in CO2 emissions from the transportation sector will require a shift away from petroleum-derived fuels. While biomass and renewable electricity provide potential pathways to lower CO2 fuels, the fuels from these sources may have significantly different chemical compositions compared to the petroleum-derived hydrocarbons found in market fuels. Engines running on low CO2 fuels must still comply with emissions regulations to achieve commercialization, and very little work has been published on the impacts of novel fuel constituents on the performance of emissions control systems. This presentation will summarize recent investigations into the catalytic reactivity of biomass-derived and petroleum-derived fuel components.
Sreshtha Sinha Majumdar, Oak Ridge National Laboratory

3:30 p.m. ORAL ONLY Co-Optimized Fuel and Multi-Mode GCI Engine
In collaboration with the US Department of Energy (DOE), HATCI, MTU and Phillips 66 have partnered to develop a Co-optimized Fuel and GCI engine to attain a minimum 15% vehicle fuel economy reduction over an FTP75 while meeting LEVIII emission targets.

To achieve this, HATCI has proposed the Co-Optima GCI engine concept based off a 2.2L I4 current production engine. Operation over several combustion modes (SI, LTC, PPCI, MCCI) depending on the fuel will be tested and co-optimized using CFD modeling.
The overall technical approach, enablers and strategy as well as a project update for the work completed in 2019 and future plans will be discussed.
Philip Zoldak, Hyundai Motor Group
Health Ready Components (IVHM)

Session Code: IIM416

Room Legacy Ballroom VII Session Time: 8:30 a.m.

Health-ready components and systems (HRCS) have been augmented to monitor and report their own condition. We believe that HRCS, paired with Integrated Vehicle Health Management (IVHM) technology, has the potential to provide significant advantages in terms of product performance, availability, and safety.

Throughout the history of the automobile industry, OEMs have designed increasingly reliable products built on top of increasingly reliable components and subsystems. The introduction of electronics and computer-based control resulted in the need for more sophisticated diagnostic systems because traditional maintenance approaches were no longer adequate.

In the past, we were primarily operating in a diagnosis paradigm which focused on detection and identification of the root cause(s) once a failure had occurred. In the new IVHM or prognosis paradigm, health monitoring and tracking of system performance can prevent unpredicted degradation and in-field failures. Health-ready components can produce a coherent picture of the health status of the vehicle, thereby enabling the transition to prognostic health management.

Chairpersons - Peter Grau, SAE-ITC

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<tr>
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<td>ORAL ONLY</td>
<td>Prognostics &amp; Vehicle Health Management in the Automotive Industry</td>
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<td>Prognostics and Vehicle Health Management (VHM) technology has begun to make significant inroads into the automotive industry. It has been successfully deployed in vehicle manufacturing and more recently in the vehicles themselves. VHM offers a multitude of potential game changing benefits including enhanced availability, reduced costs, improved customer experience, and increased safety. The need for VHM will accelerate as vehicles become more sophisticated with greater dependence on advanced sensors and communication. Emerging standards are expected to help mitigate some of the costs and risks inherent in deploying VHM.</td>
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<td>9:00 a.m.</td>
<td>ORAL ONLY</td>
<td>Predictive Maintenance in Defense and Smart Manufacturing</td>
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<td>The development of modern-day automotive and commercial ground vehicles would not be possible without the application of commercial standards that are used in all facets of platform and platform subsystem design. This development relies heavily on the use of numerous commercial standards, which have been developed in a joint effort between industry and standards making bodies. The same holds true when it comes to transforming traditional maintenance practices to Predictive Maintenance in the Defense and Smart Manufacturing sectors. In both sectors “health-ready” assets facilitate the transformation and implementation of this new practice. This presentation provides a view of the current and emerging initiatives to implement the best practices prescribed in SAE JA6268 in Defense and Smart Manufacturing.</td>
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<td>Networking Break in Exhibit</td>
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10:00 a.m.  ORAL ONLY  
**Condition Based Maintenance Plus (CBM+) in Army Ground Vehicles**

Synchronizing Condition Based Maintenance Plus (CBM+) efforts across the Army Enterprise involves the execution of several interrelated activities; CBM+ activities for data collection on-platform, data offload, data transmission, and data analysis to demonstrate value for the Warfighter and other process stakeholders. This presentation provides an overview of key technology development and demonstration initiatives related to the implementation of CBM+ across the Army ground vehicle sustainment enterprise.

Jason Duncan, US Army TACOM LCMC

10:30 a.m.  ORAL ONLY  
**A System Health Record Platform- Enabling Predictive Maintenance in Surface Vehicles**

Enabling Predictive Maintenance in Surface Vehicles requires automated collection, transformation & characterization of health-sate data generated by the vehicle's health-ready subsystems. Every Commercial Vehicle comes equipped with an on-board diagnostics (OBD) system which provides data in a standardized format for immediate accessibility and use. This data is primarily used by the industry for post failure analysis and reliability improvements, providing minimal value at the pint of maintenance. Continuously monitoring diagnostic data on-board a surface vehicle will produce the necessary historical data to produce pre-failure analysis for predictive maintenance and application of Artificial Intelligence (AI) and Machine Learning (ML) algorithms. This presentation provides an overview of the System Health Record (SHR<sup>TM</sup>)-to enable condition-based maintenance (CBM)/predictive maintenance in the surface vehicle industry.

Carlos Hernandez, Global Strategic Solutions LLC

11:00 a.m.  ORAL ONLY  
**Commercial Vehicle Fleet and Vehicle Integrated Health Management**

Commercial Vehicle Fleets have a vested interested in the adoption of IVHM technology and adopting the developing strategies and processes contained in SAE JA6268: Design and Run-Time Information Exchange for Health-Ready Components.

Wally Stegall, The Morey Corporation

11:30 a.m.  Networking Lunch in Exhibit

1:00 p.m.  ORAL ONLY  
**A Blockchain-Backed Registry for Health-Ready Components & Systems**

What is blockchain? This presentation provides a ground-level introduction to the technology and discusses some examples of how it is being used in aerospace and in recording information about qualifications and other aspects of parts that may not be clearly evident by non-destructive inspection. It concludes by presenting a brand-new blockchain-backed registry of component capabilities and endorsements from integrators indicating availability of more detailed technical information, intended to promote the more rapid development of a market in which health-ready features (as discussed in SAE’s JA6268 standard) are valued and easier to find.

Ben Towne, SAE International
Thursday, October 31

**Range Extenders for EVs**

**Session Code:** IIM308

**Room Legacy Ballroom VIII**

The Range Extenders for Electric Vehicles symposium will be a showcase of the current state-of-the-art for powertrain and fuel opportunities and challenges, policy and regulation driving designs, infrastructure, and the advances in range-extender technologies. This event will focus on the specific role of range extenders can have and the dependency on the different potential applications and the state of technologies such as energy storage, fueling infrastructure, etc. Sessions will include discussions of range extender technologies and the use of electrification to enable new or unconventional propulsion systems, and a perspective on the future of range extension technologies.

**Chairpersons:** Hugh Blaxill, Mahle Powertrain, Ltd.; Julian R. Sherborne, JRA Mechanical Engineering LLC; Scott Curran, Oak Ridge National Laboratory

**Time** | **Paper No.** | **Title**
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1:30 p.m. | ORAL ONLY | **A Supplier View of JA6268 and the SAE HRCS Consortium**

This presentation will show how Garrett is applying the principles of JA6268 to its products and services. Specific examples will show Garrett's application of JA6268 principles in its role as a supplier of turbochargers for the ground vehicles and in its role as a supplier of software and services for Advanced Controls, Integrated Vehicle Health Management and Cyber Security. In each case, the paper will discuss how these activities address the need for machine interpretable design data and the associated automation of the usage of run-time data. The presentation will conclude with a discussion of how Garrett intends to engage with the SAE HRCS Consortium and its key near-term initiatives.

Hugh Blaxill, Mahle Powertrain, Ltd.; Julian R. Sherborne, JRA Mechanical Engineering LLC; Scott Curran, Oak Ridge National Laboratory

2:00 p.m. | ORAL ONLY | **The new HRCS Consortium & Vehicle Health Management**

IVHM technology has the potential to provide significant benefits in terms of enhanced performance, improved operational efficiency, and increased safety. This technology, enabled by health ready components and systems, is already being implemented in aerospace and other industrial sectors. This presentation will review some of these developments and outline the newly formed SAE-ITC Health-Ready Components and Systems Consortium. We believe the opportunity exists to proactively accelerate IVHM and avoid the unnecessary proliferation of different approaches which would be costly and counterproductive. The HRCS Consortium will provide an industry neutral forum for developing strategies and processes for the recommended practices contained in SAE JA6268TM: Design and Run-Time Information Exchange for Health-Ready Components.

Peter H. Grau, SAE-ITC

**Propulsion engineers have always balanced requirements between the vehicle needs/wants and propulsions capabilities as well as cost drivers. With the advent of electrification propulsion engineers have a new degree of freedom to balance the overall propulsion system. We call this "using electrification to balance on ICE." We will discuss various architectures and sizing concepts to provocatively illustrate the new system tradeoffs and capabilities.**

Joel M. Maguire, BorgWarner Inc.
Student & Young Professionals Technical Paper Competition Winner: Feasibility of Multiple Piston Motion Control Approaches in a Free Piston Engine Generator (Presentation of SAE Paper 2019-01-2599)

The control and design optimization of a Free Piston Engine Generator (FPEG) has been found to be difficult as each independent variable changes the piston dynamics with respect to time. These dynamics, in turn, alter the generator and engine response to other governing variables. As a result, the FPEG system requires an energy balance control algorithm such that the cumulative energy delivered by the engine is equal to the cumulative energy taken by the generator for stable operation. In a conventional crankshaft engine, this energy balance control is similar to the use of a governor and a flywheel to control the rotational speed. In this presentation, the WVUâ€™s FPEG research team will share the model-based learnings of different piston motion control strategies with different process variables namely piston position, dead center clearance set points, trapped compression ratio and maximum velocity. The learnings from the study are used as the pathway for improving and optimizing the experimental FPEG design at WVU.

Mehar Bade, West Virginia University

Networking Break in Exhibit

Opportunities and Challenges with Internal Combustion Engine Range Extenders

Range extenders, especially via internal combustion engines, are an effective solution for mitigating some of the common challenges with battery electric vehicles. It provides the opportunities to reduce battery size and preserve battery life, and allows for normal vehicle operation in extreme climate or in regions without charging infrastructure. However, there are also challenges with the proper sizing and controls of range extender for drivability, NVH and emissions. In this presentation, Cummins will share the learnings of these aspects from a DOE funded range extender EV project.

Ke Li, Cummins Inc.

MAHLE Modular Powertrain - An insight into the development of REx technology and its wider hybrid application potential

MAHLE Powertrain has historically demonstrated to the industry its Powertrain technology capability via demonstrator engines. This includes the MAHLE REx engine developed initially in 2010. This project focussed on a low cost and compact design and was developed into a demonstrator vehicle. A brief summary of this phase of REx development will be included. Subsequently MAHLE has develop a Modular Powertrain concept based in part on the original REx concept. An increased focus on fuel economy and modularity enables the engine to be used in multiple applications of hybrid vehicle. This new concept will be described in detail.

Hugh Blaxill, Mahle Powertrain, Ltd.
When freed from the tyranny of having to operate across a full speed-load operating map, the Wankel engine has some interesting characteristics which could be of benefit in range extender applications. Furthermore, with some modification its attributes can be further improved, to the benefit of vehicle application.

The presentation will discuss some of these technologies and research into them at The University of Bath as part of the ADAPT project. Results from testing a dedicated Wankel expander are included and the concept of a “zero overlap” peripherally-ported engine is introduced, which may be very beneficially supported by turbocompounding.

James Turner, University Of Bath

Deltaâ€™s Catalytic Generator â€“ The Perfect Range Extender

Starting from a clean sheet of paper, Delta has developed a lightweight and compact 35kW generator that is ideally suited to use as a range extender for passenger cars and small commercial vehicles. The presentation will describe Deltaâ€™s perspective on the role that range-extended EVs can play in dramatically reducing CO2 and other emissions whilst also offering OEMs a vehicle architecture that is more attractive (to them and their customers) than BEV. The presentation will also provide an overview of the catalytic generator, explaining why it is such a good fit for this purpose.

Nicholas Carpenter, Delta Motorsports Ltd.

Load-leveling applications, also called range-extended applications, open up the design space for electrified vehicle (EV) applications where EV mode operation needs to be combined with extended overall operation and quick refueling. One option is to use a fuel cell system (FCS) as the on-board generator, since the FCS directly and efficiently converts chemical energy in the fuel to electrical energy for the application. In this presentation, AVL describes vehicle configurations and some examples of the FCS-electric load-leveling concept.

John Kasab, AVL Powertrain Engineering Inc.; Michael Reissig, Falko Berg, AVL Powertrain GmbH

Range extender engines, not being constrained by wide load and transient response requirements, open up a number of possibilities for interesting engine development. Often novel engine architectures require a whole new tool-chain to support the control. This talk with focus on a flexible tool chain for electrified engines with a focus on one of the most challenging engine technologies to control, the free-piston engine.

Matthew Viele, Vieletech Inc.

Panel Discussion: Future of Range Extenders

Panelists - Scott Curran, Oak Ridge National Laboratory; Hugh Blaxill, Mahle Powertrain, Ltd.; John Kasab, AVL; Ke Li, Cummins Inc.; Joel Maguire, BorgWarner Inc.; James Turner, University Of Bath;

Planned by Range Extenders for EVs Organizers / Innovations in Mobility Steering Committee