Abstracts Submitted for the 2024 SIMULIA Americas Users Conference

This document contains abstracts submitted for the SIMULIA Americas Users Conference, held in Novi, MI, on April 30-May 2, 2024. We thank the authors for their efforts in preparing these presentations.

Plenary & Keynote Presentations

Democratization of Simulation for Accelerated Medical Device Development

Suzanne Ferreri, Director R&D Design and Development, BD

BD is a leading medical device company in the world committed to enhancing the safety and efficiency of clinicians' care delivery process. The company develops innovative technology, services and solutions that help advance both clinical therapy for patients and clinical process for healthcare providers. To maintain this position, BD R&D is constantly evolving methods to deliver high-quality and safe devices to customers faster. BD has partnered with SIMULIA to develop simulation templates that enable design engineers who are not specialists in simulation to model common required tests on devices, encapsulating complex nonlinear physics in simple, easy-to-use interfaces. These templates are developed by simulation specialists so the team has confidence in the results. They allow designers to be empowered by the democratization of simulation, iterate virtually, and optimize the design faster throughout the design development process. In this presentation, we will describe the development process, actual usage of the templates in design and benefits we have enjoyed from the partnership.

Achieving Large Scale Detailed Component Level Structural Simulations

Mark Taylor, FEA Process Development Lead, The Boeing Company

Structural simulation in aerospace has progressed over the decades from simple vehicle stick models to acreage vehicle-level loads models, and now detailed component level models that can simulate complex joint loads. Advancements in the Abaqus solver along with access to larger high-performance computing environments has enabled a deeper understanding of complex designs and can greatly reduce program risks during full scale structural testing. In the past, smaller detailed models have been used to verify designs, but these models often have limited application, inconsistent modeling techniques and fail to account for changes by the surrounding structure. A larger integrated model can capture interactions over larger assemblies developed by many engineering teams while also standardize idealization and analysis approaches. Development of these complex models presents many challenges as the size and usage of these models no longer can be performed by a single analyst and now requires a team of simulation specialists to support. Consideration to the cost and effort required to build a larger model presents many challenges to the simulation analysis teams. This presentation will take a closer look at many of the issues that need to be considered when leveraging team-based model creation, configuration controls, and integration of vendor software with company processes and best practices. Simple scripts or a single application are no longer sufficient, rather a modular environment that integrates vendor and company services is necessary. An environment that can be progressively scaled to keep pace with new technology and software solutions is required.

Physics-Informed Machine Learning for Engineering Applications

George Karniadakis, Charles Pitts Robinson and John Palmer Barstow Professor of Applied Mathematics and Engineering, Brown University

Physics-informed neural networks (PINNs) and physics-informed deep neural operators, introduced in my group, have been employed across all domains from molecular scales to astrophysics, from engineering to systems-biology and finance. They blend seamlessly data and parametrized physics without the need of elaborate data assimilation techniques. In engineering, applications can play an important role as the fundamental algorithmic infrastructure for digital twins.

Virtual Testing, Simulation, and Validation: A Material Supplier's Perspective

Jameson Fee, Global Manager CAE, Celanese Corp.

As a material supplier to all business segments, Celanese is constantly improving ourselves in the way we support and run our business. From internal manufacturing digitalization to supporting our customers with accurate material cards, a multitude of digital twins have paved the way to being able to support all. In combination with internal efforts, there are also ever-developing customer requirements for support in the form of coupled simulations, more complex material testing and characterization, further detailed material cards, and thorough validation reports. This presentation will provide an overview of how Celanese is using our SIMULIA partnership and tools to support the ever-increasing requirements of the industry.

Battery Cell and Pack Synthesis: Simulation Leading Design

Faisal Sayeed, Engineering Group Manager, Battery Durability & Fatigue, and Saurabh Bahuguna, VDDV Global Technical Specialist, Battery Structures & Durability, General Motors Corp.

Conventional design process involves creation of CAD followed by analysis and subsequent iterations. This process can be slow and leads to incremental designs. The new paradigm of simulation-driven design involves analysis leading the designs by synthesizing them using physics-based tools. Implicit in the process is very fast design exploration and optimization, leading to evolutionary design in a significantly shortened timeframe. At General Motors, battery pack and cell synthesis is now the acceptable process with widely accepted understanding of the benefits. In this presentation, we will showcase the synthesis process via examples from both cell and pack design perspectives. SIMULIA tools are used in conjunction with other industry best-in-class tools to extract the maximum benefit from the state-of-the-art analysis methods. This has resulted in extremely fast design cycles with minimum use of physical hardware and testing.

Powering the Future: How Can Simulation Drive Energy Transition?

Ali Marzban, Director of Data Science and Analytics, NOV Inc.

The expanding global economy relies on the development of sustainable new energy sources. The solution to this challenge lies in the transition toward renewable energy, providing a feasible path to meet increasing energy demands while simultaneously lowering environmental impacts. Utilizing innovative designs based on simulation, we have the potential to create more reliable and efficient products, ultimately contributing to a reduction in carbon footprint. Join us in this talk as we explore the power of simulation toward a sustainable future, driven by renewable energy and a reduced carbon footprint.

SIMULIA Brand Update
Sebastien Gautier, Vice President SIMULIA Worldwide Sales & Marketing, Dassault Systèmes
SIMULIA technology and products are at the heart of Dassault Systèmes' strategy to increase the value, utility, and accessibility of virtual worlds to users and customers as well as to broaden our community. As society becomes more sustainable and circular, simulation will continue to reduce the need for physical prototypes and improve the functionality and performance of products and infrastructure for all industries throughout the entire economic lifecycle. This presentation highlights the latest from SIMULIA – trends in the simulation industry (including multiple physics, MODSIM, and AI), where we are positioned today, and where we are going. You will see that SIMULIA remains committed to delivering the most productive and complete experience in the industry to our users and customers.

Transformation Through Modeling & Simulation
Ramji Kamakoti, North America MODSIM Industry Process Director, Dassault Systèmes
MODSIM is at the heart of **3D**EXPERIENCE. We will demonstrate how MODSIM is a key enabler for transformation. MODSIM enabled processes can now reduce the times of complex modeling & simulation tasks from weeks to days. By widespread deployment of such processes, MODSIM can compress development cycle times, and yet still allow for the cutting-edge optimization of complex systems, with advanced design space exploration techniques and machine learning. This ability to do realistic virtual testing earlier allows more innovation and more efficient use of resources. The overall effect of these transformations is to deliver significant engineering business benefits – a more desirable and cost-effective product, delivered more quickly. We will follow the design of a new battery electric vehicle and demonstrate how MODSIM can affect the design process all the way from battery electrochemistry to crash analysis.

AI-Enhanced MODSIM for Design Exploration
Victor Oancea, SIMULIA R&D Sr. Technology Director, CSO Structures, Dassault Systèmes
We will explore the benefits of AI-enhanced MODSIM technology to accelerate Physics-based Design Exploration. While MODSIM compresses development cycle times, for large complex products the execution of the used physics-based solvers can sometimes be a significant bottleneck. Machine Learning-generated 3D surrogates can come to the rescue to significantly accelerate the process by eliminating the computational cost of physics computations once a model is trained. We will illustrate several multiphysics examples, including structural, fluids and electromagnetics applications from various industries. The examples include scenarios that train Machine Learning surrogates from either parametrized designs and excitations or from data that is not parametrized but may exist historically from previous years. With trained surrogates reducing execution times from hours to seconds, they may enable much more extensive optimization exercises when thousands of evaluations are no longer a prohibitive endeavor.

Customer Presentations

Long Fiber Composite Part Performance Predictions: Using FEA and Nonlinear Anisotropic Material Models

Zach Alderman, Design Engineer, & Mike Dillman, Design Engineer, Avient Corp.

Industry trends are influencing OEMs to convert legacy metallic components to high strength composites to capture benefits such as light weighting and ease of manufacturing. Long fiber thermoplastic materials are often used for metal replacement because of their high strength-to-weight ratio and dimensional stability. Avient uses Abaqus FEA software to create more precise quantitative simulation results. This presentation illustrates how Avient leverages software to help customers improve design accuracy, reduce the number of physical prototypes and expedite the product development process.

Aerospace Structures Simulation Analysis Process and Data Management

Kenneth Dang, Digital Transformation Simulation Analysis Lead Engineer and Solution Architect, and Chandra Subraya, Engineering Consultant, The Boeing Company

Structural modeling, simulation and analysis generates a large amount of models/data during product development, production and product support. Configurationally managing and maintaining the traceability of those analysis artifacts are critical to aerospace product qualification and certification (PQ&C). Simulation/Analysis Process and Data Management (SPDM/APDM) are critical to Boeing's effort in digital transformation. In this presentation, we will discuss Structural Analysis Process and Data Management (APDM) where a digital thread of analyzing aerospace structural integrity will be demonstrated by capturing CATIA geometry, generating finite element models at various levels, performing margins of safety calculation, generating Strength Check Notes (SCNs), all of which are critical artifacts for airplane certification and fleet support. Presentation demo is focused on the Interior Responsibility Center (IRC) Integrated Design Engineering and Analysis System (IDEAAS) digital thread systems in **3D**EXPERIENCE: from capturing an IRC assembly CATIA V6 model to performing analysis of the assembly to creating SCN through automation and storing SCN in **3D**EXPERIENCE PLM, which leverages **3D**EXPERIENCE PLM capabilities for data traceability and data synchronization. Details of product lifecycle management of analysis SCNs, which include the use of **3D**EXPERIENCE process composer to link and automate SCN analysis process, store/manage SCNs based on **3D**EXPERIENCE product structure, and configuration control of SCNs through **3D**EXPERIENCE impact graph, etc., will also be discussed. We will also discuss the implementation and deployment of APDM for Boeing enterprise pathfinder programs and demonstrate the benefits: Reduction in conceptual design-analysis cycle time, cost savings and enabling of first-pass quality.

3D Electromagnetic Design and Mechanical Failure Analysis of Membrane Supported Antennas Operating Over 100 GHz Using CST MWS and Abaqus

Stefan Castravete, General Manager, Caelynx Europe

The study was performed by Caelynx Europe and National Institute of R&D in Microtechnologies (IMT). 5G devices operating up to the millimeter wave band (30 GHz) are already widely deployed, offering up to 20 Gbps transfer rated. The smaller wavelengths have already led to higher integration features and on-chip antenna deployment. The next generation of communication devices (6G) will go even further and with operating frequencies up to the THz being taken into consideration. As always, one bottleneck is the wavelength and substrate dependent antenna. One approach to direct integration of high-performance antennas in mainstream CMOS/BiCMOS technologies is the use of thin dielectric membranes processed through back end of line (BEOL) deep etching of the lossy silicon substrate. With this motivation, we designed a fully parametric model of a Folded Slot Antenna Array (FSAA) using

CST Microwave Studio. The layout was optimized for operation above 100 GHz. The antenna is supported by a 2.1 µm thick SiO2/Si3N4 dielectric membrane released through deep reactive ion etching (DRIE) of low-resistivity (ρ = 10 Ω·cm) silicon. Input matching and radiation performance as a function of frequency are the main tradeoff parameters. Over 20% fractional bandwidth and peak gain of 5 dBi are obtained by 3D full wave simulations using the Time Domain Solver (Finite Difference Time Domain method). The results are validated using on wafer measurements of a fabricated test device. Since the membrane supported antenna has a symmetrical, bi-directional radiation characteristic, one application scenario will place the antenna over a metallized reflector, which will lead to the recovery of the backside radiation. The result will be a single lobe broadside radiation characteristic with a peak gain around 7-8 dBi. In case of vacuum applications, it's important to assess the effects of the pressure on the membrane. The 3D model exported by CST MWS is thus imported in Abaqus, where pressure/force/deformation analysis are performed. The breaking point and deformation of the membrane are assessed and a worst-case scenario of the deformation (right before failure) is exported as a 3D model back to CST MWS. A new 3D EM simulation is performed and the input matching and radiation characteristic changes are presented.

Enhancing Safety and Efficiency in Heavy Machinery: A Novel CAE-Based Approach for ANSI Multi-Impact Validation

Arshad Khan, Engineer, Research and Development, CNH Industrial

This presentation introduces an innovative approach in the field of Computer-Aided Engineering (CAE) for enhancing the safety and efficiency of heavy construction and off-highway vehicles. The primary focus is on improving Roll-Over Protective Structures (ROPS) and Falling Object Protective Structures (FOPS) through advanced simulation techniques. The traditional method of ensuring the integrity of these safety features heavily relies on physical destructive testing, governed by ANSI/ITSDF B56.6 standards. However, this research proposes a novel use of the Abaqus CAE platform to simulate multi-impact scenarios using a dynamic implicit solver, which offers a more time-efficient alternative to the Abaqus explicit method, particularly for simulating ten consecutive impacts of a cube. The study details a simulation protocol where a 45kg test cube is dropped 10 times from a height of 1500 mm onto the protective structures, aligning with the standard's requirements. The goal is to limit permanent deformation to less than 18 mm without structural fractures, as mandated in ANSI/ITSDF B56.6-2011, section 8.16.3. The research provides a comprehensive comparison between the simulated results and those obtained from traditional testing methods, demonstrating a high correlation in terms of permanent deformation outcomes. The findings highlight the potential for significant reductions in cost and time during the product development cycle. They also confirm the reliability of CAE tools in predicting the structural integrity of ROPS and FOPS under real-world impact conditions. This presentation suggests a paradigm shift in the methodology of heavy machinery safety testing, promoting more efficient and reliable alternatives to physical destructive testing.

Transient Snowblower Simulations in XFlow

Jamison Huber, Lead Engineer, Doosan Bobcat

A set multiphase transient snowblower simulations were performed using XFlow. Because of the wide variety of snow conditions/properties, a suitable simulation fluid had to be created first. The simulation fluid was adjusted until results were produced that correlated with baseline physical machine testing. The baseline simulation identified several key areas where improvements could be made. Multiple design iterations were then simulated using the tuned fluid. The results were analyzed, and a solution was identified that improved cast distance while maintaining overall flow through the snowblower and limiting increases in power consumption.

HVAC Cooldown Simulation of a Compact Excavator Using PowerFLOW

Alan Perrault, Senior Simulation Engineer, Doosan Bobcat

Within the compact equipment industry, operator comfort has become an important focus. One aspect of this is the HVAC system, which allows operators to comfortably operate their machine in more extreme weather conditions. CFD simulation can help accelerate the development of the HVAC system without the need to build prototypes or run physical tests. This presentation describes the process used with PowerFLOW to set up and run a solar soak simulation followed by an HVAC cooldown simulation on a compact excavator. Correlation to physical test will also be presented.

Heat Transfer Analysis of Spray-Applied Fire Resistive Material (SFRM) Protected Steel Columns

Zheng (James) Peng, Lead Scientist, FM Global

We performed heat transfer analysis of Spray-applied Fire Resistive Material (SFRM) protected steel columns that are exposed to the standard ASTM E119 temperature history. A Finite Element Analysis (FEA) model, using Abaqus, was established to simulate the heat transfer. Heat is transferred from the furnace to the exposed SFRM surface through "interactions": a "surface film condition" for the convection boundary condition and a "surface radiation to ambient" for the radiation boundary condition. Both boundary conditions require the definition of a "heat sink/source," which follows the temperature history of the furnace. The material property models by Eurocode were used for the steel and the material properties of six SFRMs determined by testing were used for the SFRMs. The model was validated using available test data. A range of commonly used W-shape steel columns protected by SFRMs with various insulation thicknesses were analyzed. The results allow for the construction of temperature history curves for each protected steel column and thus instant readings of the time needed for the column to reach any critical steel temperature (fire resistance rating). Future work includes developing a simple formula for fire resistance estimation of SFRM-protected steel columns using the extracted fire resistance rating data.

Using Wave6 to Optimize Acoustic Covers on Powertrain Components to Reduce Radiated Noise

Ricardo De Alba Alvarez, CAE Process Lead and Jason Konopa, Vehicle P/T NVH Product Development, Ford Motor Co., Julien Legault, SIMULIA R&D Software Engineering Senior Manager Dassault Systèmes

Characterizing and minimizing the radiated noise from powertrain components is important for both battery electric vehicles and traditional ICE vehicles. The radiated noise from a given powertrain component depends not just on the vibration of the component but also on the damping, insertion loss and absorption from any covers that might surround the component. The spatial variation of the thickness of the cover along with the spatial variation of any air gaps between the cover and the component can modify the acoustic performance of the cover. It is of interest to determine if there are optimal cover designs that can reduce radiated noise. This presentation describes a collaboration between Ford Motor Co. and Dassault Systèmes that used Wave6 to model the radiated noise from an electric motor. Both bare and covered configurations were analyzed and an adjoint-based optimization was performed within Wave6 in order to find optimal cover designs. The presentation will provide examples from this work along with comparisons to test measurements.

Automated Leaf Spring Suspension Modeler in Simpack

Ameya Apte, Vehicle Dynamics & Load Simulation Engineer, General Motors Corp.

Leaf springs are one of the primary suspension types for body on frame vehicles. They can have various configurations depending on the vehicle requirements. From a simulation modeling perspective, the suspension contains multiple flexible steel plates interacting in multiple ways making the multibody dynamics modeling of a topology intricate, challenging and resource intensive. Considering both aspects, tailor-made modeling of leaf springs for each vehicle program would be time

consuming, error prone and complex to standardize as a process. To allow the capability to model various leaf spring configurations and alleviate the above problems an automated tool was developed. The automated tool allows users to model a leaf spring suspension by only inputting the design parameters for that suspension. The model that is created can then be used to predict vehicle dynamics performance and loads. The tool has been developed with the flexibility to incorporate new capabilities without affecting the user workflow.

Transient Aerodynamics Simulations of a Passenger Vehicle During Deployment of Rear Spoiler

Henry Tuit Farquhar, Aerodynamics Technical Specialist, General Motors Corp.

In the context of vehicle electrification, improving vehicle aerodynamics is not only critical for efficiency and range, but also for driving experience. In order to balance the necessary trade-offs between drag and downforce without significant impact on the vehicle styling, we see an increasing amount of active aerodynamic solutions on high-end passenger vehicles. Active rear spoilers are one of the most common active aerodynamic features. They deploy at high vehicle speed when additional downforce is required. For a vehicle with an active rear spoiler, the aerodynamic performance is typically predicted through simulations or physical testing at different static spoiler positions. These positions range from fully stowed too fully deployed. However, this approach does not provide any information regarding the transient effects during the deployment of the rear spoiler, which can be critical to understanding key performance aspects of the system. In this presentation, we propose a methodology leveraging computational fluid dynamics (CFD) simulations utilizing the Lattice Boltzmann Method (LBM) enabling the accurate simulation of transient aerodynamics forces during deployment of a rear spoiler on a production level passenger vehicle. The simulation results are then compared with full-scale wind tunnel physical test data as a validation of the approach. This capability enables engineering teams to provide information to guide design decisions and can be generalized to model other types of active systems on cars such as active grilles and front splitters.

Electrode Calendaring Simulation with Abaqus Explicit

Haiyan Li, Technical Specialist, General Motors Corp.

Electrode calendaring is a common compaction process used in industry. The purpose of calendaring is to reduce the porosity of the electrode, which improves the particle contact and thus enhances the energy density of the battery. However, this process can bring some issues; for example, it may lead to particle pulverization and impaired electrochemical performance, and can cause failure of collector/foil layer because of severe wrinkling which will affect downstream operations. In order to study the effect of operation parameters on calendared electrodes, the calendaring process is simulated with Abaqus Explicit. Macro- and meso-finite element analysis methods are employed to study the calendaring behaviors in different scale levels.

Modeling Acoustic Transfer Functions in Trimmed Engine Bays Using Wave6

Chong Wang, Senior Engineer, General Motors Corp., Sascha Merz, SIMULIA R&D Software Engineering Director, & Rui Cao, SIMULIA Vibro-Acoustics Industry Process Senior Consultant, Dassault Systèmes

The transmission of airborne noise from the engine bay of a vehicle to the interior cabin is an important path that affects interior noise perceived by occupants. During vehicle development, it is important to be able to model the acoustic transfer functions to various components within the engine bay in order to set component level targets and to assess system level noise. It is also important to understand how these transfer functions are modified by various counter measures (for example, frunk absorbers, dash mats, wheel well absorbers, etc.). The acoustic space in the underhood of a modern electric vehicle can be geometrically complex and this geometric complexity can affect the way that sound propagates within the engine bay (removing geometric detail or simplifying the geometry

modifies the transfer functions). This geometric complexity therefore needs to be included in an analysis and this, in turn, affects the analysis methods that can be used. This presentation describes collaborative work carried out by General Motors and Dassault Systèmes that use new voxel-based acoustic finite element methods in Wave6 to model acoustic transfer functions in trimmed engine bays. The presentation will describe the approach and show some examples along with comparisons with test data.

Simulation of Loudspeakers in Vehicle Audio Systems Using Wave6

Wenlong Yang, Noise and Vibration CAE Engineer, General Motors Corp.

This presentation describes collaborative work carried out by General Motors, Bose Corp. and Dassault Systèmes that is concerned with the simulation of vehicle audio systems across a broad frequency range. In a previous presentation, we described simulation of acoustic transfer functions in a vehicle cabin using 'spatial gradient SEA' cavities in Wave6. In those studies, the source from each loudspeaker was described by a simple monopole. The current presentation describes an extension of the work to investigate more detailed models of the loudspeakers. In particular, mixed distributed and lumped parameter models of the loudspeakers are used in order to describe two-way coupling between the various electrical and mechanical components of the loudspeaker and vehicle interior. These models make use of the 'block diagram' functionality in Wave6 for creating mixed lumped and distributed parameter models. The presentation shows some examples of characterization of a specific loudspeaker along with comparisons against test data for acoustic radiation into various spaces.

Thermal-Mechanical + Electromagnetic Full-Wave Simulation: A Multiphysics Product Validation Workflow Using Abaqus + CST

Thomas Schlitt and Clint Patton, Senior Application Engineer – Electromagnetic, GoEngineer

Abaqus and CST Microwave Studio are used together to investigate the effect of thermal expansion on an inductive linear positioning sensor when the temperature is ramped from 23C to 125C. Abaqus/Standard solves the PCB distortion due to adiabatic thermal expansion of the sensor assembly. The deformed shape is then exported as an STL file for use in a Microwave Studio T-solver simulation. The circuit impedance and inductance are determined by CST in the undeformed (23C) and deformed shape (125C) to identify potential sensor performance degradations because of geometrical distortion and material property thermal-dependencies. This talk introduces a workflow in a sequentially-coupled thermal-mechanical-magneto-statics simulation using Abaqus and CST.

Data-Driven and Physics-Based Analysis of Downhole Tools – Packer Application

Shobeir Pirayeh Gar, Technical Advisor – Engineering Simulation & Technology, Halliburton Co.

Engineering design optimizations have been traditionally done using physics-based simulations, such as finite element analyses, where response of a system is determined through a set of partial differential equations satisfying the laws of physics. As the system becomes more complex with nonlinear behavior and highly coupled response parameters, exploring the entire design space by physics-based simulations may not be computationally cost effective. In this case, data-driven models can be added to the simulation workflow to enhance the efficiency and robustness of the optimization analysis. This presentation presents the optimization analysis of packers as one of the major downhole tools, where finite element simulations are conducted to generate discrete physics-based data points in the design space following Latin Hypercube Sampling (LHS) method. Neural network analysis is performed using the physics-based training data to build a surrogate model covering the feasible design space. A multi-objective performance function is established based on critical response parameters of the packer system for optimization. Numerical optimization analysis techniques such as genetic algorithm are used to find the optimum design. The results show the predictions of the

surrogate model are found within 5% proximity of the finite element analysis. Examples of successful design and deployment of packers using the above method are discussed. Abaqus and Isight were respectively used for physics-based and data-driven simulations as part of the SIMULIA products.

Kenworth T680 Next Gen Development Using PowerFLOW

Scott Temple, Aerodynamics Engineer, Kenworth Truck Co.

The recent public launch of the T680 Next Gen class 8 tractor came as a result of five years of development and fine-tuning. Critical to this development cycle was the use of PowerFLOW simulation software for aerodynamics and thermal performance. The team utilized an array of applications within PowerFLOW to optimize the overall system and individual subsystems to achieve a new benchmark for performance. This presentation will highlight the vehicle development process and how PowerFLOW played a central role.

Using the Latest 3D Printing Technology to Accelerate the Digital-First Process

Brent Vorst, Team Lead, Kinetic Vision

Kinetic Vision will present a study that demonstrates the effectiveness of a streamlined product development process that integrates computer-aided design (CAD), digital thickness prediction, design of experiments (DOE), 3D printing, and manufacturing line testing. By leveraging these tools, we were able to rapidly design, optimize, and manufacture a new bottle design. First, a parametric CAD model of the bottle was created in **3D**EXPERIENCE, allowing for precise control over the dimensions and shape of the product. Next, a digital thickness prediction method was used to generate accurate thickness models for all CAD designs. To identify the most promising designs, a DOE was executed using Process Composer covering a design space of geometry and material properties. The top three bottle designs were selected for further evaluation. Physical prototypes of each top design were 3D printed with realistic thickness distributions. The 3D printing technology used creates bottles that physically behave similarly to the mass-produced EBM bottles. The 3D printed bottles were physically tested on the manufacturing line to ensure their compatibility with the production process. The integration of CAD, digital thickness prediction, DOE, 3D printing, and manufacturing line testing proved to be an efficient and effective approach to product development. This digital-first method reduced the time to market by roughly 50% and the prototyping cost by 90%.

Abaqus User Element (UEL) Implementation of Time-Dependent Constitutive Behavior of Dielectric Elastomers

Kamalendu Ghosh, Research Scientist, KLA Corp.

There has been increasing interest in the constitutive modeling of dielectric elastomers due to their potential in enabling new technologies such as soft robotics, actuators, and haptic devices. Under realistic time dependent loadings, dielectric elastomers are inherently dissipative. They dissipate energy both through viscous deformation and through friction in their electric polarization process. However, majority of constitutive models and the Finite Element implementation for such models considers only mechanical dissipation. Accounting for electric dissipation, in addition to mechanical dissipation is crucial when dealing with applied alternating electric fields. A first fully coupled 3-D constitutive model for isotropic and incompressible dielectric elastomers was proposed by Ghosh and Lopez-Pamies. In the first part of this talk, the governing initial-boundary-value-problem and the constitutive model will be introduced. Following this, a detailed step-by-step procedure of the Abaqus UEL implementation of the mixed-FE formulation of the governing equations will be spelled out. In the last part, the Abaqus UEL would be deployed to fully describe the electromechanical behavior of VHB 4910 (from 3M) under a complex time-dependent electromechanical load.

Project Gamma Advanced Analysis Features

Jason Action, Aeronautical Engineer Sr. Staff, Lockheed Martin Corp.

Lockheed Martin's Advanced Development Programs' Star Drive initiative has been advancing the integration of design and analysis tools to streamline the overall process and amplify the digital thread. Project Gamma, a part of the Star Drive initiative, has used Dassault Systèmes' 3DEXPERIENCE platform to advance the utilization of the generative design and analysis capabilities. This project has also increased Lockheed Martin's capability to develop and perform Abaqus analyses within the platform as part of an overall generative design workflow. In developing and executing Abaqus models, the need to utilize non-standard keywords as part of the analysis can be a major enabler. This is often performed by injecting text edits to an input file before the analysis is initiated, which is an interruption to an integrated workflow and thus the digital thread. This presentation will highlight some of the work completed on Project Gamma to utilize inpRW to initiate a Virtual Crack Closure Technique (VCCT) analysis of a composite double-cantilevered beam from within the platform. The goal is to integrate the necessary alterations to the analysis within the platform and maintain the digital thread between the analytical model and parent geometry.

Auralization of the Sound from Microswitches Using Abaqus and Wave6

Luca Francesconi, Senior FE Mechanical Engineer, and Nuno Valverde, Logitch, and Sterling McBride, Dassault Systèmes

Microswitches are used in a range of products including computer mice and keyboards. In these products, the micro-switch is often designed to act as a "tactile device" that provides physical feedback to the user when they use the device. For mice and keyboards, this ensures that the product provides an engaging and precise navigation experience. The physical feedback can be mechanical and related to the force-time profiles experienced during operation of the device. However, the feedback can also be acoustic and related to the sound that the device makes during operation and how this sound is perceived by a user. During product development it is therefore important to model both the mechanical behavior of the device and also the sound (and sound quality) of the device during actuation and release of the microswitch. The sound of the device can be modified by installation effects and so it is also of interest to model sound in both free-field and installed conditions. This presentation describes collaborative work carried out by Logitech and Dassault Systèmes that uses Abaqus and Wave6 to model the mechanical and acoustic behavior of different microswitches (including sound quality and auralizations).

High Strain Rate Impacts on Ultra High-Performance Concrete Using a Finite Strain HJC Concrete Model

Youssef Hammi, Associate Professor, Mississippi State University

Protective structures and other construction applications have been designed with Ultra High-Performance Concrete (UHPC) because of its exceptional strength, durability, and resistance to withstand high velocity impacts of projectiles. Understanding the mechanical response of UHPC materials under high strain rate loadings is therefore important for these applications. This is conducted through both an experimentally and numerically based methodology. UHPC targets are impacted with a spherical projectile at velocities ranging from 432 to 1459 m/s and three target thicknesses ranging from 25.4 to 58.1 mm. The response of the concrete target was captured using an extended version of the Holmquist-Johnson-Cook (HJC) concrete model with its parameters calibrated to confined compressive experiments of the BBR9 concrete at low strain rate. The Holmquist-Johnson-Cook (HJC) concrete was implemented into the user material subroutine VUMAT of Abaqus/Explicit using a finite strain formulation.

Design & Development of Deepwater Active Control Device (ACD) Seal Sleeves Using Abaqus Hyperelastic Simulations

Saravanan Sundaramoorthy, Lead Elastomer Development, MPD SME, NOV Inc.

The Active Control Device (ACD) is a leading-edge technology in deep water non-rotating active sealing system used to seal and divert drilling fluid in the annulus to the topside MPD manifold during Managed Pressure Drilling (MPD) operations. This equipment is fully integrated into the drilling riser system and is located below the tension ring. In an applied surface back pressure (ASBP) MPD application, the ACD uses two independent spherical annular packers to activate and control two seal sleeve elements assembled in an 18¾ inch OD Seal Sleeve Assembly (SSA). The SSA is held in place within the annular packers by upper and lower locking dogs. When activated, the annular packers close on the seal sleeve element elastomers, causing the seal sleeves to deflect radially inward, to seal against rotating/axially moving drill string. The Seal Sleeve Assembly (SSA) consists of a polymer honeycomb insert co-molded with elastomeric component. The nonrotating Polymer insert provides wear resistance for contacting the drill string and elastomeric buffer material holds the polymer insert in place with the Annular Packer element during activation. This presentation details about the design and development of ACD Seal sleeves & Annular Packers using advanced hyperelastic simulation using Abaqus Implicit/Explicit solvers. Lab scale testing were used to define detailed material model inputs and material model characterization/validations were carried out using strain energy potential functions, Abaqus user subroutines for Elastomeric and polymeric components to capture the nonlinear and nearly incompressible attributes of the elastomeric components in the simulation. Correlation between the simulation and the prototype test results for various API 16RCD, API 16A and real-world operating conditions validates the standard design and analysis techniques/methods for further design improvements/variants. This has led to fast-track development of Active Control Device sealing element for different drill pipe sizes and reduces number of prototypes, tests needed during the qualification phase to validate the field scenarios.

Innovating Geothermal Frontiers: NOV's Technological Drive Toward Sustainable Energy Excellence

Jerry Wong, Senior Engineer, NOV Inc.

Throughout its extensive history, NOV has established a remarkable legacy of pioneering innovation and technological advancements that traces its roots back to the earliest days of the oilfield. This rich heritage serves as the foundation upon which NOV builds and evolves, consistently contributing cutting-edge technology-driven solutions encompassing core engineering, manufacturing, and project management expertise. These solutions play a pivotal role in empowering the global energy industry, especially as the world undergoes a transformative shift toward a more diversified and lower-carbon energy portfolio. As the momentum behind lower-carbon energy initiatives intensifies, particularly in geothermal projects, the demand for precisely tailored technologies becomes increasingly imperative to ensure optimal performance and cost-effective operations. The success of geothermal operations hinges on the availability of fit-for-purpose tools capable of withstanding the rigors of harsh, high-temperature environments, complemented by the expertise of seasoned personnel. In alignment with this commitment to sustainable energy, NOV strategically leverages advanced technologies such as SIMULIA's Abaqus and fe-safe. These cutting-edge tools are instrumental in the design and development of a groundbreaking downhole drilling motor, enabling NOV to push the boundaries of sustainable energy production. This innovative motor empowers geothermal operations to drill deeper, reach farther, and operate faster, thereby enhancing efficiency and effectiveness in challenging geothermal environments. In essence, NOV's dedication to advancing technology not only reflects its historical legacy but also positions the company as a crucial player in propelling the global energy industry toward a more sustainable and environmentally conscious future.

Signal Integrity Analysis for an eMMC Memory Using PCBs and Packages Module

Radu Voina, Optimal Designs; Marcel Manofu, Continental Automotive Romania; and Longfei Bai, Dassault Systèmes

This presentation comprehensively analyzes the eMMC memory and an ARM CPU using the PCBs and Packages Module of CST Studio Suite. The study leverages two distinct workflows within PCB Studio to rigorously assess signal integrity while ensuring adherence to the Embedded Multi-Media Card (eMMC) Electrical Standard criteria. The first workflow, SI-FD Analysis, focuses on examining the frequency-dependent S-parameters of selected signal nets across I/O devices. Leveraging advanced Solver Techniques, specifically 2DTL, this approach yields a comprehensive set of S-Parameter curves derived from the component pins under investigation. In the second workflow, SI-TD Analysis, the study delves into the transmission behavior of specific signal nets, considering voltage excitations and nonlinear loadings on I/O device pins. This comprehensive analysis encompasses factors such as transmission delay, reflection with overshoots and undershoots, and cross-talk. Like SI-FD, SI-TD Analysis uses robust 2DTL Solver Techniques and provides crucial voltage and current curves from the relevant component pins. By integrating these workflows within PCB Studio, this paper offers a holistic understanding of signal integrity issues between an eMMC memory and an ARM CPU. The findings contribute insights for optimizing signal performance and ensuring the reliability of electronic systems.

Fracture Mechanics Fitness-for-Service Analysis Case Studies Using Abaqus and 3D Crack Meshes

Greg Thorwald, Principal Engineer, Quest Integrity USA LLC

When a crack is found in essential equipment two common questions are (1) will it break, and (2) when will it break? The API 579-1/ASME FFS-1 fitness-for-service (FFS) standard describes methods to answer those questions. When the available API 579 crack solutions are not sufficient for complex equipment geometry, Abaqus is used with 3D crack meshes to calculate the values needed for the FFS assessment. Important Abaqus capabilities include the J-integral calculation for the focused mesh at the crack front, nonlinear material given by stress-strain curves, tied contact to connect the crack mesh with the larger mesh, and nonlinear geometry for cases with large strains. Examples presented include an assessment using a custom failure assessment diagram (FAD), a ductile tearing instability analysis, and a crack growth analysis. The custom FAD for the crack assessment is determined using elastic-plastic J-integral results and can reduce conservatism compared to the default API 579 FAD. The ductile tearing instability analysis uses multiple crack sizes to compute the elastic-plastic J-integral values for comparison to the material resistance curve. A ductile tearing analysis can further reduce the conservatism in a crack assessment permitting larger cracks or larger applied loads. A crack growth analysis using the Paris equation calculates the crack growth rates. An incremental remeshing method uses Abaqus results to calculate the elastic stress intensity values to update the crack length and crack depth growth equations. The growing crack is evaluated to determine the critical failure size.

Correlation of PowerFLOW Soiling Simulation Results with Wind Tunnel Tests

Navid Omidvar, Staff Soiling and Water Management Engineer, Rivian Automotive Inc.

The automotive industry has been increasingly focused on ensuring dependable autonomous performance, and exposure to diverse weather conditions is inevitable. Rivian, known for its adventurous enabling products, needs to face these challenges head-on. Consequently, addressing soiling performance becomes crucial in the early stages of the design process to avoid the need for late and expensive redesigns. Recognizing this, Rivian has partnered with the SIMULIA consulting team to replicate specific wind tunnel soiling tests using PowerFLOW to gain confidence in its capabilities and limitations. This presentation will delve into A-pillar overflow, door mirror soiling, and wet snow-packing scenarios on the Rivian R1S.

Computational Modeling in the Advancement of Transcatheter Aortic Valve Replacement Technology

Symon Reza, PhD Candidate, Stony Brook University

Transcatheter Aortic Valve Replacement (TAVR) stands out as a primary treatment for aortic stenosis (AS), and its potential extension to lower-risk patients highlight its importance. Despite widespread acceptance, challenges persist, particularly regarding post-procedural complexities like cardiac conduction abnormalities (CCA) and TAVR leaflet thrombosis. In response, we developed innovative computational methodologies, incorporating finite element analysis (FEA), computational fluid dynamics (CFD), and fluid-structure interaction (FSI), to evaluate the risks associated with post-TAVR CCA and leaflet thrombosis. The initial project utilized a high-fidelity four-chamber beating heart model to scrutinize mechanical parameters influencing post-TAVR CCA. The study aimed to comprehend how procedural variables and preexisting heart conditions contribute to CCA. Notably, the results identified correlations between increased implantation depth and the presence of preexisting right bundle branch block (RBBB) with the occurrence of post-TAVR CCA. In the second project, we delved into the thrombogenic risk linked to TAVR prostheses in diverse anatomical contexts, integrating FSI in an Eulerian framework with platelet stress accumulation in a Lagrangian framework. The analysis revealed that a smaller Sinotubular junction (STJ) compromises both the structural and hemodynamic performances of TAVR. Conversely, a larger STJ size improves both structural and hemodynamic TAVR performance but at the expense of elevated thrombogenic risk. These methodologies play a pivotal role in advancing TAVR device design and optimizing performance. Additionally, they provide actionable insights for integration into clinical applications, ultimately aiming to enhance patient outcomes and ensure the efficacy of TAVR procedures.

Computational Aeroacoustics Modeling of Cold End Exhaust Sub-System

Figan Lacin, Tenneco

Tenneco is one of the world's leading designers, manufacturers, and marketers of automotive products for original equipment and aftermarket customers worldwide. Through our four business groups – DRiV, Performance Solutions, Clean Air and Powertrain – Tenneco is driving advancements in global mobility by delivering technology solutions light vehicle, commercial truck, off-highway, industrial, motorsport and the aftermarket. Engineering teams at Clean Air business group supply exhaust systems for both gasoline and diesel engines to meet both emissions and acoustic related regulations. Exhaust systems are primarily divided into two subsystems: the hot end and the cold end. The hot end part of exhaust system includes components like manifolds, turbochargers, catalytic converters, DOC, DPF and SCR systems with dosing module and mixers. The cold end part of the exhaust system includes resonators, mufflers, tailpipes, and other devices for attenuating engine and flow noise. This presentation will focus on the computational method used at Tenneco for developing and validating cold end system to meet overall flow noise targets.

Democratization of Advanced Simulation on the 3DEXPERIENCE Platform

Thomas Feister, Technical Manager, Structures, TriMech Solutions LLC

The Abaqus solver is a proven and reliable robust FEA solution for a variety of applications. A new interface inside of **3D**EXPERIENCE includes functionality that will provide the power of simulation to designers that do not have the background to accurately simulate processes using FEA. This presentation will talk about the variety of solutions available in **3D**EXPERIENCE to "democratize" simulation. We will showcase simulation of the blow molding manufacturing process of a plastic bottle.

Novel Approach to Braided Wire Stent Simulation

Paul Jermihov, Sr. Solutions Consultant Structures, TriMech Solutions LLC

Braided wires are often used in medical devices, such as catheters, guidewires, and other interventional tools. These wires are designed to provide flexibility and strength, making them suitable for navigating through blood vessels and other anatomical structures during medical procedures. Abaqus FEA can be used to evaluate and optimize the structural performance and manufacturability of these critical components. This presentation will discuss a novel approach to modeling the manufacture of a braided-wire embolization device. The embolization device manufacturing steps are simulated to capture wire compaction at the marker sites. The completed device is annealed then crushed between two rigid plates so that the structural stiffness can be assessed.

Simulation of Laser Shock Processing on Specimens with Abaqus and fe-safe Software

Vignaud Granados, Professor, Universidad Politécnica de Guanajuato

Laser shock processing (LSP), a technique for metals strengthening, induces a compressive residual stress field which improves materials mechanical behavior mainly fatigue properties. One of the research lines of our working group focuses on the simulation and validation of the effect of LSP surface treatment, where computational tools such as Abaqus and fe-safe are very useful. We evaluate the viability of applying LSP to extend the fatigue life of components with and without concentrator of stress. For the LSP treatment a convergent lens was used to deliver 1.0 J and 6 ns laser pulses by a Q-switch Nd: YAG laser, operating at 10 Hz with 1064 nm of wavelength and density of 2500 pulses/cm2. The pulses were focused to a diameter of 0.9 mm on the surface of the samples without coating. The residual stress field produced by the LSP process was estimated by a finite element simulation, and, on the other hand, residual stress distribution as a function of depth is evaluated by the hole drilling method for validation. A fatigue analysis of specimens is conducted using the commercial code fe-safe and different multiaxial fatigue criteria to predict fatigue lives of samples with and without LSP. A good comparison of the simulation and experimental results was observed.

Leveraging MBD Models on VI-Grade Simulators

Jeff Hodgkins, Senior Application NVH Technical Expert, VI-Grade

Automotive companies use multibody dynamic (MBD) models as part of their vehicle development process. These models have traditionally been used for primary ride and handling evaluations using slower than real-time CAE analysis offline from simulators, and more recently high content models are being developed for secondary ride and some NVH assessments. Significant advancements in both MBD solver capability to handle real-time analysis, and in VI-grade simulators to present subjective secondary ride and NVH response, have enabled directly assessing MBD models on VI-grade simulators. In addition, higher frequency content for models that are slower than real-time can be leveraged through VI-grade's VI-NVHSim software to bring higher frequency content subjectively onto the simulator while maintaining a real-time drive capability. This presentation walks through implementation of an example Simpack demo model onto VI-grade simulators, including using a reduced DOF version of the model for real-time application in conjunction with VI-NVHSim to capture higher frequency content from the original full content Simpack model.

FEA Based Level 3 Assessment of Deformed Tanks with Fluid Induced Loads

Arindam Chakraborty, CTO-Engineering Services, VIAS3D

Fitness-for-service (FFS) of oil and gas equipment and facilities is an important engineering activity from perspective of assessing the structural integrity of critical structures. FFS enables the engineer to determine whether the equipment or facility needs a repair, or replacement, or whether it is good to continue for its remaining life. Level 3 FFS approach is used to address the complex cases and requires

an engineer to build a finite element analysis (FEA) model of the structure. This presentation describes a methodology used to evaluate the FFS approach of the deformed tanks under gravity, internal hydrostatic pressure, wind, snow, seismic and external pressure using modern measurement techniques, FEA, CFD and CAD tools. The step of direct import of scan data into CAD software to generate the digital twin of the structure is the approach that is very powerful and eliminates the ambiguity of assuming a surface by an engineer that may not be a realistic representation of the true damaged surface. This presentation shows the complete workflow of importing a laser scan data of a deformed storage tank into CAD, creating a realistic surface from the scan data, and importing that realistic surface into CFD and FEA software to perform detailed Level 3 FFS of the tank using Fluid Structure coupled approach. Acknowledgement: the work was completed in conjunction with a major oil and gas company.

Partner Presentations

Computing Tire Durability from Multibody Dynamics Simulation of Nürburgring Circuit Events

Thomas Ebbott, Ph.D., Vice President, Endurica

A future intelligent tire application may require the tracking of damage accrual based upon the actual lived experiences of a tire. This work demonstrates such an application using commercial, off-the-shelf tools: the Simpack multibody dynamics code, the Abaqus finite element solver, and the Endurica EIE and DT fatigue solvers. Nurburgring circuit vehicle events for laps on 4 P225/35R20 tires were simulated via multibody dynamics. For each of the four tires, three corner channels (slip angle, slip ratio, vertical tire load) were computed and recorded for 13 miles over 8 minutes at a data acquisition rate of ~250 Hz. Damage in the tire was accrued on a finite element mesh via Endurica DT, using strain history that was interpolated via Endurica EIE for each time step of event history. The interpolation grid, or map, was pre-computed in Abaqus using steady state rolling simulation results over the range of -15° to +15° in slip angle, -25% to 25% in longitudinal slip ratio and 0.5x to 1.5x TRA in tire load. The simulation shows how differences in actual lived tire experience vary from one vehicle corner to another, and within the tire cross section, and demonstrates the feasibility and requirements for live tracking of damage accrual.

Crossing the Line: Combining Topology Optimization, Fiber-Filled Injection Molding, and Structural Analysis

Matt Sherak, Elite Application Engineer and Senior Simulation Product Specialist, Jeff Lendermon, Senior Specialist, Shivani Patel, Manager West Simulation Application Engineer team, GoEngineer

3DEXPERIENCE integrates the powerful Tosca, SIMPOE, and Abaqus solvers in a seamless platform that once required complex workflows to combine. The speakers will walk through a bicycle bracket designed for weight using Structural Generative Engineer, then injected with 20% carbon-filled polymer through Plastics Injection Engineer, and finally import effects of fiber orientation and weld line strength reduction through Structural Mechanics Engineer. Trading between multiple engineers and programs while maintaining a single, universal fileset will appear seamless.

Sustainable CAE High Performance Computing Infrastructure Solutions from HPE and AMD

Tony DeVarco, Director, HPC and Manufacturing Vertical, HPC/AI Business Unit, HPE, and Rick Knoechel, Global Strategy Lead for Automotive and Discrete Manufacturing for the Data Center Server BU, AMD

HPE and AMD share a common goal with SIMULIA in helping customers solve simulation challenges by delivering highly efficient, best-in-class high-performance computing clusters, storage, and data management solutions. Our enterprise CAE customers are having regular discussions around thermal and power management when considering their next generation HPC cluster. Liquid cooling is an important technology to consider as it can have a significant positive impact on their thermal management strategy. It also aligns with ambitions of using high thermal design power (TDP) AMD processors that may otherwise be performance limited with air cooling. HPE and AMD's joint presentation is intended to help Abaqus customers make knowledgeable and sustainable choices regarding their selection of high-performance computing (HPC) hardware to optimally run Abaqus FEA software from SIMULIA.

Maximizing Impact of Abaqus, fe-safe & CST Results with Smart Results Processing, Digital 3D Reporting, Visual Collaboration, and Interactive Rapid Results Reviews

Prasad Mandava, CEO, Visual Collaboration Technologies Inc. / VCollab

Across all industries, companies are increasingly relying on simulation for product development. Cost and time constraints are pushing them to cut down or even eliminate physical testing. To make up for the information lost from traditional testing, organizations are turning to simulation to gain crucial design insights. This means more simulation studies are needed, but resources aren't always increasing accordingly. As a result, old-fashioned ways of post-processing, reporting & review of simulation results must make room for newer, more innovative simulation methods and tools. Abaqus/fe-safe/CST remain indispensable resources in the evolving simulation landscape. By harnessing new tools and technologies, we aim to help companies and CAE teams in streamlining result processing, reporting, reviewing and design decision making. We aim to enhance the impact of these simulation results from Abaqus/fe-safe/CST by enabling rapid results reviews, easy sharing, and collaboration on CAE insights ... leading to informed design decisions. In this presentation, we will dive into VCollab's innovative solutions that revolutionize the conventional results processing, reporting and results review tasks analysts encounter when handling Abaqus/fe-safe/CST results. Focus areas:

1. Introducing intelligent tools that streamline the extraction of failures and the associated key simulation results data. This approach reduces results file sizes associated with native CAE results and improves sharing and seamless collaboration across multidisciplinary domains through a standardized compact file format
2. Implementing advanced tools to quickly extract valuable insights from Abaqus/fe-safe/CST results, such as identifying hotspots or potential areas of concern and create 3D slides; through dynamic visual communication, stakeholders can engage more effectively, driving consensus and expediting decision-making processes
3. Providing comprehensive 3D web-based access for interactive exploration of critical simulation insights, this empowers analysts, engineers, and key stakeholders to rapidly review and discuss key simulation results/insights, facilitating faster and well-informed design decisions.

These capabilities synergize to provide users with a comprehensive understanding of simulation results data, facilitating quicker analyses and informed decision-making. By fostering effective communication and collaboration among engineering teams, our solutions enhance productivity and maximize the utility of existing CAE resources. VCollab's cutting-edge tools lie at the core of the digital transformation of simulation processes, seamlessly integrating with Abaqus, fe-safe and CST results files. By harnessing these technologies, product development teams can transition from analysis

results to high-quality design decisions with unprecedented efficiency. Some simulation processes may see a staggering 90% reduction in time, leading to significant gains in speed, accuracy, and overall effectiveness in decision-making.

Navigating Complexity: The Role of Trusted Partners and VIAS3D in Dassault Systèmes Ecosystem
Shawn Freeman, VP-Technical, VIAS3D
In this session, we will delve into the pivotal role of trusted partners in the context of Dassault *Systèmes* ecosystem, with a specific focus on VIAS3D. Beyond showcasing VIAS3D's capabilities and benefits, we will explore the broader theme of navigating complexity in today's technological landscape. We will highlight the critical need for expertise and partnership in achieving successful outcomes. Join us as we unpack the synergy between trusted partnerships, cutting-edge tools like VIAS3D, and effective strategies for addressing complex challenges in the digital age.

Understanding Hexicopter Loads
Tim Hunter, President, Wolf Star Technologies LLC
The need to understand real world loading is imperative for proper simulations. Traditional approaches may use company standards or even MBD simulations or CFD simulations. However, these approaches are at best approximations of the actual load conditions. Companies often use experimental load transducers to measure real world loading. There are two major disadvantages with this approach. The first is that the load transducers often cannot measure all of the desired load inputs for a simulation. The second disadvantage is that the application of the load transducer forces physical modifications of the subject components. The measured loads may not be the actual loads because of the mass and stiffness changes to the subject components. The commercial True-Load® Load Reconstruction software is a noninvasive solution that will be demonstrated in this application. Presented will be an example of using True-Load Load Reconstruction technology to understand complex loading on a state-of-the-art tethered hexicopter system. This approach will involve the creation of an FEA model of the hexicopter arms. The hexicopter arms will have unit loads applied to the propeller and motor. In addition, eigen-mode properties of the hexicopter arms will be calculated. These unit loads/modes will be used to construct a correlation matrix relating strain response to exterior applied loading. The operation of the hexicopter will be used in typical service environments. The advantage in this approach is to get real world structural loads, which can be used to drive accurate FEA simulations. The real world is complex, and every event is unique. True-Load loads provide real world loads for real-world simulation.

Dassault Systèmes Presentations

Automation & Optimization
The Design Exploration and Simulation Process Automation software portfolios serve as the backbone of the Dassault Systèmes Modeling and Simulation engineering platform. In this session, we will share recent developments that enable the efficient and affordable exploration of the feasible design space throughout the product development cycle using nonparametric and parametric techniques as well as the robust authoring and democratization of simulation processes. Products covered: Isight, Tosca and **3D**EXPERIENCE Apps: Process Composer, Results Analytics, Parametric Design Study and Design Exploration.

Battery Simulation
An overview of enhancements to battery simulation technology, including deterioration and aging, solid electrolytes, new elements, enhancements to loads and boundary conditions, enhancements to step control, and more.

Electromagnetics
Join us for this exciting review of the latest 2024 release updates and a glimpse into the future of Electromagnetics simulation. We will review the most recent performance and usability improvements, followed by an introduction to our new Electrical Machine Design App – fully native on the **3D**EXPERIENCE platform! We will also show some examples how AI can be exploited to speed up large DOEs significantly, and how our latest release allows you to run CST Studio Suite in the browser – no local installation necessary. Finally, we will lift the veil of secrecy just a bit to provide a glimpse into our future roadmap for Electromagnetics.

Simulation of Magnetic Noise & Vibrations in Electrical Systems Using Manatee e-NVH Software, from E-Machine Basic Design to Electric Drive Detailed Design
Acoustic noise and vibrations due to electromagnetic forces induced by electric machine operation (called e-NVH in automotive application) can be significant in many applications such as Transportation & Mobility, Industrial Equipment, Aerospace & Defense, Marine & Offshore etc. Tackling noise issues after manufacturing can be particularly expensive and may degrade electric drive performances such as efficiency, cooling, and weight. An efficient virtual prototyping workflow of e-NVH is key to accelerate development times, reduce prototyping manufacturing & testing costs, and improve engineering productivity. Manatee software is a CAE collaborative platform designed to support all engineers involved in the development of electrified systems to assess and control magnetic noise and vibration levels at all design stages, from basic electric motor design stage to system-level detailed design stage. Manatee can be run as a standalone multiphysics software with flexible modelling options for electrical, magnetic, structural dynamics & acoustics. It also comes with high interoperability, allowing flux import from CST/Opera and modal basis import from Abaqus. It comes with predefined simulation workflows and specialized magnetic noise mitigation techniques (e.g., skewing, notching, harmonic current injection) which makes it complementary to general purpose software solutions of SIMULIA portfolio. Manatee facilitates collaboration between engineers (electrical, control, mechanical, and NVH engineers) while standardizing the interfaces between electric machine designers and integrators.

Fluids
The SIMULIA Fluids portfolio provides comprehensive coverage for over 300 simulation workflows. The workflows range from plastic injection molding, HVAC system flow and heat transfer performance, and gearbox lubrication flows to high fidelity aerodynamic and aeroacoustics simulations. All Fluids roles enable the MODSIM paradigm of tight integration between modeling and simulation. In this presentation, we will describe the new capabilities and highlights delivered in the R2024x releases.

- PowerFLOW: **3D**EXPERIENCE Cloud and GPU Computing: The **3D**EXPERIENCE Cloud reduces the need for HPC resources with a highly scalable "always-on" and standardized solution. An extensive set of new capabilities enable fully automated end-to-end workflows with for SIMULIA PowerFLOW to enable vehicle development. GPU computing has shown high potential for computing aerodynamics and aeroacoustics performance KPIs for complex vehicles with higher computing power at a significantly lower cost. In this presentation, we will review the latest capabilities in SIMULIA PowerFLOW for **3D**EXPERIENCE Cloud and GPU computing.

Fluids: Design Efficient and Quiet Fan Modules in Cooling Systems
In many industries, effective thermal management is crucial for optimizing hardware performance and ensuring battery safety. From small to larger devices with powerful heat sources, there is a demand for enhanced cooling within the complete assembly. However, the use of fans in cooling modules frequently leads to uncomfortable noise. To address this, it becomes crucial to predict airflow and noise targets simultaneously, even before the development of detailed physical prototypes. This presentation explains how our innovative fan noise solution can assist customers in designing efficient fans, aligning with the need for advanced acoustic performance while maintaining thermal efficiency.

Modeling & Simulation
MODSIM unifies modeling and simulation on a common data model within a single user experience on the **3D**EXPERIENCE platform. The goal is to consider the whole product development process and break down barriers. MODSIM enables simulation to drive the entire product development process from beginning to end, from requirements to architecture, from validation to certification, and from product development to program management, including design exploration, processes, automation, change management and collaboration. In this session we will focus on some of the major updates that we delivered in the last year in our MODSIM solution packages.

Modeling & Simulation
- Stamping: MODISM on **3D**EXPERIENCE streamlines the stamping process by offering new insights into die design and part behavior. By integrating modeling and simulations seamlessly, we reduce the trial-and-error in physical iterations. By exploring the full design space of die design, we are able to identify potential defects like wrinkling or tearing early in the design process. Additionally, it facilitates collaboration between design, simulation, and manufacturing teams, ensuring seamless integration of stamped parts into final products. Ultimately, MODISM on **3D**EXPERIENCE enhances efficiency, accuracy, and quality in the stamping process, addressing its inherent complexities and challenges.
- Packaging: Improve packaging and sustainability with MODSIM

MODSIM: SOLIDWORKS Champions Transforming Innovation with MODSIM
In this session, attendees will gain insights on how SOLIDWORKS Champion customers are innovating better products in shorter time and reduced product development cost, leveraging the MODSIM approach, i.e., unified MODeling on SOLIDWORKS and SIMulation on cloud-enabled **3D**EXPERIENCE platform. Key customer highlights include QARGOS, an electric cargo scooter startup from India revolutionizing last mile logistics; WILSON CASE, a high-end custom packaging innovator from the USA, and INOVONICS, a wireless infrastructure provider developing high tech devices for security and senior living applications. Tight integration between SOLIDWORKS and the **3D**EXPERIENCE platform will be demonstrated during this session through aerodynamics, battery thermal management, drop tests, impact analysis, packaging structural integrity, antenna design & placement workflows. Engineering and Business benefits realized by these SOLIDWORKS customers resulting from implementation of MODSIM will be discussed at the end.

Multibody System Dynamics
In recent years, the Simpack Multibody technology has transformed how industries are using Multibody simulation to design their next-generation products. Simpack technology has established itself on the market thanks to its robust and reliable solver as well as its cutting-edge performance for real-time simulations. This presentation will update the audience with the latest Simpack technology capabilities as well as the introduction and updates of the new **3D**EXPERIENCE Motion portfolio, which contributes to bridging the world of engineering MODeling with scientific SIMulation.

Multiscale
In this update, we will talk about the latest development in multiscale technology. We will demonstrate an end-to-end workflow to simulation the injection molding process using both multiscale technology and sequential workflow capabilities. We will also demonstrate the mapping features used to import field results between dissimilar meshes.

Structures Update

- Introduction: Emphasize the commitment to ongoing development for the class-leading Abaqus/Standard and Abaqus/Explicit FEA solvers that are the heart of SIMULIA structural simulation, as well as enhancements to Abaqus/CAE; highlight a few major recent developments and coming topics
- Abaqus Nonlinear Mechanics: Overview of recent developments and advancements in nonlinear material and mechanics modeling capabilities in Abaqus/Standard and Abaqus/Explicit
- Abaqus Linear Dynamics, Solver Performance, and HPC Update: Overview of recent developments and advancements in linear dynamics as well as performance of the equation solvers and other HPC-related enhancements in Abaqus/Standard and Abaqus/Explicit

Structures: Abaqus Contact and Constraints
An overview of recent developments and advancements in contact and constraints capabilities in the class-leading Abaqus/Standard and Abaqus/Explicit FEA solvers that are the heart of SIMULIA structural simulation.

Vibro-Acoustics Update
Noise and vibration are becoming increasingly important in virtually every industry. Typical applications include: designing for interior noise in cars, aircraft, trains, ships, cabs and buildings; designing for exterior noise in wind turbines, urban air mobility, tires and pass-by noise; designing for dynamic environments and shock in spacecraft and launch vehicles; designing for stealth in ships, submarines and UAVs; designing for sound quality and speech intelligibility in mobile phones, loudspeakers and public address systems. In many of these applications, it is important to consider noise and vibration across the entire audible frequency range. This requires the use of a combination of simulation methods including both low frequency mesh based methods and mid/high frequency statistical wave based methods. SIMULIA's vibro-acoustic simulation software Wave6 includes the full spectrum of vibro-acoustic analysis methods in order to efficiently simulate noise and vibration across a broad frequency range. This presentation provides an overview of recent Wave6 product and application updates.