SIMULIA EuroNorth Regional User Meeting

The Midland Hotel, Manchester

14-15th September

3DEXPERIENCE®

You're guide to the 2022 SIMULIA EuroNorth Regional User Meeting

DASSAULT SYSTEMES | The 3DEXPERIENCE® Company

https://go.3ds.com/EuroNorth-RUM

Contents

Your Personal Invitation

You're invited to join the 35th SIMULIA Regional User Meeting at the Midland Hotel in Manchester city centre.

We have once again created this e-Book full of all the vital conference information you need to make the decision to join us on the 14-15th September. We hope this e-Book will help to prepare you for the RUM and we look forward to welcoming you in Manchester. The preliminary agenda is now available and it is shaping up to be one of our best events yet.

Summary of what to expect at the conference:

- Registration to both days of the RUM will again be completely free
- Keynote Speakers from Cambridge University, Rolls Royce and Jaguar Land Rover
- Learn from more than 24 customer paper presentations
- Choose from 3 Technology Sessions, choose from:
    - Structures
    - Electromagnetics
    - Fluids and Computational AeroAcoustics
- Interactive exhibition area
- Free networking banquet on the evening of the 14th September

As this is a local conference, we are able to tailor the content towards local trends and industries, making the conference more relevant to UK users. This conference allows attendees to engage with other local users enabling them to share knowledge and experiences making networking more relevant and valuable.

Who Should Attend?

Industry professionals, engineering teams, team leaders, managers and directors with an interest in state of the art multiscale, multi-discipline simulation from users, team leaders, managers and directors.

Registration

The conference is free to attend for both days, including the conference banquet. Spaces are limited and registration is essential. Please register now.

Venue & Accommodation

Venue

The Midland
16 Peter Street
Manchester
M60 2DS

Accommodation

We have negotiated a discounted Bed & Breakfast rate of £155 at the Midland Hotel.
Please follow the below instructions to secure the rate:

- Go to the website: https://www.jurysinns.com/
- Select The Midland Hotel, date and duration required
- Enter the code **LHDASS130922** in the 'promo code' box
- Complete booking

Alternative nearby accommodation:

- Premier Inn - Manchester Central Hotel
- Jurys Inn Manchester

Getting there

Train

The nearest train stations to the hotel are Manchester Oxford Road (200 metres) and Manchester Piccadilly (¾ mile). For train times and journey planning please visit national rail. The main station for nationwide services is Manchester Piccadilly

Car Parking

There is discounted parking at the NCP Car Parks. Guests will need to follow the following process in order to receive a discounted rate of £20 for 24 hours.

- Download the ParkPass app
- Set up an account before arrival to the carpark
- Auto Pay needs to be activated
- In the 'SaverID' section of the menus, enter MANCHESTERHOTELS

Should the guests require any further information or assistance with the set-up, please contact the hotel on +44 161 236 3333.

Things to do in Manchester

If you would like to explore Manchester during your visit, recommendations can be found here:
https://www.themidlandhotel.co.uk/things-to-do

Agenda - Day One

8:00 AM	Registration open		
9:00 AM	Welcome Remarks		
9:15 AM	Simulation Brand Updates & Highlights	Mark Bohm, SIMULIA WW TechSales Senior Director, | Dassault Systèmes	
9:45 AM	Keynote 1: Failure of all solid-state Li-ion batteries	Vikram Deshpande, Professor of Materials Engineering | Cambridge University	
10:15 AM	Batteries and electric drives: Multiphysics-multiscale-driven design	Joe Amodeo, SIMULIA Industry Process Director & Victor Oancea, SIMULIA R&D Technology Director | Dassault Systèmes	
11:00 AM	Break & Exhibition		
11:30 AM	Keynote 2: EM Simulation and the Connected Car	Emma Kowalczuk, Electromagnetics Chapter Lead | Jaguar Land Rover	
12:00 PM	Guest speaker: Smarter Testing - Data Driven Platform	Neil Loftus, **Airbus** & Tony Goff | **Dassault Systèmes**	
12:30 PM	Lunch including: Gold Sponsor Presentation from new SIMULIA VAR, SIMUSERV UK - Non Parametric Shape Optimisation of Electromagnetic Components using SIMULIA CST Studio Suite and TOSCA		
1:30 PM	Technology Session 1: Structures	Technology Session 2: Electromagnetics	Technology Session 3: Fluids and Computational AeroAcoustics
3:30 PM	Break & Exhibition		
4:00 PM	**Round Tables** The objective of each session is to participate in a live discussion with our technical experts and managers to discuss, hear and debate SIMULIA's strategy, capabilities and new functionalities. Conference delegates will have the opportunity to attend 3 round tables; each round table session will last for 20 minutes. Choose from: • **Workforce of the Future** • **The Future is Electric** • **The Future is Connected** • **The Future is Sustainable** • **The Future is the Cloud** • **The Future is Simulation-driven driven Design** • **Strategy & Future**		
5:00 PM	Day One Ends		
6:30 PM	Drinks Reception, followed by Banquet with the after-dinner game!		

Agenda - Day Two

8:30 AM	Welcome remarks	
8:45 AM	Keynote 3	
9:15 AM	User Papers Session 1	User Paper Session 2
1. Researcher Experimentally measured impedance boundary conditions for simulating microwave scattering from ferromagnetic wires, Dmitriy Makhnovskiy | **Plymouth University**		1. Computational Wear Analysis of Different Activities of Daily Living for Reverse Shoulder Replacement, Jessa Mae Canas | **Liverpool John Moores University**
2. EMC Specialist How to simplify power converter RF Conducted Emission models, Jason Watkiss | **Rolls Royce Control Systems**		2. A Finite Element Study of the Effect of Cross-link Stabilisation in A Lumbar Spine Tumour Model, Damien Lacroix | **University Of Sheffield**
3. Accelerating Engineering through Democratisation of Simulation at Jaguar Land Rover, Michael Brown | **Jaguar Land Rover Ltd**		3. A parametric model of the human knee optimised for contact Mechanics Laurence Marks | **Oxford Brookes University**
4. Combining measurement and simulation using a hybrid model, Kilwa Ärölä | **Rand Finland**		4. Establishing Model Credibility through VVUQ – the Key Element for in-silico Medicine, Nils Götzen | **4REALSIM BV**
10:35 AM	Break	
11:05 AM	**3D**EXPERIENCE Cloud Simulation	Adriano Gagliardi, SIMULIA Strategy, Roles Portfolio Engineering Senior Manager | Dassault Systèmes
11:35 AM	User Paper Session 3	User Paper Session 4
1. A functionally graded fractional poroelastic model of the human meniscus explains lubrication mechanisms during loading, Olga BARRERA | **Oxford Brookes University**		1. Conservatisms in equivalent static assessment of Dynamic Events, John Sawyer | **Atkins**
2. Aircraft community noise prediction in 3D environments, Yunusi Fuerkaiti | **Technische Universiteit Delft**		2. Koroyd® tubular core structure inside helmet to improve safety and comfort - Use of simulation to optimize the performance, Filippi Romain | **EC2 MODÉLISATION**
3. Brake System Limit Performance Prediction using CFD A simulation of the Grossglockner Mountain Descent with a Bentley Continental GT Speed, Stamatis Angelinas | **Bentley**		3. Finite-element model of fire-protected composite beams with web openings, Nicoletta Galluzzi | **WSP UK Limited**

4. Using Abaqus to bust the myth or expose the magic of the long screwdriver, Bob Johnson | **Realistic Engineering Analysis Limited**		4. Finite element modeling of interlaminar fracture of thin carbon fiber/polyamide6 laminates with stiffening beams, Sepehr Simaafrookhteh | **KU LEUVEN**
12:55 PM	Lunch	
1:55 PM	User Papers Session 5	User Paper Session 6
1. Numerical Simulation for the Compressive Behaviour of Carbon Fibre Prepreg under High-pressure Compression Moulding Conditions, Hao Yuan | **University Of Warwick**		1. A thermo-mechanical model of prestressed concrete hollow core slabs under fire, Waleed Hamad | **WSP UK Limited**
2. Finite element model of Specially-shaped partially encased composite columns under cyclic loading, Qiuyu Xu | **University Of Lancaster**		2. X-ray Computed Tomography and Finite Element Analysis of the Great White Pelican Beak for Lightweight Vehicle Part Design, Nicola Thomas | **Swansea University**
3. Micromechanics of yarn-level hybrid composites, Giuseppe Romano | **The University Of Manchester**		3. Fatigue life prediction of antivibration products using Abaqus user subroutine, Robert Luo | **Trelleborg AVS**
4. Aeroacoustics Simulation using SIMULIA PowerFLOW across Dyson Technology Ltd, Dr Kondwani Kanjere CEng MIMechE |**Dyson Technology Ltd**		4. Strategies for Automation of High Variability and Low Repetition Analyses, Matt Clarke | **TECHNIA**
3:15 PM	Dassault Systèmes Presentation	
3:45 PM	Conference Ends	

Keynote Speakers

Jaguar Land Rover

Emma Kowalczuk (PhD MIET)
Electromagnetics Chapter Lead, EM Simulation and Design, Digital Product Platform (DPP)

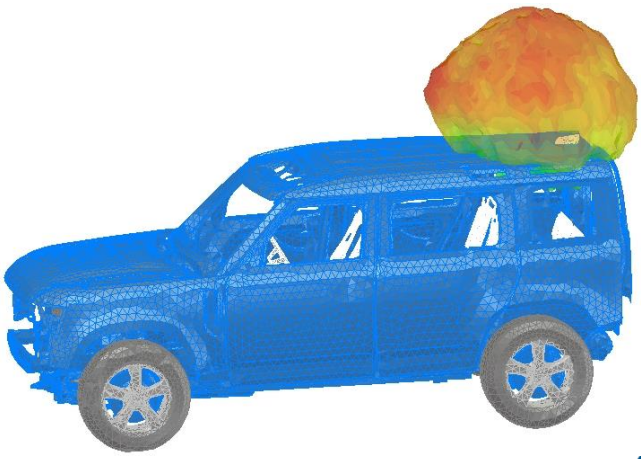
Biography: Dr Emma Kowalczuk has been with Jaguar Land Rover since 2015 and is responsible for leading Electromagnetic (EM) CAE capability development in the company. She is experienced in applying EM simulation techniques to investigate automotive Electromagnetic compatibility (EMC) and antenna installation including broadcast, cellular and passive entry passive start antenna systems. She has a particular interest in virtual test drive for cellular and V2X antennas to assess their coverage and optimise customer connectivity.

She received her M.Eng and Ph.D in Electrical Engineering from Loughborough University, where she researched photoconductive microwave switches for use in reconfigurable RF applications. She also worked as an electromagnetic application engineer for CST, presenting and publishing the benefits of EM Simulation for a wide range of industrial and academic areas.

Abstract: EM Simulation and the Connected Car
Modern luxury vehicles are connected, autonomous and electrified - to enable these key features, cars rely on wireless communication and antennas. Understanding the best design and placement of antennas and cables inside a car is a challenge – but Computational Electromagnetics (CEM) can be used to get the design right first time. An overview of how EM simulation is used at Jaguar Land Rover will be presented.

The number of antennas is ever increasing to meet customer demand for features such as software over the air, remote diagnostics, vehicle to vehicle (V2V) communication and customer infotainment including streaming of HD media. EM simulation correlation will be presented for an installed cellular antenna and challenges that face us in the future with the adoption of vehicle to everything (V2X) will also be discussed.

Autonomous vehicles also require multiple inputs from radar arrays, at 77GHz the installed performance of an array is electrically very large. Both full-wave time domain and asymptotic methods can be used to tackle the challenging vehicle environment to calculate angular error and ghost target detection to support moving towards ADAS level 3 and above. Lastly a study around electrification and Electromagnetic Compatibility (EMC) implications will be highlighted –Simulia CST Studio Suite can be used to improve battery lid design and can help tackle the complexity of cable simulations in a time scale that can provide solutions on vehicle programme delivery.



Cellular Roof pod radiation pattern, Land Rover Defender

Cambridge University

Vikram Deshpande, Professor of Materials Engineering

Biography:

Prof. Vikram Deshpande joined the faculty of Engineering at the University of Cambridge as a lecturer in 2001 and was promoted to a professorship in Materials Engineering in 2010. He has written in excess of 280 journal articles in experimental and theoretical solid mechanics. He serves on the editorial boards of a number of journals in mechanics and biomechanics including Journal of the Mechanics and Physics of Solids, Modelling and Simulation in Materials Science and Engineering and the Proceedings of the Royal Society, London. He has been awarded numerous medals including the 2020 Rodney Hill Prize in Solid Mechanics, the 2022 William Prager Medal, the 2022 ASME Koiter Medal and elected Fellow of the Royal Society, London.

Failure of all solid-state Li-ion batteries

Abstract: Solid-state batteries comprising a ceramic electrolyte and Li metal anode have the potential to deliver enhanced safety along with higher specific energies compared to liquid electrolyte Li-ion batteries. However, stiff, and strong ceramic electrolytes can suffer short circuits resulting from the penetration of Li filaments through the ceramic at charging currents above a critical current density. This is remarkable since the yield strength of Li is on the order of a few MPa while the ceramic electrolytes have strengths of many 100s of MPa and moduli in the GPa range. The failure of these Li-ion cells occurs via two interconnected processes: (i) formation of voids at the Li electrode/electrolyte interface and (ii) growth of Li filaments, that emanate from vicinity of these voids, into the electrolyte. We shall present coupled electrochemical-mechanical variational principles to understand how the electrochemistry of these cells drives mechanical failure. Our focus is on developing an understanding of how well-established ideas such as Butler-Volmer kinetics need to be modified in the context of these solid-state batteries and associated numerical techniques. The numerical solution of the variational principles provides insights into experimental observations, but numerous uncertainties remain with regards the microscale properties of the Li and solid electrolytes as well the mechanisms coupling mechanical deformations and electrochemistry.

Guest Speaker

Airbus

Smarter Testing - Data Driven Platform
Neil Loftus, Airbus

In order to enable faster, cheaper and more reliable testing at all scales, digital continuity to link physical testing and virtual testing is essential. The data driven platform aims to provide an easy to access collaborative environment for testing teams and internal customers alike. The platform is built on 3DExperience, using the concepts of single point of access to enable a digital thread to link test pyramids, design data, sensor locations, physical test data, virtual test data and reporting data.

A key aspect of this is the automated link between the physical test data repository and the simulation data created by Abaqus, since these data types are often not immediately comparable without manual processing. 3DEXPERIENCE is used to help connect these data types together and manage the processing and storage of the data so that it can be consumed in a meaningful way.

Biography: Test Engineer working for Airbus at the Aerospace Integrated Research and Technology Centre in Bristol, and a Product Owner of the Smarter Testing Data Driven Platform. Currently focussed on the Wing of Tomorrow R&T programme, and how to integrate the digital continuity benefits of Data Driven Platform to enable improved testing processes.

Gold Sponsor Speaker

Gold Sponsor Presentation from new SIMULIA VAR, SIMUSERV UK: Non Parametric Shape Optimisation of Electromagnetic Components using SIMULIA CST Studio Suite and TOSCA

Abstract: SIMUSERV is an established Value Added Reseller (VAR) of Dassault Systemes SIMULIA solutions with expertise covering the full portfolio of products. SIMUSERV has recently expanded operations to the UK to address the need for a specialist SIMULIA VAR to address the market locally. This presentation will introduce the overall SIMUSERV vision, organisation and plans to promote and support SIMULIA deployments in the UK.

The technical credentials of SIMUSERV will be illustrated through a case study of the Non-Parametric Shape Optimisation of Electromagnetic Components through the integration of SIMULIA CST Studio Suite and TOSCA. The coupling of these powerful tools allows electromagnetic Engineers to leverage the benefits of modern manufacturing techniques, such as 3D printing to improve performance and reduce cost and lead times.

Technology Sessions

1. Electromagnetics

The field of electromagnetics is a fast-growing one, and when it comes to designing, analysing, and optimizing electromagnetic components and systems, CST Studio Suite is a complete solution. The 2022 Studio Suite release contains a number of important new features and improvements, as well as several smaller changes and enhancements. Join the this session to:

- Learn about the key new features that will be available in CST Studio Suite 2022
- Explore how to setup the array task and simulate a realistic example of a radar antenna on a ship
- Learn about simulation techniques to achieve faster simulation times with accurate results for array simulations

2. Structures

Robust mechanics technology has been the heart of the SIMULIA structures solution since the first version of Abaqus. Come and join us at this session to learn both, what is new in structural simulation technology and techniques that will assist with creating robust simulations. The session will cover:

- Recent contact enhancements (including non-cicular beams, and model change type behavior in general contact);
- Advances in materials modelling (for example multiscale techniques and models for metals and plastics);
- Mechanics developments (including particle and beam element updates);
- Tips and tricks to help obtain converged solutions

3. Fluids and Computational AeroAcoustics

Computational Fluid Dynamics is often regarded as one of the most technically challenging disciplines to introduce into product development. Come and join us as we discuss how SIMULIA break down the barriers to adopting CFD as a core tool for both designers and expert engineers alike through our use of automated workflows, PLM integration and validated best practices. The session will cover:

- An overview of what technology is new, or coming soon, in our Fluids suites
- How to integrate your CFD modelling and analysis with your CAD and PLM databases
- How PowerFLOW can be used to develop quieter electric vehicles
- How the Fluids Analyst role can be used to keep motors and batteries cool

Dassault Systemes Speakers

Mark Bohm, SIMULIA WW TechSales Senior Director

Mark has been with SIMULIA for over 30 years. Contributing in a variety of sales and technical management roles, he currently leads a global technical sales group supporting advanced applications. He has degrees in structural engineering from Brown University and the University of California, Berkeley.

Victor Oancea - SIMULIA R&D Technology Senior Director

Victor earned his PhD from Duke University in 1996 in the area of computational mechanics. He then joined what was the Abaqus R&D development in Rhode Island, which today is part DASSAULT SYSTEMES SIMULIA Corp. Victor has worked in a variety of R&D positions through the years and is today the Senior Technology Director and the Chief Scientific Officer for Structural applications. In the last few years at SIMULIA Victor has led from a simulation technology perspective a variety of multiphysics/multiscale simulation initiatives including the battery cell engineering, additive manufacturing simulation efforts, micro-mechanics based multiscale materials, particle methods for extreme deformation, oil and gas multiphysics formulations, realistic human simulation capabilities and developed co-simulation-based multi-physics modeling.

Joe Amodeo - Director Process Automation & Optimisation SIMULIA R&D

Joe graduated from Cambridge University and gained a PhD from Imperial College before joining Jaguar Cars as an aerodynamicist in 1998. Joe was responsible for the aerodynamic development of a number of Jaguar vehicles, using physical tests methods and CFD and eventually became the Technical Specialist for Aerodynamics at JLR. Joe then joined Exa Corporation in 2005, as their first UK employee, in order to focus exclusively on CFD with the PowerFLOW toolset.

At Exa Joe was heavily involved in the development and deployment of the PowerFLOW toolset for automotive and motorsport across the world. In 2017 Exa was acquired by Dassault Systèmes, as part of their SIMULIA Brand. Joe now manages a team dedicated to delivering automated simulation & optimization process to SIMULIA customers worldwide

Christian H. WHITING - SIMULIA R&D Senior Director of Structural Simulation

Chris is the Senior Director of the SIMULIA R&D Structural Simulation department at Dassault Systèmes, which includes the responsibility for R&D activities related to strategy, product management and product development for structural simulation applications and solver technology.

Chris has over 20 years of simulation-related experience in computational fluids and computational solid mechanics and has held a wide range of technical and leadership positions in Product Development, Strategy and Product Management since joining Dassault Systèmes in the late 90s (HKS, Inc. at the time). After several years as a development engineer focused on core solver development, Chris expanded his activities to include structural modeling and results processing and led the development of our portfolio of Abaqus-based solutions on the Dassault Systèmes 3DEXPERIENCE Platform. Since 2016, Chris has led the overall Structures Simulation SIMULIA R&D organization responsible for development of structural simulation solutions and technology.

He has Masters of Science and Doctoral degrees in Applied Mechanics and Mechanical Engineering.

Raman Singh | EuroNorth Technical Executive Manager, MODSIM

Currently working as Technical Executive Manager at Dassault Systemes, Raman Singh leads a team responsible for Modelling & Simulation (MODSIM) technical sales activities across 11 industries and 10 countries within the EuroNorth region. Raman has over 11 years of experience working both within Industry and Academia, of which the last few years has been particularly focused on leading a large-scale CAE transformation at one of the UK's largest automotive OEMs.

Round Tables

On Wednesday 14th September we will host a Round Tables session at 4pm. The objective of each session is to participate in a live discussion with our technical experts and managers to discuss, hear and debate SIMULIA's strategy, capabilities and new functionalities. We hope this session will allow delegates to raise specific points on the topics of most interest to them. Conference delegates will have the opportunity to attend 3 round tables; each round table session will last for 20 minutes. Choose from:

- Workforce of the Future
- The Future is Electric
- The Future is Connected
- The Future is Sustainable
- The Future is the Cloud
- The Future is Simulation-driven driven Design
- Strategy & Future

Workforce of the Future

Industry is already modernizing itself and bringing in new technologies that focus on innovation and sustainability, but that process needs to speed up. We must accept that people need be able to work together without silos: redefining how they can effectively **collaborate** no matter where they are. That requires social innovation, social collaboration and social engagement.
And as graduates join this new, more **flexible workforce**, and older generations depart, it's vital not to lose their valuable knowledge and know-how. To make sure that happens we need to connect people and roles, using the latest digital tools to work together experientially – delivering a digital continuity of knowledge that will accelerate both our digital business transformation and your career.
As society changes and technologies evolve, engineering schools must adapt and apply new methods to better prepare students for the workplace. Around the globe, societies devoted to advancing engineering education are facilitating collaboration between academia and industry to equip students with the skills to design a better world.

Climate change, burgeoning urban populations and a lack of basic amenities in developing countries are among the new and emerging challenges that universities must train a new generation of engineers to tackle. To do so, however, they must also train their students to think about challenges in new ways and to use the most advanced technologies in solving them.

Questions to be discussed at the roundtable:

- What are the Software portfolios that Dassault Systemes has to offer Academic customers?
- Are Academic Institutions aware of the vast range of products available to them?
- What other help and Services are available to Academics?
- Are Academic customer's up-to-speed with the requirements of our large commercial customers?
- What do we get right about our interactions with you? What do we get wrong?

The Future is Electric

In recent years, the landscape for electric vehicles has changed dramatically. New automotive experiences are making their way onto the streets, enabled by swift technological advances in areas like virtualization and autonomous driving. Meanwhile, regulatory trends are bringing forward the timeline on electrification for many manufacturers, even as consumer demands shift towards greater sustainability. The number of electric cars on the road still lags behind ICE (internal combustion engine), but it is growing rapidly: electric car sales broke all records in 2020, in spite of the crisis caused by the covid-19 pandemic.1 What are the stakes for electric vehicle development, and how can we expect technologies to shape the market for EV innovators in the next few years?

Future is the Cloud

Cloud computing is at the forefront of everyone's thoughts. Although it has been around for some time, the pandemic has seen businesses put a renewed focus on the shift to cloud with simulation being a natural partner to cloud computing. Many view cloud in the context of simulation as being all about High Performance Computing for excess demand. But it is more than that. Cloud gives businesses access to new service-based business models, to the latest technology without requiring major capital investments, to the level of operational integration that they need. Cloud can enable businesses to put more focus on product innovation and spend less time on maintaining the infrastructure to support it. There are many benefits (and barriers) to cloud adoption today, but one thing is for certain - the future of simulation will be in the cloud.

Questions to be discussed at the roundtable:

- What are the key pain points businesses seek to address with cloud computing?
- Are companies aware of what's needed to work in a cloud-based environment?
- What are the barriers to cloud adoption for businesses?
- How can cloud computing support businesses to drive product innovation better and faster?
- Can cloud ever be more secure than on-premise infrastructure?
- What do we get right about cloud? What do we get wrong?

The Future is Simulation driven Design

Gone are the days when we could design in a vacuum, relying only on the collective experience of a team to produce a viable product. Industry standards and consumer expectations have driven deeper conversations in relation to product design and how best to meet these challenges.

How do we create not just a functional, but rather a better performing, easily producible and cost effective product?

Physical testing has slowly made way for virtual and realistic simulation to help answer these questions, driven by needs for; faster design iterations, the ability to interrogate internally with ease and investigate situations not feasible to conduct physically.

What impact can this all have on designers and simulation experts in the future?

Questions posed at the roundtable:

- Is simulation now a requirement for efficient and agile design innovation?
- At what stage in design should simulation be utilised?
- Should simulation be accessible to simulation experts only?
- Does simulation optimization and automation remove uniqueness?
- What hinders or drives adoption of simulation within your industry?

Strategy & Future
Join the senior management team at the Strategy Round table to discuss how new technologies provide opportunities to drive process change in the deployment of simulation and the resulting business benefits

User Presentation Abstracts

User Presentation Session One

1. Researcher Experimentally measured impedance boundary conditions for simulating microwave scattering from ferromagnetic wires, Dmitriy Makhnovskiy | Plymouth University

Abstract: The magnetic structure of conductive ferromagnetic wires plays a significant role in their microwave scattering properties. In the cmWave range, the skin layer remains comparable to the wire micron radius up to several GHz. Thus, almost entire wire volume gets involved in forming a scattered electromagnetic field. In the hybrid approach we are developing, the solution of the internal electrodynamic problem is replaced by an impedance boundary condition obtained from experiment. To implement this approach, an accurate method for measuring impedance over a wide frequency range is required. We proposed using the PCB-based measurement cells where the wire sample is connected between the surface microstrips. In addition to measuring impedance in the frequency range up to 15 GHz, these cells allow the application of external stimuli to the sample, such as a magnetic field, tensile stress, or heat. The use of non-coaxial fixtures, as well as a cm length of the wire sample, has required the development of a multi-stage calibration procedure. It includes SOLT calibration of VNA together with the coaxial cables, deembedding of the PCB microstrips, as well as compensation for phase shift along the wire sample. The developed calibration allows the correct measurement of S_21-parameter for its subsequent conversion into the surface impedance. We used an array with experimental values of the complex surface impedance to simulate in CST Studio Suite the response of a wire irradiated with a plane wave. The developed approach makes it promising to use numerical solvers for modelling the wire-based composite structures.

2. EMC Specialist How to simplify power converter RF Conducted Emission models, Jason Watkiss, Controls Engineer | Rolls Royce Control Systems

Abstract: Modelling of RF Conducted Emissions in a power converter can be simplified by using measurements of common mode impedance to ground of the electrical machine and its common mode voltages. The presentation aims to show these measurements, and how they can be imported into a computer model using 3D CST tools to predict RF Conducted Emissions. Focus will also be on the cabling modelling from the electrical machine to the converter. This methodology is consistent with EMI modelling approaches adopted in IEEE papers and other sources.

3. Accelerating Engineering through Democratisation of Simulation at Jaguar Land Rover, Michael Brown, Technical Specialist | Jaguar Land Rover Ltd

Abstract: Engineering is truly on a technological dawn of a new age of automation. At RUM 2016, we introduced our democratisation of simulation strategy and early progress made in developing CAE Templates in 3D Experience. Development of associative CAD and automated CAE methods had previously been distinctly separated over time within Jaguar Land Rover's Body and Chassis Engineering Department. We explored the efficiency gains which had been realised through automated and standardised CAD/CAE templates.

At RUM 2019, we showed our successful implementation of simulation automation, the impact of it on our engineers and we have touched on the potential of what automated analysis can give us. Demonstrating key indicators of adoption of this new technology.

This year's presentation will explore this journey and evidence we can now share on recently revealed products. Furthermore, we will discuss the impact on our engineering community, the importance of empowering our engineers to make data driven decisions and what it takes to drive this transformation into a large engineering company.

4. Combining measurement and simulation using a hybrid model, Kilwa Ärölä, Simulation Manager, | Rand Finland

Abstract: A hybrid modelling approach is used to study the structural dynamics of a powerplant generator set structure. The measured data from a limited number of points is expanded into field outputs covering the entire structure. A hybrid model utilizing an Abaqus simulation model and measured data is presented, a brief overview of the theory behind the model is given, and its use in a practical engineering case is demonstrated.

Measurements in machine dynamics are usually conducted with accelerometers and strain gauges. With these sensors only pointwise results are obtained. To get a complete picture on how a structure behaves in operation, lots of measurement points are needed. This is time consuming and costly. It may also be impossible to fit sensors in every interesting location due to, for example, limited available space.

In machine dynamic simulations, one challenge is the definition of realistic loading conditions considering all dynamic excitations acting on the studied structure. Limited accuracy in the loading, introduces errors to the simulation results. With a hybrid model and mode-based expansion, problems in loading condition accuracy in simulations is avoided.

By combining a realistic simulation model and measurement data using a hybrid model, one can get comprehensive understanding of the operation of the product with fewer measurement points. Hybrid model can be utilized for example in product development, condition monitoring, predictive maintenance, and to increase the overall understanding on how the product functions.

User Presentation Session Two

1. Computational Wear Analysis of Different Activities of Daily Living for Reverse Shoulder Replacement, Jessa Mae Canas | Liverpool John Moores University

Abstract: The mug-to-mouth cycle has been one of the most widely used activity of daily living (ADL) to investigate wear on shoulder joint replacement (SJR). This is because the cycle's range of motion (ROM) is likened to ordinary activities such as reaching the back of the head and picking up a light weight off the floor. However, the effect of other activities such as driving, carrying a baby, or social activities like golf on the longevity of these implants are still unknown.
This paper proposes a finite element FE wear model capable of actuating the same physiological ROM and loading of these ADLs. An in-house wear algorithm has been developed to predict wear on an FE model of a 42mm reverse shoulder prosthesis. The ADL simulated is a mug-to-mouth cycle with a frequency of 1Hz, and ran equivalent to 5million cycles. The model was validated using experimental results of a mug-to-mouth shoulder simulation study. FE results show a volumetric wear of 8mm3/million cycle, which is in the range of the experimental result of 12.0±3.9mm3/million cycle. Contact pressure of 1.6MPa at the highest load of the cycle is also comparable to literature.

The FE model, together with our in-house algorithm, is being used to investigate the effect of varying ADLs on the longevity of the SJRs, starting with driving. Findings can be used to introduce an implant durable across the active lifetime of patients, without needing revision surgery and bringing active lifestyle for patient receiving these implants.

2. A Finite Element Study of the Effect of Cross-link Stabilisation in A Lumbar Spine Tumour Model, Damien Lacroix, Chair in Biomedical Engineering | University Of Sheffield

Abstract: Spinal metastases are common in cancer patients, and cross-link stabilisation could benefit the structural stability and integrity of the lumbar spine after fusion surgery. However, the cross-link might diminish the therapeutic qualities of radiotherapy or proton beam therapy, which thereby needs more specific evidence on clinical decisions. A finite element (FE) model of a fixation device was developed using Abaqus (Dassault Systemes). The device was inserted virtually into a FE model of the lumbar spine (L1 to S1) between L2 and L4. A bone tumour of either 1.3%, 10.1%, 38.3%, 71.5% and 92.1% of bone volume was simulated. A 300N compressive, a 20 lateral bending and 7.5 Nm torsional load were simulated on the top of L1 and the stress and strain distributions within the device and the bone vertebrae and discs were calculated. Results indicate that under compression the fixator reduce stress around the tumour when its size is lower than 50% but insignificant when larger. Under flexion the stress distribution was similar with or without the fixator. Under torsion the von Mises stress was significantly reduced when tumour size was larger than 50%. The effect of the cross-link bar and its position were most significant in torsion for larger tumour and stress was reduced mostly when the bar was positioned closer to L4 vertebrae. This study provides recommendations on the use and placement of cross-link bar in a spinal fixation system depending on the tumour size.

3. A parametric model of the human knee optimised for contact Mechanics, Laurence Marks, Visiting Research Fellow, Associate Lecturer | Oxford Brookes University

Abstract: A parametric model of the human knee has been generated (Fig. 1) which not only provides accurate and rapid calculation of contact behaviour between the soft tissues of the meniscus and cartilage, but also rapid model regeneration across a range of morphologies driven by parameters obtained from the survey of medical images. Barrera's group [1] recently discovered material properties of the three-layer structure in menisci, which clinically relevant computational models now need to consider. The menisci layers are positioned in the contact regions, further driving the requirement to create high quality, and optimised meshes. The role of the ligaments which connect the ends ("meniscal roots") of the meniscus to the skeletal sections is critical [2], and these are included in the model using connectors, which also drive rapid solution and assessment of model variables (i.e., menisci kinematics).
The flexibility to change geometrical parameters and the generation of optimised computer models have been lacking in previous knee models. Here, a range of morphologies has been generated and evaluated. The models were sensitive to knee joint morphologies showcasing load path variation in the joint. These parameterised models have demonstrated the ability to replicate structural responses critical to the function of the knee and potentially to medical interventions in this area.

1. Establishing Model Credibility through VVUQ – the Key Element for in-silico Medicine, Nils Götzen | 4REALSIM BV

Abstract: Establishing Model Credibility through VVUQ – the Key Element for in-silico Medicine
Nils Götzen, Vincent Bouwman, Tahir Turgut, Omar Zahalka, Gaëtan Van den Berg
Establishing the credibility of computational models, which are potentially used in virtual clinical

trials or in general during the development of medical devices, is the key element to generate the needed trust of customers, regulators, patients, and other stakeholders. We demonstrate by means of an FEM/FSI model-development of a TAVI (Transcatheter Aortic Valve Implantation) device, how a careful planning, implementation, and execution of an hierarchical & tiered verification-, validation-, and uncertainty quantification-process can help to achieve that goal. We go through the process of defining the necessary Verification (VER) and Validation (VAL) requirements, following state-of-the-art standards and show how this is applied to individual model components and entire model assembly. A high level discussion of the individual VER & VAL activities and encountered challenges will provide information that can also be used in other industries. Special attention is given the increasingly important field of Uncertainty Quantification (UQ), which needs to be applied to the computational model but also the experimental activities and is an integral part of the VAL. Since developed FEM/FSI models are too complex to be used in classic Monte-Carlo simulations, the development and usage of meta-models (emulator) will also be addressed. The presented material and data is originating from the EU-funded SimInSitu project (grant agreement 101017523), which led by 4RealSim Services BV as the consortium coordinator.

User Presentation Session Three

1. A functionally graded fractional poroelastic model of the human meniscus explains lubrication mechanisms during loading, Olga BARRERA | Oxford Brookes University

Abstract: Experimental evidence shows that the permeability, hence the rate of fluid flow, inside the meniscal tissue is not a constant quantity in both time and space. This type of behavior is described by a poroelastic model in which the pore pressure diffusion equation is ruled by non-integer order derivatives. The order of the derivative and the anomalous permeability change through the thickness of the meniscus. This paper focuses on implementing "anomalous" transport phenomena with mechanics in a porous solid within the theory of poroelasticity through a UMATHT subroutine. We analyse consolidation problems and compare results with both analytical solution and experimental values. Moreover, we run the model of a knee patient specific model in dynamic conditions and show results regarding lubrication and contact mechanisms in the knee joint. We observe the role that the meniscus plays in wetting the surrounding soft tissues.

2. Aircraft community noise prediction in 3D environments, Yunusi Fuerkaiti | Technische Universiteit Delft

Abstract: Aircraft flyovers around residential areas feature a moving sound source and long-range propagation affected by atmospheric and ground conditions. Although high-fidelity CFD solvers have been widely used to simulate aircraft noise sources from component level to entire vehicle configuration, CFD can be very computationally expensive to account for various atmospheric and ground effects. This work presents a novel noise propagation approach based on the Gaussian Beam Tracing (GBT) method that accounts for complex source directivity, weather conditions, and irregular ground topology for the evaluation of aircraft noise footprint. The approach takes a precomputed noise sphere as input and propagates the acoustic pressure fluctuations through a moving inhomogeneous atmosphere over realistic three-dimensional (3D) terrain. The helicopter geometry designed by Dassault Systemes is used as a case study. Acoustic impacts of varying source directivity, wind velocity, and ground topology are studied. Significant changes in the acoustic footprints are observed, suggesting the importance of including local weather and ground conditions in evaluating aircraft community noise.

3. Brake System Limit Performance Prediction using CFD A simulation of the Grossglockner Mountain Descent with a Bentley Continental GT Speed, Stamatis Angelinas, R&D Vehicle Motion – Brake Systems | Bentley

Abstract: The brake system of a passenger car must be designed in a manner that allows the vehicle to be stopped effectively and safely, even under conditions of high thermal stress placed on the system components. The Grossglockner Mountain Descent is an industry-standard test procedure aimed at establishing the worst-case brake fluid temperatures attained in the system under prolonged braking and ensuring these are below prescribed safety limits.
An Automotive OEM typically has a requirement to test different brake system configurations (brake disc sizes, hose lengths and materials, dirt-shield designs etc.). This leads to a number of Mountain Descent tests being performed, which require a substantial commitment of resources (test vehicles and Engineers, instrumentation, travel etc.).
In this presentation we examine the modelling of this test via CFD and correlation of simulation results to a benchmark vehicle test. The correlated model can then be utilised to quickly change parts of the brake system and compare results without the need for physical re-testing, allowing for significant resource savings and a reduction in test fleet CO2 output.

4. Using Abaqus to bust the myth or expose the magic of the long screwdriver, Bob Johnson | Realistic Engineering Analysis Limited

Abstract: About 10 years ago my son, Sam, visited me in the Scottish Borders and promptly got his van stuck in a ditch. Myself and some running colleagues could not push him out so we set about trying to tow him out with my small car and 8 metres of tow rope. Try as I might I couldn't find enough traction to pull him out; my wheels just spun on the tarmac road. We reverted to the AA not certain that they would manage to get him out either.

When the AA man finally arrived, he unfurled some 40 metres of tape and pulled him out with minimal revs, no wheel spin and precious litte fuss. The highly-efficient AA "rescue" made our attempts look feeble in the extreme. The striking difference for me was the length of rope used – we used around 8 metres and the AA man used some 40 metres. The additional length allowed the towing vehicle to "invest" some strain energy in the rope and this elastic effect hauled Sam out of the ditch "easy as pie".

In the same vain, that is stored elastic energy, my dad always insisted that a long screwdriver would "break" the hold of a steadfast screw far better than a short, stubby screwdriver. My dad died in 1995 and this problem, or rather the proof or otherwise of it, has been with me ever since. Some engineers consider that the extra length cannot "generate" a turning effect and that the benefit of a long blade (if any) is purely in the mind of the user/holder.

In order to cast light on both the "translational" problem (the tow rope) and the "rotational" problem (that of the long screwdriver), Abaqus models will be generated in order to bust (or otherwise support) these myths. The problems therefore are easily understood but can a high-grade simulation package such as Abaqus be used to account for the "feel" and/or "effectiveness" of varying lengths of rope or short, stubby screwdrivers?. The scene is set for a technical paper studying two simple problems but with enhanced results-post processing and hopefully mind-boggling outcomes!

User Presentation Session Four

1. Conservatisms in equivalent static assessment of Dynamic Events, John Sawyer, Principal Engineer, Design and Analysis | Atkins

Abstract: The assessment of structures that need to be resistant to impact are often completed using simplified single degree of freedom models. This simplifies the approach and allows designs to be assessed for impact using a static analysis to find the peak stress field and assess the resistance of the structure. This work aims to compare this simplified technique with direct analysis of the problem using an ABAQUS/Explicit models in an effort to assess the conservatism inherent in the simplified method.

2. Koroyd® tubular core structure inside helmet to improve safety and comfort - Use of simulation to optimize the performance, Filippi Romain, Director | EC2 MODÉLISATION

Abstract: The aim of the study performed by EC2 Modélisation is to conduct finite element numerical simulations of shock absorption and penetration tests on a helmet. The helmets studied contain a shock absorbing tubular core structure produced by Koroyd. The main target of this method is to improve and validate the helmet design following the standards requirements.

Standards for helmets have an energy absorption test which most of the time consists of a helmet drop onto an anvil. Each standard specifies a drop velocity and an anvil shape. Thus, depending on the application and the design requirements the helmet construction has to be optimised. Design changes require prototypes and many destructive tests implying tooling and testing costs. This study presents a numerical method as a predictive approach to design the helmets before the validation test campaign. The results of the present method fit very well the different experimental results obtained with Koroyd® material (it is built with thousands of co-polymer extruded tubes, thermally welded to create a consistent engineered core).

This numerical method and the integration of Koroyd® material is a useful tool for guiding the development of helmet technologies and other structures. The request for increased safety and breathability lead to the development of multifunctional materials, having multiple optimized properties

3. Finite element model of Specially-shaped partially encased composite columns under cyclic loading, Qiuyu Xu | University Of Lancaster

Abstract: Prediction of seismic behavior of Specially-shaped partially encased composite (SPEC) columns by finite-element modeling presents a challenging problem due to the complex interactions between various failure modes, including local buckling of the thin-walled steel flange plates. In this study, a seismic finite element(FE) model of SPEC columns was developed by the dynamic explicit formulation offered by Abaqus, where C3D8R solid elements, C4R shell elements and B31 beam elements were used for concrete, steel and rebars, respectively. Concrete damage plasticity was simulated by a modified Mander model that is capable of capturing concrete confinement from stirrups and steel section based on effective lateral constraint. In addition, the Bauschinger effect was considered in the uniaxial constitutive model of steel.

The parameters required to define yield, flow and hysteresis in the concrete plastic damage model were calibrated against test results and the theoretical results available in the literature. Finally, the model was validated by comparing the predicted hysteretic performance of the SPEC columns under cyclic loading with test results, showing satisfactory predictions on some of the most important dynamic performance indicators, such as pre-peak load, post-peak behavior, and failure modes. The study demonstrates that Abaqus is a

powerful modelling tool that can be used conveniently by engineers to simulate realistic dynamic design problem involving complex geometry and strong nonlinear material properties.

4. Finite element modeling of interlaminar fracture of thin carbon fiber/polyamide6 laminates with stiffening beams, Sepehr Simaafrookhteh | KU LEUVEN

Abstract: Thin laminated composites are an intriguing material class to industry and researchers. Firstly, they promise material savings. In addition, they can be produced in an isothermal condition; several material properties affected by the cooling rate and degree of crystallinity can thus be assumed uniform through the thickness. Moreover, thin laminates can be applied in thin material joints (e.g., metal-to-composite). The present work is part of ongoing research on the bond strength of thin carbon fiber-reinforced/polyamide6 (CF/PA6) laminates and focuses on the double cantilever beam (DCB) test for determining the mode I fracture toughness. To prevent large deformations or premature failures in a thin specimen during testing, stiffening beams are typically bonded to the specimen using adhesive. Here, a finite element model is developed in Abaqus, which combines the advantages of the virtual crack closure technique (VCCT) and cohesive zone modeling (CZM) to design thin specimens with aluminum stiffening beams. VCCT is used to compute the energy release rate (ERR) of mid-plane delamination. Furthermore, the adhesive between aluminum and CF/PA6 is modeled using CZM. The simulation confirms a propagating disbonding between aluminum and CF/PA6 that had previously been observed experimentally, thus demonstrating the inability of some common adhesives to prevent such disbondings in the present specimen. Next, the numerical model is used to design the specimen (e.g., determine aluminum thickness) for successful DCB experiments. Lastly, the model is used to predict the fracture behavior of thin CF/PA6 laminates and compare the VCCT-based ERRs to those calculated using different data-reduction equations.

User Presentation Session Five

1. Numerical Simulation for the Compressive Behaviour of Carbon Fibre Prepreg under High-pressure Compression Moulding Conditions, Hao Yuan | University Of Warwick

Abstract: The recent advancement in fast curing resin systems has made the high-volume manufacturing of structural composites possible for automotive applications through the compression moulding of carbon fibre prepregs. This has also enabled a single-shot compression moulding process combining continuous fibre based prepreg and discontinuous fibre based sheet moulding compounds (SMC). The application of hybrid fibre architecture can combine the superior material properties of continuous fibre composites with the great design flexibility of discontinuous fibre composites. However, it also introduces additional design for manufacturing challenges compared to a prepreg-only compression moulding process, as the presence of SMC can typically increase the in-cavity pressures from less than 20 bar to over 200 bar. The higher pressures can cause significant disruption to the fibre architecture in the continuous fibre reinforcement, such as server change in fibre orientation and tow spreading, which can adversely affect the mechanical properties of the materials. Therefore, it is crucial to develop a reliable process simulation to predict and mitigate the formation of these defects.

This study aims to develop a constitutive material model for carbon fibre woven prepregs under the high-pressure compression moulding conditions using Abaqus/Explicit. A hyperelastic material model will be developed and implemented through VUMAT subroutines and experimental data from prepreg compression tests are used to generate the model input data. The simulation results will be correlated with the experimental data in terms of the overall force-displacement curve, pressure distributions and thickness variations in the sample etc.

2. Finite-element model of fire-protected composite beams with web openings, Nicoletta Galluzzi, Associate Director | WSP UK Limited

Abstract: The assessment of the behaviour of composite beams with large web openings in fire is important when a performance-based design approach is adopted for steel frame structures. The current design practice of cellular beams at the fire limit state is based on fire tests performed under a standard fire time-temperature regime with simple support conditions. In a performance-based design approach, the response of the structure is calculated using more realistic fire scenarios, hence it is key to investigate the behaviour of protected beams with web openings in complete frames under natural fires.
This presentation investigates the effects of restraint conditions and applied thermal regime on the performance of fabricated beams with web openings under fire when considered as isolated simply supported elements and in a composite floorplate. The potential difference in response is illustrated with the aid of 3D nonlinear FE thermo-mechanical modelling in Abaqus. The simply supported beam and the composite beam with a portion of the slab are modelled using a shell-element modelling approach. A heat transfer analysis is undertaken to determine the thermal regime in the slab. For the beams, the temperatures across the cross-section are determined using the SCI publication RT13569. A structural model of the composite beam in the standard fire test and within a real structure is developed to assess the response under the thermal regime obtained.
The presentation also examines the effects of modelling beams using beam elements instead of shell elements on the performance of floorplates in fire.

3. Micromechanics of yarn-level hybrid composites, Giuseppe Romano | The University Of Manchester

Abstract: The study looks at how the homogenized effective elastic properties and the micro-stress fields are impacted by yarn-level hybridization in a thermosetting composite lamina. In this analysis, representative volume elements and repeating unit cells are generated in Abaqus using a Python script. The model was created using a 3D model that was meshed with C3D8R and C3D6, and the microstructural output has a total fiber volume fraction of 0.6; an algorithm from the literature was applied to reach this fiber volume fraction. Using analytical methods and data from the literature, the model's accuracy has been verified. To conclude, the main goal of this work is to have a reliable and fast approach to predict the lamina constants based on different fiber contents and combination; with this approach both industry and academy can benefit of an optimized technique to balance in-plane and out-plane properties of the lamina.

1. Aeroacoustics Simulation using SIMULIA PowerFLOW across Dyson Technology, Dr Kondwani Kanjere CEng MIMechE | Lead NVH Research Engineer | Dyson Technology Ltd

At Dyson we continuously strive to find ways to reduce the noise from our products. As part of this effort, we have adopted SIMULIA PowerFLOW for the prediction of flow generated noise. An overview of the applications of PowerFLOW to simulate the aerodynamic noise of components/sub-systems and full products is presented. The predicted noise levels are in very close agreement with measurement and offered very useful insights into the noise sources and mechanisms responsible for the noise.

User Presentation Session Six

1. A thermo-mechanical model of prestressed concrete hollow core slabs under fire, Waleed Hamad, Associate, Advanced Structural Analysis | WSP UK Limited

Abstract: The application of prestressed concrete hollow core slabs (HCSs) with steel deltabeams is gaining popularity in the construction industry as it enables slim floors with longer spans solutions. In addition, previous fire tests have revealed that deltabeams have good fire resistance without being protected and HCSs show high level of inherent fire resistance. However, as compartmentation is a mainstay of fire strategies to ensure that any fire is contained within the compartment of fire origin, compartment walls should be able to accommodate the deflection of the floor above and have suitable head details between the wall and floor. Whilst HCSs deflect less than conventional floors at ambient temperature, their deflection at elevated temperature may be more than that allowed by the head details and thereby breaching the integrity requirements for compartmentation.
This presentation investigates the performance of HCSs under fire by means of a 3D nonlinear FE thermo-mechanical modelling in ABAQUS. A typical-span slab model is developed using solid 8-node brick elements for concrete and 2-node truss elements for steel and prestress strands, adopting symmetry boundary conditions to reduce computations. Firstly, a thermal analysis model of the slab is analysed under standard fire considering convection, radiation, and heat loss. Secondly, a structural model of the slab is developed simulating the prestressing process, the behaviour under gravity loads and the performance under fire as per the thermal regime obtained from the thermal analysis. Concrete damage plasticity is adopted for concrete whereas a von-Mises true stress-strain model is used for steel plasticity.

2. X-ray Computed Tomography and Finite Element Analysis of the Great White Pelican Beak for Lightweight Vehicle Part Design, Nicola Thomas, PhD Researcher | Swansea University

Abstract: Naturally occurring structures have the ability to inspire innovative solutions to engineering problems. This research details a structural analysis of the mandible of a great white pelican, borrowed from the National Museum of Wales, Cardiff, as a prospective source of bioinspired design. The internal architecture of the lower mandible was investigated using X-ray computed tomography, micro-CT, at the Advanced Imaging of Materials, AIM, core facility in the Faculty of Science and Engineering, Swansea University. The internal structure comprised a hollow tube with reinforcement from struts arranged in repeating patterns. The 3D volume was segmented and meshed before conducting Finite Element analyses on sections of the mandible. Linear elastic FE analyses showed the sections had greater stiffness in the dorsoventral direction. Buckling analyses were conducted on a low-fidelity model, constructed using a combination of beam and shell elements. The results of these analyses help to provide understanding of the roles of the different regions of internal structure in terms of their effect on the buckle resistance. First positive Eigenvalues were recorded and showed that buckle resistance was highest when all internal structures were present. Removing sections of the internal structure showed which regions provided the greatest contribution to buckle resistance, indicating how this type of bioinspired structure could be used to design lightweight structures for engineering components such as those found in aerospace and automotive applications.

4. Fatigue life prediction of antivibration products using Abaqus user subroutine, Robert Luo, Principal CAE Engineer | **Trelleborg AVS**

Abstract: Rubber components are widely used in industry for antivibration applications. The durability requirement must be met before the products are manufactured. Hence, the fatigue assessment of the components is essential in the design stage. A three-dimensional criterion of fatigue damage, i.e., effective tensile strain calculated from three principal components, has been developed successfully with Abaqus user subroutine option. The fatigue damage εt is defined as

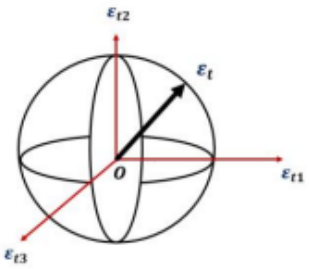
$\varepsilon t = \sqrt{\varepsilon t1^2 + \varepsilon t2^2 + \varepsilon t3^2}$ $\varepsilon ti > 0$, $\varepsilon t1 \geq \varepsilon t2 \geq \varepsilon t3$ (1)

The fatigue crack direction $\boldsymbol{d}$ is

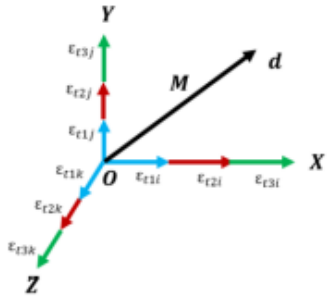
$\boldsymbol{d} = [\, , dj\, , dk]$ (2)

where $di = (\varepsilon t1i + \varepsilon t2i + \varepsilon t3i)/M$ i, j, k

$M = \sqrt{(\varepsilon t1i + \varepsilon t2i + \varepsilon t3i)^2 + (\varepsilon t1j + \varepsilon t2j + \varepsilon t3j)^2 + (\varepsilon t1k + \varepsilon t2k + \varepsilon t3k)^2}$



Geometric illustration of $\boldsymbol{\varepsilon_t}$.



The illustration for the direction of $\boldsymbol{\varepsilon_t}$.

To determine the damage value, the crack direction and visualization of the damage, only option is to use Abaqus interface: user subroutine UVARM. To obtain the correct results, a step-by-step procedure of the verification has been followed. The prediction is validated against the observation of experimental results. More details will be provided in the presentation

5. Strategies for Automation of High Variability and Low Repetition Analyses, Matt Clarke, Principal Simulation Engineer | **TECHNIA**

Automation of Finite Element Analysis is becoming increasingly popular for a number of reasons. The principal benefits are often cited as reduction of development times, increased analysis quality, democratization of the analysis process and ability to ease resource issues.
Within the consultancy group at TECHNIA automation is essential to meeting customer deadlines, but presents particular challenges due to the highly variable nature of consultancy projects. In addition, repetition of analyses is typically limited.

To meet these conflicting requirements, a strategy has been developed to identify opportunities for automation using tools that can be deployed across multiple projects, and therefore justify the investment in

time required to produce robust solutions. An important aspect of this is the selection of appropriate tools based on experience with technologies such as scripting, templated analyses and process integrators. Two key features of the process at TECHNIA are the incorporation of features to aid automation in model build and optimizing the balance between automation and user input.

The presentation will describe several case studies of implementing effective automation solutions for both Established Products and 3DExperience, with a focus on novel aspects of each study. These case studies will highlight how the automation was developed, the rationale behind the technology deployed and show examples of use in analysis. The benefits to the project that were gained through automation will be emphasised. Whilst the solutions described were developed to meet particular needs within the TECHNIA consultancy business the tools deployed are of wider use to the simulation community.

Sponsors

GOLD SPONSOR

SILVER SPONSORS