NAFEMS americas events

The International Association for the Engineering Modeling, Analysis and Simulation Community

CONFERENCE PROGRAM & AGENDA

Engineering Analysis & Simulation in the Automotive Industry

Creating the Next Generation Vehicle

November 8th, 2018 | Troy, MI

nafems.org/americas

Keynotes from the Ford Motor Company on "*The aDRIVE Simulation Framework: Automated Driving Refined in Virtual Environments*" & The Ohio State University Simulation Innovation and Modeling Center on "*Curriculum Innovation to Meet the Growing Demand for Simulation Talent*"

Three Tracks with presentations from industry, software providers, researchers, and academia

Panel Discussion led by Ford Motor Company on "*Technology Gaps in Delivering Full Automotive Virtual Validation*"

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The automotive engineering community is now confronting the largest technology transformation since its inception. This includes the electrification of powertrains for more efficient consumption and cleaner emissions, the reinvention of the battery with fast wireless charging capabilities and finally the advent of a fully autonomous vehicle. Compounding to these technology changes, the automotive companies design verification process is moving away from a major reliance on physical testing to almost a full virtual simulation product verification process.

Hence, the challenges to the automotive engineers are enormous and require a significant increase in the upfront use of numerical simulation capabilities, methods and processes such they're able to efficiently design, manufacture and deliver these very innovative technologies to the market in greater speeds than ever before.

Conference Overview

NAFEMS and participating speakers will cover these topics, and more, at, "Engineering Analysis & Simulation in the Automotive Industry: Creating the Next Generation Vehicle." Located at the MEC in Troy, MI, attendees from the major automotive manufacturers and suppliers will gather at this annual event, in a pre-competitive manner, to exchange ideas, identify best practices, and drive the near-future direction of technology.

This event aims to deliver information and insights on critical topic areas in a manner that maximizes the "take-away" value for attendees. An event agenda and concept championed by several leading figures in the automotive industry will provide the opportunity to learn about the latest technologies and practices, which attendees can later share and apply within their own organizations.

Sponsors

We would like to extend a special thanks to the sponsors of the 2018 NAFEMS Americas Conference on "Engineering Analysis & Simulation in the Automotive Industry: Creating the Next Generation Vehicle." Please be sure to visit and speak with each of our sponsors during the conference to see and hear about the latest advancements in their technologies.

AGENDA - Thursday, November 8th

Program subject to change.

Plenary Session: Auditorium

9:00

Welcome & Introduction
A. Wood, Americas Regional Manager, NAFEMS

The aDRIVE Simulation Framework: Automated Driving Refined in Virtual Environments
A. Micks, Ford Motor Company

Curriculum Innovation to Meet the Growing Demand for Simulation Talent
S. Midlam-Mohler, The Ohio State University

10:40 Break in Foyer

	Auditorium	Room 101	Room 102
	CASE STUDIES (SESSION 1) Chair: E. Ladzinki, SMS_ThinkTank	**TRACK 1** Chair: C. Lee, Ford Motor Company	**TRACK 2** Chair: R. Ramkumar, Dana Holding Corp.
11:10	**Addressing the Challenges of Vehicle Electrification** S. Bahuguna, Dassault Systemes SIMULIA Corp.	**Intelligent Simulation Automation is Foundational to a Widening Technology Landscape** M. Panthaki, ARAS Corporation	**Systems Engineering – Challenges for Management in the Automotive Industry** F. Popielas, SMS_ThinkTank
	Top Five Mistakes Companies Make When Adopting Cloud Computing for CAE R. Mach, TotalCAE	**Modularization of FEA Models as Key Enabler for Simulation Data Management** C. Wang, General Motors Corporation	**Advanced Physics Based Sensor Simulation Approaches for Testing Automated and Connected Vehicles** T. Gioutsos, Tass International
	Topology Optimization for Additive Manufacturing Considering Overhang Angle R. Hoglund, Altair Engineering, Inc.	**Appropriate Level of Simulation in Tumble Port Evaluation** A. Megel, Southwest Research Institute	**How High-Performance Computing in the Cloud Is Accelerating Advanced Driver Assistance Systems Simulations** B. Mendez, Rescale

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12:40 Lunch in Dining Room

	CASE STUDIES (SESSION 2) Chair: A. Megel, Southwest Research Institute	**TRACK 1** Chair: D. Detwiler, Honda R& D, Americas, Inc.	**TRACK 2** Chair: K. Zouani, Ford Motor Company
1:30	**Enabling Democratization By Engineers, For Engineers** J. Aldred, HBM Prenscia	**Generative Design for Automotive – Benchmark and Challenge Problems** K. Meintjes, CIMdata, Inc.	**Electric Drive Noise and Vibration Analysis** W. Röver, Dassault Systemes SIMULIA Corp.
	Multi-Objective Optimization for Cost and NVH Performance A. Barnard, ESTECO North America, Inc.	**Automating Parametric Redesign of Structural Thinwalled Frames from Topology Optimization Results** L. Wang, The Ohio State University	**Multidisciplinary Simulations Provide a Pathway to Lightweight Automotive Systems** T. Palmer, MSC Software
	BMW Case Study: MBD – Nonlinear FEA Cosimulation for Analyzing Extreme Load Cases Y. Fan, MSC Software	**Parametric Optimization of CFRP Composite Material Model Properties for Accurate Energy Absorption Prediction in Crashworthiness Simulations** A. Sheldon, Honda R & D, Americas, Inc.	**Application Of Taguchi's DFSS Approach to the Study of Differential Gear Noise** N. Roy, American Axle Manufacturing

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3:00 Break in Foyer

	CASE STUDIES (SESSION 3) Chair: S. Hanim, Ford Motor Company	**TRACK 1** Chair: K. Meintjes, CIMdata, Inc.	**TRACK 2** Chair: F. Popielas, SMS_ThinkTank
3:30	**Innovative and Practical CAE/CAD Methodologies for Concept Stages of New Vehicle Development** R. Chaney, Detroit Engineered Products	**Design and Optimization for Engine Mount Stiffness Using MBD Approach** G. Pahwa, Mahindra Automotive North America	**Motor and Gear NVH CAE Analysis for a Hybrid Transmission Development** M. Saadat, Ford Motor Company
	Predictive Modeling for INDYCAR's Driver-in-the-Loop Aerodynamic Simulators M. Shaxted, ParallelWorks (R Systems)	**Multiphysics Optimization Process for Design of Electric Motors** L. Fernandes, Altair Engineering, Inc.	**System Simulation for Electric Vehicle Development** P. Musunuru, ESI North America

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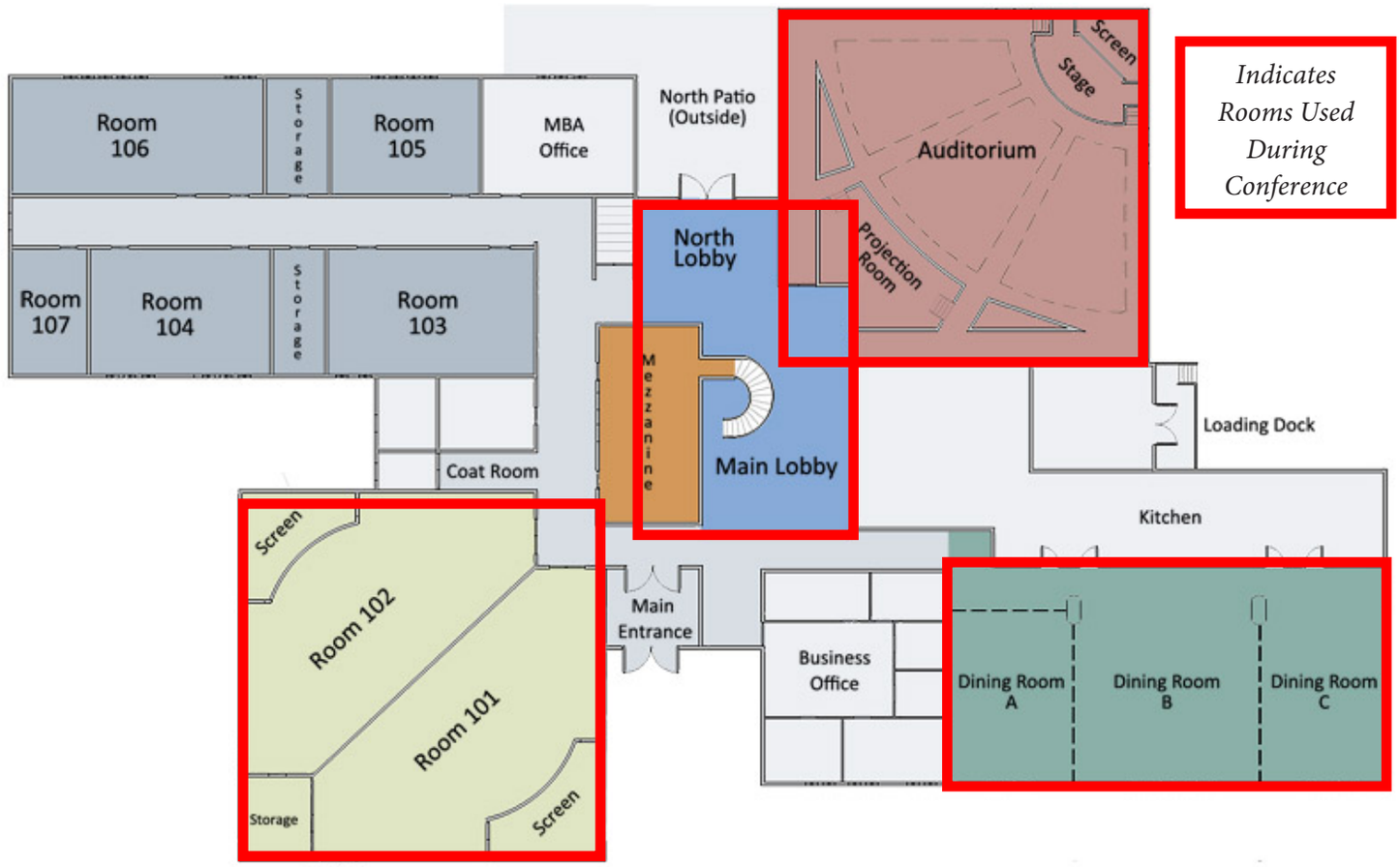
4:30 **PANEL DISCUSSION:** Auditorium
- **Technology Gaps in Delivering Full Automotive Virtual Validation**
Led by M. Felice, Ford Motor Company

5:30 **Networking Reception in Foyer**

MEC Floor Plans



Exhibiton Hall (Lobby Areas)

Exhibitmpq will include

- *Dassault Systemes SIMULIA Corp.*
- *TotalCAE*
- *Altair Engineering*
- *ESTECO*
- *MSC Software*
- *Detroit Engineered Products (DEP)*
- *R Systems*
- *HBM Prenscia*
- *ARAS Corporation*
- *OSU SIMCenter*

Conference Venue

Management Education Center
811 W. Square Lake Road
Troy, MI 48098

NAFEMS

As the only non-profit international association dedicated to the analysis, simulation, and systems engineering community, NAFEMS has established itself as the leading advocate for establishing best practices in engineering simulation. Over 30 years later, industry end-users, software and hardware solutions providers, researchers, and academic institutions continue to recognize NAFEMS as a valued independent authority that operates with neutrality and integrity. NAFEMS Americas supports over 300 member companies located in the Americas region who are actively engaged in the analysis, simulation, and systems engineering community.

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Andrew Wood (NAFEMS)

Presenter Name: Barnard, Ansley

Presenter Company: ESTECO North America, Inc.

Presentation Title: Multi-Objective Optimization for Cost and NVH Performance

Submission Type: Sponsor Case Study

Keywords: Simulation, Optimization, Costing, Case Study

Abstract:

As companies seek to decrease cost and time to market for their products, high quality simulation has become a critical component in the early design phase. Simulation controlled through an optimization algorithm can make better use of computational resources by autonomously and intelligently guiding the engineer to solutions that meet their objectives and constraints and reveal greater understanding across the breadth of their design space. However, in many cases, multiple objectives exist and are often in conflict with each other making it difficult to determine a single optimized solution. Multi-objective optimization can be an effective strategy to solve these problems. Much like performance metrics, product manufacturing cost is highly influenced by early design decisions and including an understanding of it during this phase provides a key opportunity to shape the product for cost effectiveness while design and manufacturing processes are still malleable. However, engineering design and simulation is often conducted well before product costing, limiting the scope of affordable design changes that can be made once costing analysis has been completed. Integrating feature based product cost models with physics-based simulation in an optimization loop provides an opportunity to drive engineering design from the cost perspective while meeting the same performance requirements. In this presentation, we will share a multi-objective optimization for a chassis component. Evaluating both Noise, Vibration, and Harshness (NVH) performance and part cost simultaneously, the optimization will seek a solution that is both affordable and high-performing. We will present a method of integration between the part design parameters, NVH simulation, and manufacturing cost models to yield a system of optimized solutions for a cost effective part. The results of the analysis will be presented, showing a spectrum of solutions across multiple objectives from which one or more final designs could be selected.

Presenter Name: Felice, Mario

Presenter Company: Ford Motor Company

Presentation Title: Technology Gaps in Delivering Full Automotive Virtual Validation

Submission Type:

Keywords:

Abstract:

The objectives of the panel discussion are to actively engage the audience (including OEM experts and Suppliers) and examine the many technical challenges facing Automotive CAE Engineers needed to satisfy the ever demanding efficiency needs to deliver quicker, simpler and more accurate analyses in support of shorter development times in combination with elimination of physical testing. The expectation from the panel discussion is to explore the possibility for establishing a consortium among OEMs and Suppliers to develop the most critical technology gaps identified as part of the panel discussion.

Presenter Name: Fernandes, Linus

Presenter Company: Altair Engineering, Inc.

Presentation Title: Multiphysics Optimization Process for Design of Electric Motors

Submission Type: Presentation

Keywords: Multiphysics, Optimization, Electric motors, traction motors, electromagnetics, noise, vibrations, magnetic torque, motor design, electric vehicle

Abstract:

The use of electric motor increases in the automotive application with the electrification of vehicle. Electric motors are changing the existing vehicle architecture. Internal combustion engines (ICE) are replaced by traction motor or in-wheel motor drive systems. Electric motor reduces cost, number of parts in the vehicle, packaging size, complexity, helps reduce CO2 emission and increases overall efficiency, ability to integrate different features related to power electronics. Designing electric motor becomes a complex challenge when the overall performance of the vehicle is considered. A poor design of the electric motor assembly can cause durability, noise and vibration issues for the vehicle. The vehicle structure design should be able to sustain the magnetic torque and electromagnetic forces generated by the motor. Secondly, even though an electric vehicle could emit lower noise than a vehicle powered by an I.C. engine, there are multiple sources of noise in the vehicle. Controlling the noise emitted by the electric motor, could improve the overall noise emission characteristics of the vehicle. Structural analysis is widely used in the design process of automobiles and electromagnetic analysis is used in the design of electric motors. This presentation deals with coupling electromagnetics and structural mechanics to design electric motors and the vehicle structure it connects to. A finite element analysis is performed to design the electric motor, to optimize its magnetic torque and the noise radiated by the motors due to the electromagnetic forces acting on the stator. Method to identify the parts contributing to the maximum structural vibrations is shown in this process. Finally, an optimization using a parametrized CAD model is performed to improve the structural and electromagnetic properties of the motor. Global response search method algorithm is used in the optimization process. The advantage of using global response search method algorithm is also discussed in the presentation.

Presenter Name: Gioutsos, Tony

Presenter Company: Tass International

Presentation Title: Advanced Physics Based Sensor Simulation Approaches for Testing Automated and Connected Vehicles

Submission Type: Presentation

Keywords: Simulation, Sensors, Testing, Autonomous, Automated, Connected, Physics, Camera, Lidar, Radar, V2X

Abstract:

In order to provide a “due care” testing approach to automated and connected vehicle technology, an advanced sensor simulation must be involved. Although real-world or field tests are required as well as test track testing, simulation can provide a bulk of the testing and also provide tests not producible via real or test track testing. However, to provide the most accurate and best validation, sensor simulation closest to “raw data” would be preferred. Furthermore besides the deterministic set of data that a simulation program can produce, it is also important to produce probabilistic models that correlate to real world data. Advanced physics based sensor models with deterministic and probabilistic components are introduced. The models described include: Camera, Radar, Lidar and V2X. These models can be used to produce ROC (Receiver Operating Characteristic) curves and other measures of detection and estimation system performance. Using these measures allows for a robust system for real world operation.

Presenter Name: Hoglund, Robert

Presenter Company: Altair Engineering, Inc.

Presentation Title: Topology Optimization for Additive Manufacturing Considering Overhang Angle

Submission Type: Sponsor Case Study

Keywords: topology optimization, additive manufacturing, overhang constraint

Abstract:

Throughout the automotive industry, topology optimization plays a crucial role in the design of structural parts for light-weighting and performance gains. In the topology optimization process, the optimal material distribution of a structure is determined for a given set of boundary conditions and constraints, within a certain design region. However, one of the traditional challenges involved with topology optimization includes manufacturability of the optimized designs using traditional processes. The results of topology optimization, given complete freedom over a set design space, often do not produce parts that can easily be cast or formed, and thus manufacturing constraints introduced into the optimization formulation are necessary to be able to realize the design for production. Since additive manufacturing (AM) brings a level of increased design freedom compared to typical casting, machining and stamping processes, it has generated increased interest as a method to manufacture near optimal structures generated by topology optimization. However, AM brings its own set of design challenges, including the necessity of support structures in part production, thermal distortion, and amount of post-processing required. In metal powder-based additive manufacturing, structures produced by the path of the laser in the powder-bed setup can only be printed up to a certain maximum overhang angle (OHA) from the vertical. This angle depends on the machine parameters and material characteristics, and is typically about 45º from the normal to the powder bed. At OHA greater than this, the powder, which is melted several layers at a time to cool and form the structure, burns underneath the structure without enough reinforcement underneath to anchor the structure to the build plate. For this reason, the standard practice is to create support structures, which are generated underneath the main structure, to support these areas. However, support structures can complicate postprocessing, build time, and part surface quality, so it is often desired to effectively minimize their usage. OHA consideration helps to determine optimal structural topology in a design space while either avoiding all overhanging members or finding a good compromise between structural performance and the need for support structure. This talk gives a technical review and workflow examples for considering OHA in topology optimization.

Presenter Name: Megel, Anthony

Presenter Company: Southwest Research Institute

Presentation Title: Appropriate Level of Simulation in Tumble Port Evaluation

Submission Type: Presentation

Keywords: tumble, cylinder head, development, CFD, flow, ports

Abstract:

Simulation software vendors are promoting advances in software usability to advance the use of simulation tools into the hands of designers and design engineers. While this can increase the amount of simulation that is performed during product development, it can call into question the accuracy of the simulation results when that simulation is taken out of the hands of the analysis expert. Thus, the concern arises of speed/quantity vs. accuracy. However, it is most important to focus on the design question that is being answered by the simulation. That is, do you need an accurate result or do you need a reliable comparison? This presentation illustrates one example of defining the analysis requirements and applying the appropriate level of simulation (published by the authors as SAE paper 2016-01-0636). This work focused on intake port development for cylinder heads of spark-ignition engines. Tumble characteristics are generated by a combination of intake port geometry, valve lift and timing, and piston motion. While attempts to characterize tumble from steady-state cylinder head flow benches have been the traditional approaches, the ability to correlate the results to operating engines is limited. Very limited research has been published since 2000 – around the same time simulation began to take hold throughout engine development. The only available methods that account for both piston motion and valve lift are detailed computational fluid dynamic (CFD) analysis or optical measurements of flow velocity. Southwest Research Institute performs extensive combustion and charge air motion CFD using a moving boundary (adaptive mesh) under transient conditions. However, the complexity of this type of simulation makes it reserved for engine CFD experts. Additionally, the time required to set up, perform and post-process this analysis limits the amount of design iterations that can be evaluated. These approaches are too resource intensive for rapid comparative assessment of multiple port designs. The objective of this research was to develop a methodology to rapidly assess comparative intake port designs for their capability to produce tumble motion within the combustion chamber. In an engine development program, using this comparison, only the optimum design would then be submitted to the CFD expert for final tumble flow evaluation using moving boundary transient analysis to achieve accurate results of all air flow parameters desired. Based on the best features of current steady-flow testing, a simplified computational approach was identified to account for the important effects of the moving piston. The method was compared to moving-boundary CFD analysis. After some refinement, this method could consistently rank the tumble performance of comparative port designs and lead to the same conclusions as predicted with moving-boundary CFD simulation. Total resource requirements were less than one third that of the moving-piston analysis for the same engine.

Presenter Name: Mendez, Bernardo

Presenter Company: Rescale

Presentation Title: How High-Performance Computing in the Cloud Is Accelerating Advanced Driver Assistance Systems Simulations

Submission Type: Presentation

Keywords: ADAS, Advanced driver systems, Simulation democratization, HPC in the cloud, Co-simulation, Parallelization, On-demand

Abstract:

Advanced driver assistance systems, or ADAS, are designed to automate, adapt and enhance in-vehicle systems for road safety and improved driving experience. Multiple technologies are used to determine the vehicle surrounding conditions and to notify, alert, warn or control the vehicle if needed in order to support avoiding an accident or to provide a comfortable ride. These technologies require substantial simulation diversity and computational resources to achieve satisfactory product quality. ADAS research areas can be grouped into five key technologies: (i) visual sensing via multi-cameras and computer recognition; (ii) sensing via LiDAR (Light Detection and Ranging), commonly used to make high resolution maps, and RADAR (Radio Detection and Ranging), used to detect other vehicles and objects in the vicinity but with a longer range; (iii) connectivity framework, providing geographic and traffic information, as well as peer-to-peer communication; (iv) artificial intelligence (AI) and machine learning (ML) algorithms to provide vehicle autonomy; and (v) automotive human machine interface (HMI) design. Automotive manufacturers and tier-1 suppliers develop and validate ADAS in three ways: (i) testing the system on a prototype vehicle directly on the road; (ii) on a test-bench combining computer simulations of virtual vehicles or real-time embedded control systems with physical components, a technique more commonly known as hardware-in-the-loop simulation (HILs); or by (iii) using CAE simulation tools to model the physics of the complete vehicle or vehicle system under a wide range of different test scenarios. Historically, most of the CAE simulation tools used for ADAS are run using a low number of core processors, typically 1 to 8 CPUs; either due to models that don't require complex numerical methods for the engineering problems or mathematical physics that needs to be solved, or due to having model setups that rely on having fast communication speeds between the CPU and an embedded system or physical hardware connected to it. This limitation has forced some manufacturers to evaluate their models in only a handful of different scenarios from the broad spectrum of driving conditions their system might face on the field or to delay their development cycle on a market that is booming. Others, have started to look into leveraging high-performance computing (HPC) clusters to be able to run many more simulation conditions and in a shorter time span. For manufacturers that already have an HPC cluster on-premises it becomes a question of capacity and managing priority queues with other finite element simulations that typically use this resource; for those who don't have one, it become a question of cost, having to make a significant capital investment on a fast depreciating asset without knowing what the actual demand will be on an emerging technology as ADAS. Cloud HPC technology can be used for these applications providing unlimited computational resources completely on-demand. This presentation focuses on leveraging an advanced engineering model simulation of an ADAS workflow across multiple solvers with the HPC large scale parallelization capability on the cloud. We will discuss the challenges to overcome when deploying an ADAS workflow onto the cloud infrastructure, including user interface, networking, and data storage. We will also demonstrate the benefit of deploying ADAS workflow on the cloud through case studies and a live example.

Presenter Name: Micks, Ashley

Presenter Company: Ford Greenfield Labs

Presentation Title: The aDRIVE Simulation Framework: Automated Driving Refined in Virtual Environments

Submission Type: Keynote

Keywords:

Abstract:

It has become increasingly apparent that simulation will be a necessary addition to real-world testing in order to thoroughly validate vehicle features at higher levels of autonomy. Numerous suppliers and research projects have emerged in this space, and Ford has prototyped a simulation workflow that flexibly meets the needs of specific projects through the use of open source gaming engine technology. This work complements existing modeling workflows within Ford, to fill gaps required to train and test next generation algorithms.

Presenter Name: Midlam-Mohler, Shawn

Presenter Company: The Ohio State University

Presentation Title: Curriculum Innovation to Meet the Growing Demand for Simulation Talent

Submission Type: Keynote

Keywords:

Abstract:

Simulation has become a key technology enabling advances in advanced vehicles. This success has driven a demand for new graduates that have improved capabilities in simulation. The Ohio State University Simulation Innovation Center (SIMCenter) is partnering with academic units to help shape these graduates through a wide number of academic programs and unique research experiences. This presentation will provide an overview of this multi-faceted approach with some specific examples of traditional classroom education, experiential learning activities, and teaching through research.

Presenter Name: Musunuru, Purna

Presenter Company: ESI North America

Presentation Title: System Simulation for Electric Vehicle Development

Submission Type: Presentation

Keywords: Electric Vehicles, NVH, Energy Management, Thermal Management, Battery Ageing, System Simulation, SimulationX, Modelica

Abstract:

As the automotive OEMs across the world start the development of next generation electric vehicles, they face unique challenges in terms of battery technology, system architecture, operating strategies and NVH. While effective choice of the first three is required to meet the requirements on metrics such as range of the vehicle, thermal management of the battery pack, energy management and lifetime of the battery, the absence of a conventional IC engine poses unique challenge for NVH since the cabin is relatively quieter in case of electric vehicles. System simulation is used both very early in the V-model of the product development for design concept evaluation as well as in the later half of the V-model for HIL and control software testing. As most products are made-up of multi-physical systems, system simulation focuses on interaction of all the subsystems and components of a technical system including the control aspect. This study presents the use of system simulation to evaluate design concepts in the electric vehicle development using the system simulation tool SimulationX. Based on the non-proprietary modeling language Modelica, SimulationX provides a platform dedicated to system simulation for modeling, simulation, analysis and post-processing of multi-physical systems. It comes with pre-built libraries that cover basic physical domains such as mechanics, electrics, magnetics, thermal-fluid etc. as well as dedicated libraries such as power transmission, vehicle drives & controls, electric energy storages etc. to cater specific applications. The presentation highlights the use of SimulationX to build subsystem and system level models and analyze the aspects of energy & thermal management, powertrain NVH and controls. While the energy management presents modeling and analysis to meet metrics such as energy consumption, battery lifecycle (cyclic and cylindrical aging), range, powertrain component sizing, thermal management analysis addresses the areas of battery heating & cooling and HVAC. Similarly, powertrain NVH analysis discusses how to build detailed transmission models to help identify the noise sources, minimize noise emissions, evaluate stresses in the components due to vibrations and perform efficiency studies. In addition, a framework to couple system simulation model with FEM based vibroacoustic model for interior cabin noise predictions will be discussed. Finally, the use of system simulation to arrive at control strategies for operating mode, transmission gearshift, battery thermal management system will be presented.

Presenter Name: Palmer, Tim

Presenter Company: MSC Software

Presentation Title: Multidisciplinary Simulations Provide a Pathway to Lightweight Automotive Systems

Submission Type: Presentation

Keywords: Automotive, durability, NVH, material modelling, multi-physics, co-simulation

Abstract:

As propulsion systems move more aggressively to battery electric architectures, the motivation and urgency to reduce automotive structural weight is even more important. This emphasis on lightweight systems presents new challenges for NVH, durability and Crashworthiness development, and the interaction between these once-siloled domains. Simulations are also being challenged to be more accurate as reliance on testing is reduced and the development risks have increased. MSC is providing enhanced simulation solutions that address these challenges Challenges also exist for the developers of software tools used to simulate complex interactions between the various attributes, such as durability and NVH, or aerodynamics/flow and acoustics. The need for multi-physics (multi-discipline) simulations has encouraged the development of co-simulation strategies and dedicated user interfaces that enable use of multiple software to solve multi-physics problems. Case studies will be presented that highlight the use of multi-physics simulations and not only the successes, but also the challenges that face engineers developing the next generation of vehicles and innovative solutions that are being provided by the CAE software industry.

Presenter Name: Panthaki, Malcolm

Presenter Company: ARAS Corporation

Presentation Title: Intelligent Simulation Automation is Foundational to a Widening Technology Landscape

Submission Type: Presentation

Keywords: Essential Components for Reducing Physical Testing, Intelligent Simulation Automation for SPDM, SPDM within PLM, Simulation Automation for Design Space Exploration and Generative Design, Simulation Driven Design, CAD/CAE Integration, Simulation Governance

Abstract:

The authors will describe why Intelligent Simulation Automation (ISA) is an essential component of a widening technology landscape in the automotive industry, required to implement a successful transition from a major reliance on physical testing to almost a full virtual simulation product verification process. ISA is also key to enabling a wide range of other strategic priorities including Digital Thread traceability within the PLM backbone, Digital Twin analysis for predictive maintenance and design improvements, design space exploration, generative design, and the quality assessment of additive manufactured products. At their core, each of these requires mainstreaming simulation automation and data management to work robustly across significant (and unpredictable) design changes and entire product families that share common functional/architectural characteristics. The current, manual, inefficient and silo'ed simulation process must be replaced by CAD-enabled, "lights-out" automation that is safely accessible across the product development team – Intelligent Simulation Automation enables this. The desire to automate simulation processes has existed for decades. The technique of choice is often scripting/programming, with unsatisfactory results, limited repeatability and minimal ROI. The ad hoc nature of this approach has resulted in fragmented solutions that do not work well across the entire design space, are difficult to comprehend, and isolated from other product information. Since the 1990's, optimization (PIDO) tools, have provided "process integration" to automate simulation steps. However, design changes, essential for any design space exploration (DSE), rely on automatically editing model files without semantic knowledge of their content which significantly limits the design change scope that can be explored at higher fidelity. The authors will describe why more effective enterprise-wide SPDM is foundational to achieving closed-loop traceability with requirements, test results, and design data and Intelligent Simulation Automation which better comprehends design changes. ISA is a fundamentally different approach that works robustly across significant design changes and across an entire product family, while supporting the appropriate level of mixed-fidelity models from 0-D through 3-D and the various physics. Different from the scripting and PIDO approaches, the introduction of a neutral CAE data model directly into the PLM platform for SPDM provides an abstract model which significantly expands the design scope of the automation templates, enabling analysts to focus on real simulation challenges instead of administration. The authors will present use cases in the automotive, electronics and heavy equipment industries to demonstrate how various companies have achieved ROI using Intelligent Simulation Automation.

Presenter Name: Popielas, Frank

Presenter Company: SMS_Thinktank

Presentation Title: Systems Engineering – Challenges for Management in the Automotive Industry

Submission Type: Presentation

Keywords: Systems Engineering, System Modeling and Simulation, CAE, sustainable Innovation, Maturity, Simulation & Analysis, Cultural change, digital twin, internet of things

Abstract:

To remain competitive in our modern fast-paced engineering environment companies are challenged, not only to leverage the latest technology to their processes and engineering tools in product and process development, but they are also being tasked to re-invent themselves as a business. Companies can no longer afford to develop products in a “vacuum” but must now interact across well defined “silos” of subject matter experts during product development, market introduction as well as in-service to retirement. In our modern connected world, to properly utilize virtual engineering, companies must be able to adopt methods and processes that enable technologies such as the Internet-of-Things (IoT), Digital Twin, etc. Systems Engineering thinking and the enablement and deployment of the latest best practices and solutions in this space are crucial for the successful development of complex systems that have become part of most products in today’s world. Within companies, it has become apparent that tools alone will not save the day. Tools alone can no longer be the guiding factor for developing sound business processes. Companies need to re-think the way they work and organize themselves. They need to start thinking in terms and order of: Organization / Culture - Processes - Tools. This requires, especially for management, a more active engagement model while at the same time provide an environment for creativity and flexibility for their workers. Traditional methods to run a business are no longer sustainable for the long term. Some critical adjustments must be made to allow for innovation. One of the major challenges traditional engineering companies face in this context is, how to merge simulation & analysis with the world of systems engineering into system modeling and simulation (SMS) and how to realize the benefit from creating such system modeling and simulation driven engineering environment. In this presentation we will discuss the technical challenges management is currently facing and how they can be addressed in this ever-increasing complex engineering environment.

Presenter Name: Röver, Wulf

Presenter Company: Dassault Systemes SIMULIA Corp.

Presentation Title: Electric Drive Noise and Vibration Analysis

Submission Type: Presentation

Keywords:

Abstract:

Next-generation vehicles will be electrically powered, which means that the sound of the internal combustion engine will no longer be present to cover any other noise. Therefore, crafting the acoustic experience inside the car is highly important in order to sustain the level of quality perceived expected by consumers. One step towards the analysis on vehicle level is the investigation of sub-systems: Electro-magnetic forces and gear whine are leading to the noise and vibration characteristics of electric drive systems. In order to meet requirements for comfort and reliability, multi-domain analysis with linked simulations of the entire system are required. For enabling engineers to easily run trade-off studies and ultimately parametric optimizations, the holistic use of parametric models is essential. On the example of a flexible multi-body simulation including electromagnetic forces, we will show how the multi-domain analysis is carried out and how automated model updates and process execution dramatically reduce the time and effort to study numerous design alternatives.

Presenter Name: Saadat, Masoud

Presenter Company: Ford Motor Company

Presentation Title: Motor and Gear NVH CAE Analysis for a Hybrid Transmission Development

Submission Type: Presentation

Keywords:

Abstract:

Tonal noise such as motor whine and gear whine is more prominent for an electric drive (e-drive) powertrain in a HEV or BEV vehicle. The source of the motor whine is the motor electromagnetic forces, whereas the gear whine originates mainly from gear transmission errors. Structural response of the powertrain to the excitations can result in excessive noise which can negatively affect customer satisfaction. This paper presents CAE analyses on such noise of a HEV transmission for an e-drive powertrain NVH assessment and improvement. Predicted motor forces from ANSYS Maxwell electromagnetic analysis are applied for assessing airborne and structure borne noises of the transmission. Gear NVH attribute is investigated through advanced Romax modeling and analysis. The CAE analyses are conducted throughout the HEV transmission development to guide in design selections for NVH, assessments against targets, and necessary counter measures for NVH improvements. The CAE predictions are validated through the correlations to test data.

Presenter Name: Shaxted, Matthew

Presenter Company: Parallel Works

Presentation Title: Predictive Modeling for INDYCAR's Driver-in-the-Loop Aerodynamic Simulators

Submission Type: Sponsor Case Study

Keywords:

Abstract:

INDYCAR's adoption of modeling and simulation has been instrumental in improving race speed, safety and entertainment over the years. Improvements to aerodynamic kits prescribed to the racing teams is constant, with the objective of reducing vehicle drag and increasing speed, while balancing competition between leading and trailing vehicles. INDYCAR continues to push aerodynamic improvements, and with help of it's research partners ARC, R Systems & Dell EMC and Parallel Works, it is pioneering new methods to enable more exhaustive modeling, near-real-time predictions of outputs and ultimately, driver-in-the-loop simulators whereby vehicle changes can be physically tested far before an aerodynamic kit is specified. This presentation will showcase the beginning of these cutting-edge innovations, including the development of parametric models for exploring vehicle draft position, creation of response surfaces for key metrics, and the integration of these response surfaces into predictive methods that will eventually enable the near-real-time driver-in-the-loop simulators.

Presenter Name: Singh Pahwa, Gurdeep

Presenter Company: Mahindra Automotive North America

Presentation Title: Design and Optimization for Engine Mount Stiffness Using Multibody Dynamics Approach

Submission Type: Presentation

Keywords: Engine mount; Vibration design; DOE; Design optimization

Abstract:

An engine mounting system is the primary means of providing vibration isolation between the engine and chassis. This paper introduces a new method to develop an optimal and robust solutions of engine mounting system. In this study, design optimization of engine mount for passenger vehicle is proposed using MSC.ADAMS and modeFRONTIER. The load cases are developed for powertrain normal mode analysis, static load analysis, Idle and engine shake analysis with 6-DOF and 13-DOF models. Multiple load cases are run simultaneously to evaluate engine mount linear, non-linear and dynamic stiffness to optimize for all the load cases. Multi-objective formulation gives a range of pareto optimal solutions. Robustness assessment is also performed on pareto designs by including uncertainties in the design parameters, enabling a developing set of samples generated around pareto nominal design point. These samples will be used in estimating probability distribution functions for output variables. The goal of this study is to identify a design is robust against parameters change within their defined range. The optimum parameters obtained from robustness assessment are then applied for full vehicle car model. A significant reduction in the transmitted force and engine displacement is demonstrated.

Presenter Name: Wang, LS

Presenter Company: The Ohio State University

Presentation Title: Automating Parametric Redesign of Structural Thinwalled Frames from Topology Optimization Results

Submission Type: Presentation

Keywords: Topology optimization, Light weight structures, parametric cross-section design

Abstract:

With the increasing demand for a shorter lifecycle of automotive production to stay competitive in the field, automotive manufacturers often share the components of the newer models closely with the related product families or previous generations. Combined with the constant push from the US regulations for higher fuel efficiency automotive manufactures are actively looking at different approaches to design and manufacture light weight vehicles while maintaining their crashworthiness. Driven by these two motivations, in this paper, we proposed the methodology of automating the parametric redesign of structural thin wall frames using topology optimization results. Generally, in the process of designing an automobile, the stylists will first develop a conceptual design, together with the interior and exterior packaging of the vehicle. Then, designers will optimize the topology of the Body In White (BIW) at the component level before moving on to Finite Element Analysis (FEA) and crash simulation and eventually the final design of the vehicle. Usually, due to the complexity of the of the vehicle model, the computation time to run the FEA and crash simulation is very high. In this research the topology optimization of the BIW is used to design new lighter structures by looking at the cross-sectional properties of the topology optimization results and matching them with properties of a new sheet-metal part's cross sectional design in the allowable design space.

Presenter Name: Wang, Cong

Presenter Company: General Motors Corporation

Presentation Title: Modularization of FEA Models as Key Enabler for Simulation Data Management

Submission Type: Presentation

Keywords: Simulation Data Management, CAE model modularization, Enabler for CAE leading design

Abstract:

At leading automotive OEMs, CAE community have been stepping up to face the increased challenges: • More stringent vehicle mass/performance targets and packaging requirements • Further emphasis on up-front CAE synthesis to lead the vehicle development • Proliferation of vehicle variants and loadcases with reduced development time • Increased bandwidth for sharing vehicle architectural and commodity parts • Global execution and work sharing At GM, CAE is increasingly called upon to • Make early assessment/synthesis and deliver actionable insight in the form of proposals/counter measures for product innovation • Balance and manage requirements/targets and their flow down • Leverage and execute through effective global engineering work sharing among full-functional engineering centers at numerous regions (i.e., not just one mega engineering center supported by satellite groups) To help meet the challenges, GM CAE is on a journey for value-driven Simulation Data Management (SDM) implementation as part of its CAE strategy. When taking a general look at how SDM has been planned or implemented at various companies/institutes in different industries, we have observed the plans/implementations at many large OEMs and cast in various themes have explicitly or implicitly the following common assumptions: • Need a comprehensive and high fidelity design "freeze" as starting point • Perform CAE assessment/review mainly in discovery mode of the tracked design • Most CAE objects remain in the native format of individual CAE apps and many are constructed at relatively high granularity mapped to on-going design but without internal modularization In essence, CAE's effort is mainly focused on performance statusing of the on-going design at current gate/milestone and suggest remediation to be addressed by next gate/milestone. In this context, SDM can indeed help tracking and bringing together CAE objects with proper pedigree. In reality, we know that (the ".." in the bullets below is left for imagination): • Design never freezes except for … • Synched PDM/CAD data are not necessarily complete and mature except for … • Each key review gate needs to be a decision (not discovery) gate based on most upto date design status and proposals (which may not have gone through a synched PDM/CAD release) • SDM's value will be limited if CAE objects are still trapped in siloed apps and granularity not aligned not aligned with CAE proposal development At GM, we view the SDM implementation from the perspective that it is a decision support function meant for leading the design, but not part of the digital product design & release process itself. This requires further comprehending the traits and needs of assembling and managing CAE models as compared to PDM/CAD. We see the need for a modular approach to reconsider how CAE models and objects should be built and assembled that would promote much improved inter-operability, rapid decompose, re-content, and re-assembly, not just for a given model, but also for a family of relevant models. Enablers coming out of the modularization effort are expected to facilitate: • Model content management of 'surrogates/abstracts/functional' from other sources as well as from PDM/CAD • Subsystem and components model/module re-use • CAE proposal development and rapid and systematic model updating • Management of CAE proposals This paper will discuss the development of such enablers and their applications.