Innovations in Mobility
Technical Session Schedule
As of 09/09/2019 07:45 pm

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; Hong Jiang, Ford Motor Company; Jim Borgerson, General Motors; Scott Halley, Lubrizol Corp.

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<th>Time</th>
<th>Paper No.</th>
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<tr>
<td>8:30 a.m.</td>
<td>ORAL ONLY</td>
<td>Keynote Presentation: Mobility and the Grid: A Vision for a Symbiotic Future</td>
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<td>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</td>
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<td>Networking Break in Exhibit</td>
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<td>Ford (Invited)</td>
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<td>10:30 a.m.</td>
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<td>New Allison 10 speed Transmission for Chevrolet &amp; GMC</td>
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<td>The new Allison 10 speed Transmission will be paired with the Duramax 6.6L engine in the new 2020 Chevrolet &amp; 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</td>
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<td>Networking Break in Exhibit</td>
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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.

3:30 p.m.    ORAL ONLY    Does DCT still have a chance in NA? As a P2 Hybrid it has!

Hybridization of powertrains and (automatic) transmissions is widely recognized as the pivot in achieving CAFC and CO2 compliancy in most large regions. Particularly also in NA, GHG and CAFC improvement targets for the coming decade are amongst the most stringent globally. In parallel, there is also a trend of ever increasing popularity of light trucks and SUVs at the cost of the car sedan. As a Tier1 transmission manufacturer, Punch Powertrain is moving towards transmission developments with intrinsic hybridization and higher system torque. Hybridization comes in many flavors starting from mild hybrid 48V towards high voltage plug-in hybrid solutions.

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.

The innovative gear structure in DT2 therefor leaves enough room to integrate the P2 hybrid electric motor in an off-axis fashion. This strong electric motor (~100kW) in the DT2 solution enables further smoothening by electric launch capabilities surpassing the characteristics of the already smooth torque converter launching behavior. Furthermore, it helps to achieve proper towing capabilities and establishes a broad max. torque plateau over the entire engine speed range. The DT2 hybrid transmission is identical for both HEV as well as PHEV implementations and as such it is very flexible in continuous tailoring of the vehicle electrification mix to required CO2 fleet compliancy. The same DT2 hybrid DCT is also available as a 48V mild hybrid system which is an interesting solution for lower duty sedan cars.

DCTs are known for its high efficiency contributing further to the fuel saving and zero emission driving range in case of PHEV implementation. Also by comparison with other full hybrid solutions, we show evidence for low cost vs. high capabilities of the DT2 hybrid solution.

Alexander Serrarens, Punch Powertrain Nederland BV

4:00 p.m.    ORAL ONLY    Presentation

Robert S. Smyczynski, FCA US LLC
Automated and autonomous vehicles promise 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>8:30 a.m.</td>
<td>ORAL ONLY</td>
<td><strong>Keynote Presentation: Advanced Driver Assistance Systems: The ADAS Road to AV Reality</strong>&lt;br&gt;Jill Sciarappo, Intel</td>
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<td>1:00 p.m.</td>
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<td><strong>New Mobility in Cities - What It Takes to Make Things Truly Better</strong>&lt;br&gt;A modern mobility system promises relief to over-crowded inner cities and suburban dwellers burdened by long commutes: Shared, digitally enabled ‘on demand’ and emission-free electrically powered shuttles move people exactly where they want to go, when they want to go, on roads freed from the traffic jams caused today by too many private vehicles. What does it take to realise this desirable vision? Why is today’s reality still so different?&lt;br&gt;Arthur Kipferler, Berylls Strategy Advisors</td>
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Preparation for the Mobility Revolution by Creating Immediate Value Today

Just like so many other aspects of our daily lives, the mobility revolution is changing the way we rent cars and get around from A to B. Ride-hailing services like Uber and Lyft are already routine options for personal transportation and now ride sharing, on-demand rentals, subscription services, and even self-driving vehicles are easing into the picture.

While it’s true that today’s emerging mobility services present new challenges, they do not spell the end of the traditional automotive industry. And, as new options emerge such as next-generation fleet management opportunities as well as the ability to launch new mobility services with custom platforms like Fleetonomy, more and more players, are joining the mobility race. Automotive OEM’s, car rental companies, and many new players in the industry such as global energy corporations, are reshaping their business models and transforming into mobility service providers as well as preparing themselves to lead the new transportation market when autonomous vehicles become a reality.

This presentation will go through the opportunities that mobility service providers have in the new TaaS market and how companies can maximize their fleet management capabilities by leveraging AI-based, Multi-Service Fleet technology in order to generate immediate profit as well as secure their position as leaders of this emerging space.

The audience will gain a new perspective on efficiency-focused and AI-based fleet management systems as well as learn about the market potential and what they can achieve while launching their new mobility services.

Israel Duanis, Fleetonomy

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

Tuesday, October 29

Smart Cities (initiatives) - Connected Vehicle Pilots - Program Updates, Further Smart City and Smart Community Initiatives, and Smart State Initiatives

Session Code: IIM501
Room Legacy Ballroom II
Session Time: ALL DAY

Connected Vehicle Pilots - Program Updates: The US Department of Transportation (USDOT) has instituted a Connected Vehicle Pilot Deployment program to spark innovation among early developers and identify challenges that can only be understood and overcome by putting these emerging technologies to work in real-world situations, solving real-world problems. More than $45 million has been awarded to pilot sites across the country that are helping connected vehicles make the final leap into public deployment so that they can deliver on their promises to increase safety, improve personal mobility, enhance economic productivity, reduce environmental impacts, and transform public agency operations. Moreover, these sites are laying the groundwork for even more dramatic transformations as other areas (private companies, states, transit agencies, commercial vehicle operators, freight shippers, etc.) follow in their footsteps. This session offers updates on the currently running pilot programs.

Further Smart City and Smart Community Initiatives: The USDOT Smart City Challenge continues to drive innovation in communities across the country. This session highlights the efforts of forward-looking leaders who are defining the future of the transportation network and mobility requirements in their cities.

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<td>Joanna Pinkerton, Central Ohio Transit Authority</td>
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9:00 a.m. ORAL ONLY 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. ORAL ONLY Presentation

Christina Kopp, Tampa-Hillsborough Co. Expressway Auth

10:30 a.m. ORAL ONLY Presentation

TTI (Invited)

11:00 a.m. ORAL ONLY 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 Presentation

City of Boulder (Invited)
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 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.

Mark de la Vergne, City of Detroit
Tuesday, October 29

Hybrid and Electric Powertrain: Batteries and Thermal Management, Fast and Wireless Charging, and Fuel Cells Vehicle Developments

**Session Code:** IIM302

**Room Legacy Ballroom IV**

The session will focus on new developments in solid-state technology, thermal management and battery stacks, and improving battery life.

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<td>Denise Gray, LG Chem Michigan Inc. Tech. Center</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>Interconnected Issues in Battery Thermal Management, High Voltage Configurations, and Fast Charging</td>
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<td>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.</td>
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<td>Brian Robert, Ford Motor Company</td>
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<td>Overview of Adhesives, Sealants, and Heat Transfer Materials for Battery Systems: A New SAE International Committee</td>
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<td>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.</td>
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<td>Darren Hansen, Dow Chemical Company</td>
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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 potential 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 based on simulation studies only, 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, for four different powertrain types.

The two intersection approach scenarios considered in this study include an approach to a red light where coming to a complete stop is avoidable (short red light) and one where a complete stop is determined necessary (long red light) thanks to advance information from vehicle-to-infrastructure communication (V2I). The four powertrain types tested in this study include an advanced conventional vehicle, a conventional vehicle with idle stop-start capability, a hybrid electric vehicle (HEV), and a battery electric vehicle (BEV). The experimental results are compared to simulation results for the same intersection approach scenarios and eco-driving strategies, and show the difference in benefits for different powertrain types. Based on the eco-approach strategies for these two scenarios, a maximum fuel/energy consumption benefit of almost 8% was observed for the intersection with a short red light and almost 20% for the intersection with a long red light, in both cases by the HEV.

Simeon Iliev, Argonne National Laboratory

Presentation

Volkswagen (Invited)

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.


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

Networking Break in Exhibit

Presentation

Nikola (Invited)
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.

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.

### Internet of Things, Data Management, and Blockchain

**Session Code:** IIM404  
**Room Legacy Ballroom V**  
**Session Time:** ALL DAY

The Internet of Things is a key enabler in the connectivity between ADS vehicles and other intelligent devices within the mobility ecosystems. Speakers will address how new developments in cloud services, telematics, and over-the-air (OTA) software updates are impacting greater levels of automation in future vehicles.

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<td>10:00 a.m.</td>
<td>Panel</td>
<td>Panel Discussion: Internet of Things (IoT)</td>
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Nick Pudar, StackView Advisory LLC (Invited)
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.

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<td>Timothy Frazier, Cummins Inc.</td>
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<td>To Be Announced, Westport</td>
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<td>Argonne National Labs (Invited)</td>
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<td>3:00 p.m.</td>
<td>Panel</td>
<td>Panel Discussion</td>
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<td>Moderators - Robert Marlay, US Dept. of Energy</td>
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Planned by Natural Gas Organizers / Innovations in Mobility Steering Committee
Interior Occupant Protection for Automated Vehicles

Session Code: IIM406
Room Legacy Ballroom VII
Session Time: ALL DAY

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).

Organizers - Aditya Belwadi, Children’s Hospital of Philadelphia; Jason Lee Forman, Jason R. Kerrigan, Univ. of Virginia; Donald Parker, Exponent Failure Analysis
Chairpersons - Donald Parker, Exponent Inc.

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<tr>
<td>8:30 a.m.</td>
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<td>Considerations for Collision Load Cases and Occupant Protection in Level 4 and 5 Autonomous Vehicles</td>
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<td>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.</td>
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<td>Robert Lange, Exponent Inc.</td>
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<td>9:00 a.m.</td>
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<td>Integrated Safety - Safety Concepts for Future Interiors</td>
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<td>&lt;p&gt;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.&lt;/p&gt; &lt;p&gt;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.&lt;/p&gt; 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. &lt;/p&gt; The paper discusses development challenges, opportunities and availability of technologies based on examples.</td>
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<td>Frank Laakmann, TRW Automotive GmbH; Martin Seyffert, Lothar Zink, ZF Group</td>
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<td>9:30 a.m.</td>
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<td>Networking Break in Exhibit</td>
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<td>10:00 a.m.</td>
<td>ORAL ONLY</td>
<td>Changes in Types of Crashes</td>
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<td>Douglas J. Stein, Autoliv ASP</td>
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<td>10:30 a.m.</td>
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<td>Tim Smith, Polaris</td>
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11:00 a.m. ORAL ONLY Presentation
Raul Arbelaez, Insurance Institute for Highway Safety

11:30 a.m. Networking Lunch in Exhibit

1:00 p.m. ORAL ONLY Presentation
John Capp, General Motors

1:30 p.m. ORAL ONLY 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.
Dan Parent, US Dept. of Transportation

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.

Moderators - Jason Forman, Univ. of Virginia
Panelists - Raul Arbelaez, Insurance Institute for Highway Safety; John Capp, General Motors; Timothy Goodman, Babst Calland; Richard Marks, EcoV Environmental Transportation Inc.; Tim Smith, Polaris Industries Inc.; Cecilia Sunnevag, Autoliv Development AB;
Additive Manufacturing in the Automotive Industry

**Session Code:** IIM101  
**Room Legacy Ballroom VIII**  
**Session Time:** ALL DAY

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** - Chandan Mozumder, General Motors; Abhay Vadavkar, Center For Automotive Research

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<th>Time</th>
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<tr>
<td>8:30 a.m.</td>
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<td><strong>Keynote Presentation: Drive to Production: The Expanding Role of Additive Manufacturing in the Automotive Industry</strong></td>
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<td>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.</td>
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<td>Kevin Quinn, General Motors</td>
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<td>Oakridge National Lab (Invited)</td>
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<td>David Darbyshire, DASI Solutions - SolidWorks</td>
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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

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

Networking Break in Exhibit

Panel Discussion: Standards

Moderators - John Wilczynski, National Center for Defense
Panelists -
  Dave Abbott, GE Aviation; Shane Collins, Additive Industries; Jessica Coughlin, Bechtel Marine Propulsion Corporation; Kathryn Hyam, American Society of Mechanical Engineers (ASME); James McCabe, American National Standards Institute; Lisa Spellman, Medical Imaging Technology Alliance;

Planned by Additive Manufacturing Committee / Innovations in Mobility Steering Committee

Tuesday, October 29
Transmission and Driveline (Part 2 of 2)

Session Code: IIM303


Wednesday, October 30

Transmission and Driveline (Part 2 of 2)

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 - Hussein Dourra, Magna Global IT Canada; Rob Mangan, Link Engineering Company

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<tr>
<td>8:30 a.m.</td>
<td>Panel</td>
<td>Panel Discussion: Electrification</td>
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<td>Moderators - To Be Announced</td>
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<td>Networking Break in Exhibit</td>
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<tr>
<td>10:00 a.m.</td>
<td>ORAL ONLY</td>
<td>Vehicle Dynamics Modeling Estimation and Control - A Mechatronics Approach</td>
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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.

Ahmed El-Shaer, Dana
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 destroking. 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
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.

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.

The ProteanDrive in-wheel technology offers high power and torque density. Designed to maximise efficiency and simplify the vehicle production process, all of our models are in-wheel motors with integrated power electronics and digital control, packaged with a compatible friction brake. All made using patented technologies to withstand a 300,000km vehicle lifetime, including water and dirt ingress, shock and vibration, pot-holes and kerb strike.

Ahmad Kilani, Protean Electric
5G? V2X? Edge Computing? Where will it end for enabled digital services and connectivity? Where should we be investing our time and in which technology? How do we manage it and what are the best tools for each situation? Experts talk about these and other technologies that make Terabits of information flowing through tomorrow's vehicle. Hear experts address technical drivers to meet known and unknown customer expectation?

Navigation is critical to ensuring passengers get to their destinations quickly, safely, and as efficiently as possible. HD mapping is 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.

Robert Neff, Intrass / Sales and Marketing Insight

**Chairpersons -** Robert Neff, Intrass / Sales and Marketing Insight

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<td>T-Systems International GmbH (Invited)</td>
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<td>Networking Break in Exhibit</td>
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<td>10:00 a.m.</td>
<td>ORAL ONLY</td>
<td>V2X: From here to 5G</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>Ravi Puvvala, Savari Networks</td>
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<td>Steven Bayless, ITS America</td>
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<td>Drive Ohio (Invited)</td>
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<td>1:00 p.m.</td>
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<td>Advancing Automated Driving with HD Maps</td>
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<td>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.</td>
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<td>Praveen Chandrasekar, TomTom</td>
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<td>Digital Maps: Types and Needs</td>
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<td>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.</td>
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<td>David Craig, General Motors LLC</td>
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<td>Waze (Invited)</td>
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<td>4:00 p.m.</td>
<td>ORAL ONLY</td>
<td>Understanding Weather at Road Level - Operational Performance Gains Using HD Mapping and Road Surface Modeling</td>
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<td>To operate safely and efficiently, autonomous vehicles must generate and ingest a large volume of sensor data, enabling the AI systems to make complex, real-time decisions. A critical input to improving the performance of these vehicles is the very near-term forecast of the road surface state (road surface temperature, amount of liquid and frozen material on the road surface) and its condition (dry, wet, snow and ice). Reliable analysis of the road surface conditions significantly reduces the number false disengagements and allows for safe autonomous operations in complex domains. This is accomplished by integrating road state forecast data (current and future) into the HD mapping fabric, providing a “virtual sensor” of changing road surface conditions along all roads. This presentation will address the autonomous vehicle disengagement challenges, road surface modeling, integration with HD mapping platforms, system validation, and performance verification issues related to road weather.</td>
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<td>Mark Flolid, Global Weather Corporation</td>
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Planned by ADAS to Automated Driving Organizing Committee / Innovations in Mobility Steering Committee

Wednesday, October 30

Urban Mobility (applications) - Micromobility, City-wide Mobility, and Air Mobility

Session Code: IIM504

Room Legacy Ballroom II

Session Time: ALL DAY
8:30 a.m.  ORAL ONLY  

Keynote Presentation: SMART Mobility: Results from DOE’s Energy Efficient Mobility Systems Program

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

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.

Moderators - Annie Chang, SAE International

Panelists - Christopher Cherry, University of Tennessee; 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.

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?”

Panelists - Philip George, Schaeffler Group USA Inc.; Greg McGuire, Mcity; Monique Stinson, Argonne National Laboratory; Mark Thomas, Ridecell;

2:30 p.m.  Networking Break in Exhibit

3:00 p.m.  Panel  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?”

Panelists - J. Scott Drennan, Bell Flight; Parimal Kopardekar, NASA; Jon Rimanelli, Airspace Experience Technologies Inc.;

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

Wednesday, October 30

Sensor Fusion, Integration and Data Collection

Session Code: IIM403  Room Legacy Ballroom III  Session Time: ALL DAY

Sensors represent the nervous system of vehicles by collecting inputs from the external environment and feeding this information to a driver and/or central computing center within the vehicle. The move from L2+ to L4+ automation has resulted in an exponential growth in the amount of data being collected. How this data collected, processed, and resulting decisions made are critical to the development of L4+ vehicles. Industry experts will discuss new sensor technology, integration, data collection, data processing, and vehicle decision-making.

Chairpersons - Walid Aldeeb, Infineon Technologies AG
8:30 a.m.  ORAL ONLY  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 smoothen 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

9:00 a.m.  ORAL ONLY  Presentation

To Be Announced, ZF

9:30 a.m.  Networking Break in Exhibit

10:00 a.m.  ORAL ONLY  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
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

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.
Building the Vision for Autonomous Mobility

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

Solid State Lidar Technology: A Response to Current Challenges in Autonomous Driving

<p>Beside electrification, 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>

<p>Environmental perception is a crucial part of automated driving functions. Today Radar and camera technology are established as sensing technologies for advanced driver assistance systems. Only recently, Audi expanded its sensor suite by a LiDAR sensor. Whereas LiDAR is not necessarily required for level 2 automation it is widely seen as mandatory for higher-level automation.</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.

Panel Discussion: LiDAR Technology

Moderators - Rini Sherony, Toyota Motor North America Inc.
Deployment of Smart Manufacturing Technologies Throughout the Automotive Value Chain

Session Code: IIM102
Room Legacy Ballroom IV  Session Time: ALL DAY

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

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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>Keynote Presentation</td>
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<td>Michael Mikula, Ford Motor Co., Ltd.</td>
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<td>9:30 a.m.</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>To Be Announced, Accenture</td>
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<td>Karthik Gopalakrishnan, Robert Bosch LLC</td>
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<td>11:00 a.m.</td>
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<td>Supporting Intelligent Supply Chain and Manufacturing Technologies</td>
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<td>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.</td>
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<td>Darren Coil, Microsoft Corporation</td>
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<td>Adrian Jennings, Ubisense Inc.</td>
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<td>2:30 p.m.</td>
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<td>Networking Break in Exhibit</td>
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<td>3:00 p.m.</td>
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<td>Jeffrey Liaw, Martinrea</td>
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As AI expands its development into mobility the impact will be felt throughout vehicle development, design and deployment in driverless car technology, ADS, Connectivity, and enhanced user experience.  Come hear experts discussion new algorithms and programming advancements, evolving neural network technology, social and economic impacts and new applications in vehicle automation.

Similar to Artificial Intelligence, machine learning is a critical function to allow for greater levels of machine automation. Experts in the technology of machine learning discuss how this is employed in automated vehicle applications. In addition, the session will address future research and developments of this technology as it relates to increasing vehicle automation.

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<tr>
<td>3:30 p.m.</td>
<td>Panel</td>
<td>Panel Discussion: Future of Manufacturing</td>
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<td>Moderators - Monika Minarcin, Accenture</td>
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<td>Panelists - Ted Brown, Totally Automated Systems; Adrian Jennings, Ubisense Inc.;</td>
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Wednesday, October 30

Artificial Intelligence (AI) and Machine Learning (ML)

**Session Code:** IIM405

**Room Legacy Ballroom V**

**Session Time:** ALL DAY

As AI expands its development into mobility the impact will be felt throughout vehicle development, design and deployment in driverless car technology, ADS, Connectivity, and enhanced user experience. Come hear experts discuss new algorithms and programming advancements, evolving neural network technology, social and economic impacts and new applications in vehicle automation.

Similar to Artificial Intelligence, machine learning is a critical function to allow for greater levels of machine automation. Experts in the technology of machine learning discuss how this is employed in automated vehicle applications. In addition, the session will address future research and developments of this technology as it relates to increasing vehicle automation.

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<tr>
<td>8:30 a.m.</td>
<td>ORAL ONLY</td>
<td>Artificial Intelligence for Autonomous Vehicles</td>
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<td>Is Artificial Intelligence the answer for operational command of autonomous vehicles?</td>
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<td>Bob's multimedia presentation will offer an overview of the &quot;state of the art&quot; in artificial Intelligence as applied to autonomous vehicles. He will discuss developments and research that are exploring machine learning from recognizing objects and drawing conclusions for machines that think like humans. A unique comparison of Vehicle Automation Levels to Artificial Intelligence Levels will be presented.</td>
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<td>Bob will present topics regarding ethics, machine/human interaction and machine interdiction as AI assisted automated vehicles join the network of roadways that exist today.</td>
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<td>Robert Neff, Intrass / Sales and Marketing Insight</td>
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<td>9:00 a.m.</td>
<td>ORAL ONLY</td>
<td>Towards Kinematic Reconstruction of Roadway Scenes from Single-Camera Input</td>
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<td>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.</td>
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<td>Jason J. Corso, University of Michigan</td>
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<td>Networking Break in Exhibit</td>
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10:00 a.m.  ORAL ONLY  How AI is making Drivers Better through ADAS

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 session 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.

Abhijit Thatte, AEye Inc.

10:30 a.m.  ORAL ONLY  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.

11:00 a.m.  ORAL ONLY  Presentation

Maya Pindeus, Humanising Autonomy

11:30 a.m.  Networking Lunch in Exhibit
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 "black boxes.\" 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 \"holistic AI\" approach based on an actual implementation.

Monika Minarcin, Accenture
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.  
**Networking Break in Exhibit**

10:00 a.m.  **ORAL ONLY**  
**Top 10 Bio-derived Blendstocks to Improve Turbocharged Gasoline Engine Efficiency**

Daniel J. Gaspar, Pacific Northwest National Laboratory

10:30 a.m.  **ORAL ONLY**  
**Performance-Advantaged Ether Diesel Bioblendstocks by a priori Design**

Derek Vardon, National Renewable Energy Laboratory

11:00 a.m.  **ORAL ONLY**  
**Effects of Fuel Composition on Emissions and Emissions Control Catalyst Performance**

Josh Pihl, Oak Ridge National Laboratory

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

1:00 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 4 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

1:30 p.m.  **ORAL ONLY**  Presentation

   .. TBD

2:00 p.m.  **ORAL ONLY**  Presentation

   .. TBD

2:30 p.m.  Networking Break in Exhibit

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**Wednesday, October 30**

**AV Testing, Validation and Certification**

**Session Code: IIM410**  
**Room Legacy Ballroom VII**  
**Session Time: ALL DAY**

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).

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<td>Panel Discussion: Human Autonomy Interactions</td>
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Realizing human-machine operational synergy in any L3+ self-driving car requires the orchestration of interconnected hardware, software and data elements. Sophisticated command and control systems with hierarchical decision-making capability operating are required to harness the capabilities of human-automation systems-of-systems. Traditional ISO26262 V-diagrams are unable to scale to address the new complexity created by multi-scale, multi-hierarchy hardware-software interactions. Efforts such as ISO 21448, currently under development, attempt to combine existing best design practices and simultaneously adopt new design and testing techniques required to deal with Safety of the Intended Functionality (SOTIF) of self-driving cars. This session is intended to discuss the emerging trends in abstractions/formalisms/methods being created to support both the initial development efforts as well as longer-term systematic verification and validation.
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 processes, and testing techniques to meet the material needs of these vehicles. 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).

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.
8:30 a.m.  ORAL ONLY  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.
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

Networking Lunch in Exhibit

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.

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.

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

Networking Break in Exhibit
The autonomous vehicle operating condition heavily depends upon the regulation, ownership and density of the vehicles sharing the same road. Compared to a traditional human controlled vehicle, an autonomous vehicle may potentially drive up to averagely 1200 miles a day on various road surfaces, which will yield significantly different customer usage of the vehicle, thus the vehicle components will be subjected to very different duty cycles compared to traditional vehicles. It is important to understand the differences such that our experiences and facilities used to develop traditional vehicles can be smoothly transit to developing autonomous vehicles and their components. This panel will provide an opportunity to discuss the impact of the duty cycle differences on vehicle development, how and why the materials should be further developed to adapt the duty cycle changes to meet the comprehensive requirements for the autonomous vehicle development.

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;

Planned by Next Gen Materials Committee / Innovations in Mobility Steering Committee

Thursday, October 31

All Wheel Drive

Session Code: IIM309
Room Cornerstone I
Session Time: ALL DAY

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.

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

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<th>Time</th>
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<tr>
<td>8:30 a.m.</td>
<td>ORAL ONLY</td>
<td>Keynote Presentation</td>
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<td>Don Hillebrand, Argonne National Laboratory</td>
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<td>9:30 a.m.</td>
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<td>Networking Break in Exhibit</td>
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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

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.
ORAL ONLY

11:00 a.m.  AWD Battery Electric Performance SUV with Dual eMotor Control Algorithm for Optimal Efficiency

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

11:30 a.m.  Networking Lunch in Exhibit
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 off-highway 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 low-speed 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, Todd Tousignant, 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

Wayne Petzke, AVL
Thursday, October 31

Regulations, Consumer Metrics, Legal, and Insurance

Session Code: IIM411
Room Legacy Ballroom I

Transportation regulations and consumer metrics are two critical influencing factors in how automated vehicles are developed and deployed into the public. Domestic and international regulators will discuss current work to ensure safe, efficient and reliable automated vehicle operations.

Chairpersons - Donald Parker, Exponent Inc.

Time | Paper No. | Title
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8:30 a.m. | Panel | Panel Discussion: Legal Topics

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: Legal Topics (continued)

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

3:30 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

4:00 p.m. | ORAL ONLY | Presentation

Michael Kocevar, JTEKT Corp.

Planned by All Wheel Drive Committee / Ground Vehicle Advisory Group
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  Presentation

David Woessner, Local Motors Limited

2:00 p.m.  ORAL ONLY  Consumers Uncertain about AV Technologies

An overview of AAA’s research into consumer attitudes, understanding, and adoption of AV technologies.

Gregory Brannon, AAA

2:30 p.m.  Networking Break in Exhibit

3:00 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, Blackburn LLC

3:30 p.m.  ORAL ONLY  The Real-world Effects of Existing Driver Assistance Systems and What We can Expect Moving Forward

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

4:00 p.m.  ORAL ONLY  Presentation

NHTSA (Invited)

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

Thursday, October 31

Next Generation Infrastructure, The Macro Mobility Ecosystem, and Communications

Session Code: IIM507

Room Legacy Ballroom II  Session Time:  ALL DAY
8:30 a.m. ORAL ONLY Keynote Presentation: Emerging Mobility Solutions - What Lies Ahead?
Jim Barbaresso, HNTB Corp.

9:00 a.m. ORAL ONLY Keynote Presentation: Smart Cities, Mobility, and Human Behavior - Seamless integration?
There are many developments in the emerging realms of smart vehicles, smart mobility, and smart cities. Given the rapid pace of recent technology advances, it is easy to imagine a future of safe and frictionless travel within rationally planned urban mobility systems. It is also easy to forget that the best-laid plans for future mobility will go awry if they don't account for the expectations and preferences of the people who live, work, and travel throughout the urban fabric. In this presentation, Carla Bailo, CEO of the Center for Automotive Research (CAR) in Ann Arbor, will explore the implications of human behavior on the adoption of transportation technologies and mobility services. This presentation will be a must-see for those seeking to better understand the complex interactions between mobility, the built-environment, and the people and culture within a region.
Carla Bailo, Center For Automotive Research

9:30 a.m. Networking Break in Exhibit

11:00 a.m. ORAL ONLY Presentation
To Be Announced

11:20 a.m. ORAL ONLY Mobility Is A Land-Use Issue: How Can Big-Data Help Us Intelligently Assess and Manage the Price and Use of Our Streets
Dana Chermesh, DRAW Brooklyn

11:30 a.m. Networking Lunch in Exhibit

1:00 p.m. ORAL ONLY Presentation
Barry Einsig, CAVita, Econolite Group Inc.

1:30 p.m. ORAL ONLY Presentation
American Center for Mobility (Invited)

2:00 p.m. ORAL ONLY Presentation
To Be Announced

2:30 p.m. Networking Break in Exhibit
Panel Discussion: Enabling Infrastructure Communications

The convergence of connected vehicles, automated driving, and intelligent transportation is forcing the simultaneous upgrade of key infrastructure systems, especially the communications networks. V2X is rolling out using current DSRC technology with an eye towards 5G as it becomes a reality. Vehicular communication will further enable safety with near real-time information updates. This convergence portends a revolution that will rely on these systems to operate efficiently—all while maintaining personal privacy, system security, and data integrity. This session will discuss the challenges to enabling the latest infrastructure communication updates as well as visions to the future capabilities of a connected vehicle and infrastructure network.

Moderators - Ford (Invited)
Panelists - AT&T (Invited); Nokia (Invited); James Misener, Qualcomm Technologies Inc.; Jovan Zagajac, 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.

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<td>Stephen Ciatti, PACCAR Technical Center</td>
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<td>Jerry L. Gibbs, US Government</td>
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<td>10:00 a.m.</td>
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<td>Thermal barrier coatings - just a bunch of hot air?</td>
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<td>Thermal barrier coatings have long held promise to reduce heat transfer losses from internal combustion engines, resulting in increased thermal efficiency and potentially lower emissions. These coatings have been the subject of research for many decades, however they have been largely unsuccessful with conventional combustion strategies. This brief presentation will identify areas of opportunities to advance TBCs to their full potential.</td>
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<td>Ashwin Salvi, Achates Power Inc.</td>
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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  Upcoming Emissions Regulations, Aftertreatment Solutions and Key Challenges

Advanced diesel engines offer unmatched fuel efficiency and reliability and in the foreseeable future expected to be the leading technology of choice for the HD diesel trucks. The upcoming emissions regulations around the world demands the improved performance and extended durability of the aftertreatment systems. In this contribution we will review the technology drivers, evolutionary and revolutionary engine and aftertreatment solutions and a few fundamental catalyst component challenges that have to be addressed for designing the aftertreatment systems.

Krishna Kamasamudram, Cummins Inc.

1:30 p.m.  ORAL ONLY  Presentation

Hai-Ying Chen, Johnson Matthey Inc.

2:00 p.m.  ORAL ONLY  Presentation

Ameya Joshi, Corning Inc.

2:30 p.m.  Networking Break in Exhibit

3:00 p.m.  ORAL ONLY  Presentation

Mei Li, Ford Motor Company

3:30 p.m.  ORAL ONLY  Presentation

Mark Carroll, Federal-Mogul Corp.
The Current and Future State of XR in the Automotive Industry

**Session Code:** IIM103  
**Room:** Legacy Ballroom IV  
**Session Time:** ALL DAY

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.

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**Thursday, October 31**

**Keynote Presentation**

8:30 a.m. ORAL ONLY  
**Greg Melling, Unity Technologies**

**Networking Break in Exhibit**

9:30 a.m.

**Presentation**

10:00 a.m. ORAL ONLY  
**Volkswagen (Invited)**

**Bosch Technical Training Supported by Augmented Reality**

10:30 a.m. ORAL ONLY  
**Phil LaFond, Bosch Automotive Service Solutions LLC**

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.

**Presentation**

11:00 a.m. ORAL ONLY  
**Boeing (Invited)**

**Networking Lunch in Exhibit**

11:30 a.m.

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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.

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**Planned by Engine and Materials Convergence Organizers / Innovations in Mobility Steering Committee**
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  Presentation
This presentation will encompass XR with an overview of cutting edge product design and vehicle conceptualization remote collaboration. Will present state of the art XR training systems with verifiable benefits analysis for hazardous and non-hazardous subject matter. Real world training methodologies as implemented in the existing market with proven track records.
Philip Little, The PAC Group

2:00 p.m.  ORAL ONLY  Presentation
NASA (Invited)

2:30 p.m.  Networking Break in Exhibit

3:00 p.m.  ORAL ONLY  Presentation
Brad Waid, Educator, Emerging Technology Leader, Global Influencer

3:30 p.m.  Panel  Panel Discussion
Panel Discussion
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<a href="https://www.sae.org/servlets/techSession?REQUEST_TYPE=AUTHOR_BIO&saetkn=ERPTop4gdC&PROD_CD=19IIM-0212&PRESENTATION_TITLE=Learn+more+about+the+Panel+Participants&SCHEV_GA=">Learn more about the Panel Participants</a>

Moderators - Elizabeth S. Baron, Immersionary Enterprises LLC
Panelists - Randy Nunez, Ford Motor Co., Ltd.;

Planned by Extended Reality Committee / Innovations in Mobility Steering Committee

**Cybersecurity**

**Session Code:** IIM415

**Room Legacy Ballroom V**

**Session Time:** ALL DAY

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>Faye Francy, Auto-ISAC</td>
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9:00 a.m.  ORAL ONLY  Vehicle-level Cyber-security 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 cyber-security 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 cyber-security 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 cyber-security 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 cyber-security 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

9:30 a.m.  Networking Break in Exhibit

10:00 a.m.  ORAL ONLY  From start-up to a Tier-1, a journey in automotive cyber-security

The challenges of cyber-security 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 cyber-security challenges in modern mobility, possible solutions and the start-up gone Tier-1 perspective.

Liron Kaneti, Argus Cyber Security, Ltd.

10:30 a.m.  ORAL ONLY  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
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.

### Time | Paper No. | Title
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8:30 a.m. | ORAL ONLY | Keynote Presentation

**BMW (Invited)**
9:10 a.m.  ORAL ONLY  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. The main objective of this control algorithm is to match the power generated by the engine to the power demanded by the generator. 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 general, if the generator consumes more energy in a cycle than the engine provides, the system moves towards a stall. If the generator consumes less energy, then the effective stroke, compression ratio and maximum translator velocity must rise steadily from cycle-to-cycle until the heat transfer losses stop the increase. Moreover, when stiff springs are added to the FPEG system, the dynamics becomes more sinusoidal and more consistent with increasing spring stiffness. To understand the behavior of proposed control and cycle-to-cycle variations, a comprehensive FPEG numerical model with a 1kW target electric power was developed in MATLAB®/Simulink. An FPEG system corresponding to that numerical model has been operated in the laboratory. This MATLAB®/Simulink numerical model has been used to examine the sensitivity of FPEG dynamics and performance parameters to the changes in design and operating inputs. A difficulty during the modeling is associated with the cycle-to-cycle energy balance, and this difficulty is also reflected in the real-world FPEG control. Therefore, the authors have devised a control strategy similar to the real world intended control methodology. In this numerical model, two different feedback control methodologies were implemented and investigated. These control methodologies were applied to regulate the generator load with selected control or input variables, namely peak pressure, mid-stroke piston velocity, trapped compression ratio and dead center set points. The controllers with optimized coefficients demonstrated the feasibility of energy balance management during the transient operation. Based on the simulation results, the controllers with compression ratio, peak pressure and dead center clearance set points as control variables demonstrated stable FPEG operation whereas the mid-stroke velocity failed to achieve the steady-state operation due to deviation in the piston dynamics. The simulation results from this study will be used as the pathway for improving and optimizing the experimental FPEG design.

Mehar Bade, West Virginia University

9:30 a.m.  Networking Break in Exhibit

10:00 a.m.  ORAL ONLY  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.
10:30 a.m. ORAL ONLY  **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 developed 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.

11:00 a.m. ORAL ONLY  **The Wankel Engine as a Range Extender: Some Lines of Research**

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-portered engine is introduced, which may be very beneficially supported by turbocompounding.

James Turner, University Of Bath

11:30 a.m. Networking Lunch in Exhibit

1:00 p.m. ORAL ONLY  **Presentation**

Nicholas Carpenter, Delta Motorsports Ltd.

1:30 p.m. ORAL ONLY  **Fuel Cells for Load Leveling**

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

2:00 p.m. ORAL ONLY  **Presentation**

Matthew Viele, Viele Tech.

2:30 p.m. Networking Break in Exhibit

3:00 p.m. Panel  **Panel Discussion: Future of Range Extenders**

**Moderators** - Scott Curran, Oak Ridge National Laboratory

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

**Thursday, October 31**

**Health Ready Components (IVHM)**
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.

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<th>Time</th>
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<tr>
<td>8:30 a.m.</td>
<td>ORAL ONLY</td>
<td><strong>Prognostics &amp; Vehicle Health Management in the Automotive Industry</strong>&lt;br&gt;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. Steve Holland, General Motors</td>
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<td>9:00 a.m.</td>
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<td><strong>The new HRCS Consortium &amp; Vehicle Health Management</strong>&lt;br&gt;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 JA6268™: Design and Run-Time Information Exchange for Health-Ready Components. Peter H. Grau, SAE-ITC</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>Predictive Maintenance in Defense and Smart Manufacturing</strong>&lt;br&gt;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. Luis Hernandez, Global Strategic Solutions LLC</td>
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<td>A Blockchain-Backed Registry for Health-Ready Components &amp; Systems</td>
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<td>What is blockchain? This presentation provides a ground-level intro...</td>
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<td>Condition Based Maintenance Plus (CBM+) in Army Ground Vehicles</td>
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<td>Synchronizing Condition Based Maintenance Plus (CBM+) efforts across...</td>
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<td>1:00 p.m.</td>
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<td>A System Health Record Platform- Enabling Predictive Maintenance in Surface Vehicles</td>
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<td>Enabling Predictive Maintenance in Surface Vehicles requires automa...</td>
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<td>2:30 p.m.</td>
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<td>Networking Break in Exhibit</td>
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Net Zero Carbon Fuels
Session Code: IIM307
Room Legacy Ballroom VIII  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.
8:30 a.m.  ORAL ONLY  Keynote Presentation
Michael Berube, US Department of Energy

9:30 a.m.  

10:00 a.m.  ORAL ONLY  Presentation
Michelle Kidder, Oak Ridge National Laboratory

10:30 a.m.  ORAL ONLY  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 CO2 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

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. <p>
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.

Sunita Satyapal, US Dept. of Energy

11:30 a.m.  

1:00 p.m.  ORAL ONLY  Presentation
Ling Tao, National Renewable Energy Laboratory
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<td>3:00 p.m.</td>
<td>Panel</td>
<td>Panel Discussion: Lifecycle and Techno Economic Analyses (LCA &amp; TEA)</td>
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Planned by Net-Zero Carbon Fuels Technology Organizers / Innovations in Mobility Steering Committee