# 6th BETA CAE INTERNATIONAL CONFERENCE

10-12 JUNE 2015, THE MET HOTEL
THESSALONIKI, GREECE

## Conference Guide

BETA CAE Systems SA
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# 6th BETA INTERNATIONAL CONFERENCE

June 10-12, 2015, The MET HOTEL, Thessaloniki, Greece

# Conference Guide

# Contents

# Welcome

Dear Attendees.

BETA CAE Systems SA welcomes you to our biannual BETA CAE International Conference. We would like to thank you for honoring us with your participation to our 6th appointment and for helping us make this event a recognized tradition that brings the CAE community closer.

We at BETA CAE Systems SA, remain loyal to our mission to provide the CAE community with innovative, technically advanced, user friendly, and easy to deploy software products and methodologies. By closely collaborating with our customers and partners we offer solutions that bring CAE to new stages, and go beyond time and cost reduction for simulation, allowing engineers to perform tasks and achieve targets which couldn't be reached before. We achieve this through breakthrough advances to our flagship products and brand new software. In this years' conference you will be introduced to the results of our ongoing efforts to address complexity in the CAE processes.

During the three days of the conference, more than 65 presentations will outline the latest advances in CAE strategies, methodology, techniques, and applications related to our products. Additionally, in our technical gallery, you will have the opportunity to engage in private or open technical discussions, and demonstrations with our executive, development, and service engineers and promote your interests and requests for future developments.

We would like to express our special gratitude to all those who contributed with technical papers and presentations, and especially to the Keynote Speakers, Dr. Vasilios Bakolas from Schaeffler Technologies AG & Co. KG, and Professor Sadayuki Ujihashi, chair of JNCAP, Professor Emeritus at Tokyo Institute of Technology, who both have distinguish careers and positions in their organizations.

We wish you a pleasant stay during the conference and we are looking forward to seeing you to our next conference in 2017.

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BETA CAE Systems SA

# Programme

# Agenda

| Tuesday, June 9 | |
|---|---|
| 16:30 - 18:30 | **Pre-Registration** \| Hotel Lobby |
| 20:00 - 22:00 | **Welcome Reception** \| Roof Pool Bar |

| Wednesday, June 10 – Morning Sessions | | | |
|---|---|---|---|
| 8:30 - 9:00 | **Registration** \| Foyer | | |
| | **Session 1** \| Maistros A<br>chair: Prof. A. Michailidis, Aristotle University of Thessaloniki | | |
| 9:00 - 9:10 | **Welcome**<br>Chryssa Sferidou<br>BETA CAE Systems SA, Greece | | |
| 9:10 - 9:20 | **Opening speech**<br>Dimitris Angelis, President<br>BETA CAE Systems SA, Greece | | |
| 9:20 - 9:50 | **Keynote Speech: How can CAE support Innovation?**<br>Dr. Vasilios Bakolas<br>Schaeffler Technologies AG & Co. KG. | | |
| 9:50 - 10:30 | **Latest developments in BETA CAE Systems product line**<br>Chryssa Sferidou<br>BETA CAE Systems SA, Greece | | |
| 10:30 - 11:00 | **Coffee Break & Technical discussions** \| Technology Gallery - Foyer | | |
| | **Session 2A** \| Maistros A<br>chair: S. Seitanis, BETA CAE Nordic AB | **Session 2B** \| Maistros B<br>chair: S. Chatzimoisiadis, BETA CAE Systems SA | **Session 2C** \| Zephyros<br>chair: N. Drivakos, BETA CAE Systems SA |
| 11:00 - 11:30 | **A new approach on data management for the CAE model-building process at BMW: DCM-GUI**<br>[1]Michael Tryfonidis*, [2]Hans-Peter Daunhert, [2]Marcel Meder<br>[1]BETA CAE Systems SA, Greece,<br>[2]BMW Group, Germany | **Geometry parametrization with morphing boxes and integration in a multi-disciplinary optimization**<br>Paul-Edouard Munch<br>Dr. Ing. h.c. F. Porsche AG, Germany | **Performance-oriented partners in simulation - engine development as an example**<br>Dr.-Ing. Michael Klein*, Dr.-Ing. Reinhard Helfrich<br>INTES GmbH, Germany |
| 11:30 - 12:00 | **Complete solution for model build-up**<br>Irene Makropoulou*, George Nikolaidis<br>BETA CAE Systems SA, Greece | **ACP - An optimization product design and development approach**<br>Akbar Farahani<br>ETA Inc., USA | **FEM analysis of a belt conveyor driving drum**<br>A. Mihailidis, E. Bouras*, E. Athanasopoulos<br>Aristotle University of Thessaloniki, Greece |
| 12:00 - 12:30 | **ANSA DM: simulation data management in pre- and post-processing**<br>Dimitrios Katramados*, Athanasios Roubies, Dimitrios Krontsos<br>BETA CAE Systems SA, Greece | **Morphing strategies library presentation**<br>Joshua Sims*, Sunil Earla, Ravi Nimbalkar, Yatin Kumbhar<br>BETA CAE Systems USA Inc., USA | **Development of an automatic procedure for safety analysis of elevator frames following the EN-81 regulation**<br>Dr. Ioannis Zyganitidis<br>BLAU EI O.E., Greece |
| 12:30 - 13:00 | **Data process for CAE – structural analysis: from data hunting to drag & drop**<br>Uwe Krempels<br>Daimler AG, Germany | **Optimization of morphing parameters using ANSA and VR&D Genesis**<br>Nick Kalargeros*, Dr Roger Darlington, Mark McNally<br>Jaguar Land Rover Ltd, UK | **Design and topology optimization for additively manufactured structural parts: a formula student case study**<br>H. Bikas*, J. Stavridis, P. Stavropoulos G. Chryssolouris**<br>Laboratory for Manufacturing Systems and Automation, Department of Mechanical Engineering and Aeronautics, University of Patras, Greece \| **Corresponding author |
| 13:00 - 14:30 | **Lunch** \| The MET Hotel Restaurant | | |

| Wednesday, June 10 – Evening Sessions | | | |
|---|---|---|---|
| | **Session 3A** \| Maistros A<br>chair: A. Perifanis, BETA CAE Systems SA | **Session 3B** \| Maistros B<br>chair: K. Haliskos, BETA CAE Systems SA | **Session 3C** \| Zephyros<br>chair: S. Kleidarias, BETA CAE Systems SA |
| 14:30 - 15:00 | **Analyzing scatter of crash simulation results using the DIFFCRASH plug-in within μETA**<br>[1]Dominik Borsotto*, [2]Antonios Perifanis, [2]Dimitrios Siskos<br>[1]SIDACT GmbH, [2]BETA CAE Systems SA, Greece | **High-end solutions for CFD with ANSA/μETA**<br>Vangelis Skaperdas<br>BETA CAE Systems SA, Greece | **Sheet metal forming optimization using ANSA and LS-DYNA**<br>Simone Ferrero*, Caterina Tribuzi<br>Nova Analysis, Italy |
| 15:00 - 15:30 | **Crash CAE in the all new Volvo XC90 and SPA platform**<br>Domenico Macri*, Anders Sandahl, Johan Jergeus, Oscar Centeno, Anders Ericsson, Weijia Wu, Emil Claesson, Per Anders Eggertsen, Mathias Retzlaff, Michelle Khoo<br>Volvo Car Corporation, Sweden | **The influence of mesh characteristics on OpenFOAM simulations of the DrivAer model**<br>Grigoris Fotiadis*, Vangelis Skaperdas, Aristotelis Iordanidis<br>BETA CAE Systems SA, Greece | **Automation Tool for sheet metal stamping using ANSA**<br>Ramesh Venkatesan, Jithesh Erancheri, Nanda Kumar<br>Kaizenat Technologies Private Limited, India |
| 15:30 - 16:00 | **Coffee Break & Technical discussions** \| Technology Gallery - Foyer | | |
| | **Session 4A** \| Maistros A<br>chair: Y. Kolokythas, BETA CAE Systems SA | **Session 4B** \| Maistros B<br>chair: D. Souliotis, BETA CAE Systems SA | **Session 4C** \| Zephyros<br>chair: E. Giordano, BETA CAE Italy Srl |
| 16:00 - 16:30 | **New technologies for Occupant Safety model set-up and analysis**<br>Athanasios Fokylidis*, Athanasios Lioras<br>BETA CAE Systems SA, Greece | **FEMZip compression and faster μETA visualization of CFD results**<br>[1]Pinaki Banerjee*, Stefan Müller, [2]George Kalaitzidis, [2]Dimitrios Siskos<br>[1]SIDACT GmbH, Germany,<br>[2]BETA CAE Systems SA, Greece | **The effect of masticatory loading on the cervical loop region of the incisor in rodents**<br>[1]T. Mitsiadis*, [2]A.Tsouknidas, [3]V. Karatsis, [2]N. Michailidis<br>[1]Institute of Oral Biology, University of Zurich, Switzerland,<br>[2]Dept. of Mechanical Engineering, Aristotle University of Thessaloniki, Greece,<br>[3]BETA CAE Systems SA, Greece |
| 16:30 - 17:00 | **ANSA scripting for automated pedestrian marking and simulation input**<br>[1]Yogesh Upreti [1]Matthias Erzgraeber [2]Thanassis Fokylidis<br>[1]Adam Opel AG, Germany,<br>[2]BETA CAE Systems SA, Greece | **Thermal simulations with THESEUS-FE and ANSA: Optimizing thermal comfort in an office building environment**<br>Dr. Daniel Köster<br>P+Z Engineering GmbH, Munich, Germany | **MFAT - A basic fatigue module for μETA-post**<br>[1]Anders Jonsson*, [2]Martin Sjöberg, [2]Johnny Grenwald<br>[1]DynaMORE Nordic AB, Sweden,<br>[2]BAE Systems, Sweden |
| 17:00 - 17:30 | **Pedestrian protection head impacts in glass correlation FEM test in the new SEAT Leon**<br>Angel Segura Santillana*, Carlos Arregui-Dalmases, Javier Luzon-Narro<br>SEAT Centro Técnico, Spain | **Design optimization with ANSA morph**<br>Tobias Eidevåg*, David Tarazona Ramos*, Mohammad El-Alti<br>Alten AB, Sweden | |
| | **Session 5** \| Technology Gallery - Foyer | | |
| | **Technical discussions, demonstrations and meetings** | | |
| 20:00 - 21:00 | **Dinner** \| The MET Hotel Restaurant | | |

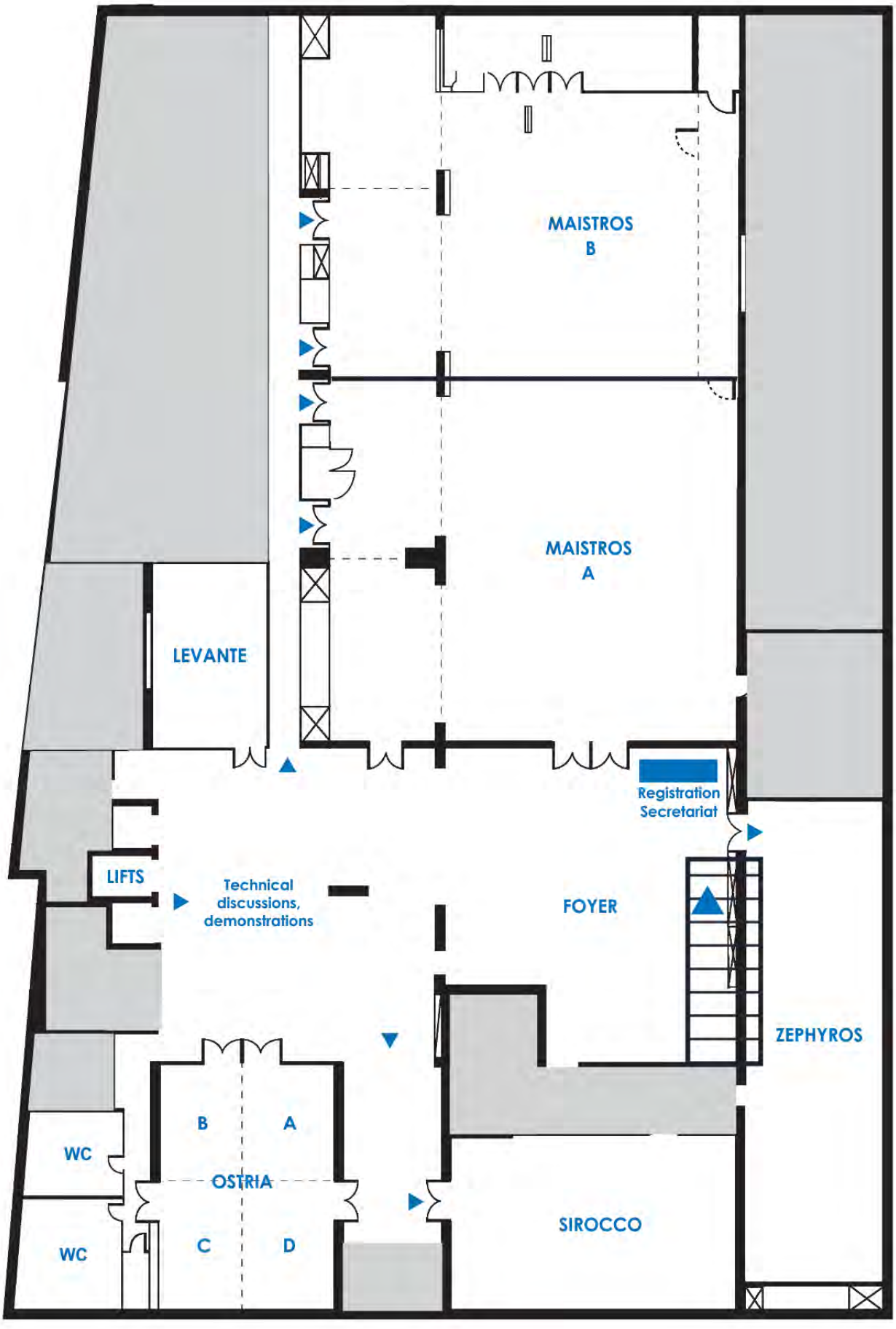
| Thursday, June 11 – Morning Sessions | | |
|---|---|---|
| | **Session 6** \| Maistros A<br>chair: K. Kiouptsidis, BETA CAE Systems SA | |
| 9:00 - 9:30 | **Future developments in BETA CAE Systems product line**<br>Christos Kolovos<br>BETA CAE Systems SA, Greece | |
| 9:30 - 10:00 | **ΕπILYSIS: a new FEA solver**<br>Stefanos Chatziangelidis<br>BETA CAE Systems SA, Greece | |
| 10:00 - 10:30 | **SPDRM implementation in a European automotive OEM**<br>[1]Irene Makropoulou*, [2]Niclas Dagson, [1]Menelaos Pappas<br>[1]BETA CAE Systems SA, Greece,<br>[2]ALTEN AB, Sweden | |
| 10:30 - 11:00 | **Coffee Break & Technical discussions** \| Technology Gallery - Foyer | |
| | **Session 7A** \| Maistros A<br>chair: V. Pavlidis, BETA CAE Systems SA | **Session 7B** \| Maistros B<br>chair: V. Skaperdas, BETA CAE Systems SA |
| 11:00 - 11:30 | **A new approach on processing large scale computer tomography data in conjunction with high-end CAE pre-processing**<br>[1]Daniel Heiserer*, [2]Michael Tryfonidis<br>[1]BMW Group, Germany<br>[2]BETA CAE Systems, Greece | **The benefit of ANSA tools in the Dallara CFD process**<br>Simona Invernizzi<br>Dallara Engineering, Italy |
| 11:30 - 12:00 | **Design improvement through enhanced processes available within NVH Console**<br>Tassos Sarridis*, Vasileios Pavlidis<br>BETA CAE Systems, Greece | **Automated optimization of a CAE external aerodynamics for aero-drag reduction**<br>[1]Andrea Serra*, [1]Massimiliana Carello, [2]Marco di Nonno<br>[1]Politecnico di Torino, Italy, [2]BETA CAE Italy Srl, Italy |
| 12:00 - 12:30 | **Pleasure vessel vibration and noise finite element analysis**<br>[1]Sergio Macchiavello*, [2]Angelo Tonelli<br>[1]D'Appolonia S.p.A., Italy, [2]Rina Services S.p.A., Italy | **Numerical simulations of flow through S-Duct**<br>[1]Pravin Peddiraju, [1]Arthur Papadopoulos, [2]Vangelis Skaperdas, [3]Linda Hedges*<br>[1]BETA CAE Systems USA, Inc., USA,<br>[2]BETA CAE Systems SA, Greece,<br>[3]CFD Consultant, USA |
| 12:30 - 13:00 | **Global damping validation and a new modal contribution feature for squeak & rattle simulation**<br>Samy Bazine, Jens Weber*<br>Volvo Car Corporation, Sweden | **Customization of μETA post for display of results from a molding simulation**<br>[1]Prasanna Kondapalli*, [1]James McGuire, [1]Damiano LaRosa, [2]Deepak Lokesha, [2]Joshua Sims<br>[1]BASF Corp., U.S.A,<br>[2]BETA CAE Systems USA Inc., USA |
| 13:00 - 13:10 | **Group Photo** | |
| 13:10 - 14:30 | **Lunch** \| The MET Hotel Restaurant | |

| Thursday, June 11 – Evening Sessions | | | |
|---|---|---|---|
| | **Session 8A** \| Maistros A<br>chair: M. Tryfonidis, BETA CAE Systems SA | **Session 8B** \| Maistros B<br>chair: A. Iordanidis, BETA CAE Systems SA | **Session 8C** \| Zephyros<br>chair: D. Katramados, BETA CAE Systems SA |
| 14:30 - 15:00 | **Increased accuracy in squeak & rattle simulations by enhanced material properties, damping values and aligned evaluation directions**<br>[1]Mehrdad Moridnejad, [1,2]Casper Wickman, [1]Jens Weber, [2]Lars Lindqvist, [2]Rikard Söderberg<br>[1]Volvo Car Corporation, Sweden<br>[2]Chalmers University of Technology, Sweden | **Importance of accuracy in CFD simulations**<br>Vedat Akdag<br>Metacomp Technologies, USA | **Laminated composite products: simulation process made easy**<br>Ioannis Nerantzis<br>BETA CAE Systems SA, Greece |
| 15:00 - 15:30 | **Improving efficiency of ACMS and AMLS domain composition methods for large vibratory systems using re-analysis concepts**<br>[1]Zissimos Mourelatos*, [2]Santosh Patil, [2]John Skarakis<br>[1]Oakland University, Rochester MI, USA,<br>[2]BETA CAE Systems USA Inc., USA | **CFD analysis of supersonic and hypersonic wings using ANSA and µETA tools**<br>Kaleeswaran Balasubramaniam*, Shivakumar Biradar<br>Xitadel CAE Technologies, India | **Analysis of pressed composite automotive tailgate using ANSA & µETA**<br>Andy Ngai, Mark Arnold<br>PENSO, UK |
| 15:30 - 16:00 | **Coffee Break & Technical discussions** \| Technology Gallery - Foyer | | |
| | **Session 9A** \| Maistros A<br>chair: N. Trakatelis, BETA CAE Systems SA | **Session 9B** \| Maistros B<br>chair: E. Chatzivasiloglou, BETA CAE Systems SA | **Session 9C** \| Zephyros<br>chair: S. Chatziangelidis, BETA CAE Systems SA |
| 16:00 - 16:30 | **3D shape recognition using ANSA scripts**<br>Koji Otani<br>Integral Technology Co., Ltd., Japan | **Multiobjective duct optimization with open source CFD solver**<br>[1]Fabio Vicenza*, [1]Daniele Obiso, [2]Stamatina Petropoulou, [1]Daniele Speziani<br>[1]Phitec IngegneriaSrl, Italy,<br>[2]ICON Technology & Process Consulting Ltd, United Kingdom | **Simulation of carbon-roving-structures-extreme light and strong by filament wound reinforcement**<br>[1]Dirk Dreißig*, [2]Peter Faßbänder, [1]Ulrich Hindenlang<br>[1]LASSO Ingenieurgesellschaft mbH, Germany,<br>[2]FS Software & Konstruktionen GmbH, Germany |
| 16:30 - 17:00 | **Automatic generation of multibody simulations in ANSA by usage of graph-based design languages**<br>Constantin Diez<br>Adam Opel AG, Germany | **On vortex shedding from trailing edge of a full-scale marine propeller blade**<br>Saeed Javdani*, Nicholas Mitroglou, John S. Carlton<br>City University London, School of Engineering and Mathematical Sciences, UK | **Execution and evaluation of the optimization process for a multi-material damping treatment**<br>M. Jaber*, H. Schneeweiss<br>BMW Group, Germany |
| 17:00 - 17:30 | **Design and study of door components for a two-seater electric vehicle in side impact conditions**<br>P. Bazios*, P. Spanoudakis, N. Tsourveloudis<br>School of Production Engineering and Management,<br>Technical University of Crete, Greece | | **Size and shape optimization of overmolded continuous glass fiber laminate with short glass fiber reinforced polyamide for maximum impact resistance using ANSA, LS-OPT, and LS-DYNA coupled with ULTRASIM®**<br>Praphulla Chandra*, Rodrigo Orozco<br>BASF Performance Materials, USA |
| 17:30 - 18:30 | **Session 10** \| Technology Gallery - Foyer | | |
| | **Technical discussions, demonstrations and meetings** | | |
| | | | |
| 20:00 - | **Dinner - Social Event: ''Greek Night''** \| "Warehouse C", Port of Thessaloniki | | |

| Friday, June 12 | | |
|---|---|---|
| | **Session 11** \| Maistros A<br>chair: I. Makropoulou, BETA CAE Systems SA | |
| 9:00 - 9:30 | **Keynote Speech: Introduction of active safety technology into new car assessment programmes**<br>Prof. Sadayuki Ujihashi<br>Chair of JNCAP, Professor Emeritus at Tokyo Institute of Technology | |
| 9:30 - 10:00 | **The evolution of BETA CAE Systems suite scripting capabilities into a full CAE development platform**<br>Yianni Kolokythas*, Michael Giannakidis<br>BETA CAE Systems SA, Greece | |
| 10:00 - 10:30 | **Process automation tools for accelerating CAE processes in ANSA environment**<br>Umesh Mallikarjunaiah*, Mrityunjaya Yeli, Prakash Krishnaswamy, Xitadel Group, India | |
| 10:30 - 11:00 | **Coffee Break & Technical discussions** \| Technology Gallery - Foyer | |
| | **Session 12A** \| Maistros A<br>chair: G. Korbetis, BETA CAE Systems SA | **Session 12B** \| Maistros B<br>chair: G. Fotiadis, BETA CAE Systems SA |
| 11:00 - 11:30 | **Multistage optimization of automotive control arm through topology and shape optimization**<br>[1]Duane Detwiler, [2]Emily Nutwell*, [3]Deepak Lokesha<br>[1]Honda R&D Americas, USA,<br>[2]Ohio State University SIMCenter, USA,<br>[3]BETA CAE Systems USA Inc., USA | **CFD comparison for the SARM rotary engine with a conventional reciprocating Otto cycle engine**<br>[1]V. Gkoutzamanis *, [2]D. Mertzis, [1]S. Nikolaidis, [1]S. Savvakis<br>[1]the SARM Project, Greece,<br>[2]Lab. of Applied Thermodynamics, Dept of Mechanical Engineering, Aristotle University of Thessaloniki, Greece |
| 11:30 - 12:00 | **Application of non-parametric sizing optimization for car body parts using Simulia Tosca structure and ANSA**<br>[1]Georgi Chakmakov*, [2]Serafim Chatzimoisiadis<br>[1]Dassault Systèmes, Bulgaria<br>[2]BETA CAE Systems, Greece | **Prediction of resistive soot sensor behavior in diesel exhaust via 3D simulation** of **soot deposition**<br>P. Fragkiadoulakis*, D. Mertzis, S. Geivanidis, Z. Samaras<br>Lab. of Applied Thermodynamics, Dept. of Mechanical Engineering, Aristotle University of Thessaloniki, Greece |
| 12:00 - 12:30 | **Connecting rod optimization integrating modeFrontier with ANSA**<br>[1]Alberto Clarich*, [1]Marco Carriglio, [2]Giulio Bertulin, [2]Günther Pessl<br>[1]ESTECO SpA, Italy, [2]BMW Motoren GmbH, Austria | **A numerical simulation of single and two-phase flow in porous media; A pore-scale observation of effective microscopic forces**<br>M. Aboukhedr*, Dr. K. Vogiatzaki, Prof. M. Gavaises, Dr. N. Mitroglou, City University London, UK |
| 12:30 - 13:00 | **Morphing, optimization and automation strategies in ANSA - The efficient way to optimization**<br>Onkar Mande*, Ravi Nimbalkar<br>BETA CAE Systems USA Inc., USA | **Mesh curving techniques and parallel simulations of high order discontinuous Galerkin schemes on unstructured meshes**<br>[1]F. Hindenlang, [2]G. Gassner, [3]C.-D. Munz<br>[1]Max-Planck Institute for Plasma Physics, Garching<br>[2]Mathematical Institute, University of Cologne<br>[3]Institute for Aero- and Gas dynamics, University of Stuttgart |
| | **Session 13** \| Maistros A<br>chair: S. Saltiel, BETA CAE Systems SA | |
| 13:00 - 13:30 | **Closing Remarks** | |
| 13:30 - 15:00 | **Lunch** \| The MET Hotel Restaurant | |

# Venue Plan

## THE MET HOTEL, site map



# Technology gallery

## THE TECHNOLOGY GALLERY

The technology gallery (showroom) will be located at the foyer. It will offer participants a un ique opportunity to interact with our Customers Service and Software Development engineers, and to discuss on current practices and requests for future software developments.

This technology gallery will be organized in different application areas and disciplines including:

- Crash / Safety
- Durability / Composites
- NVH
- CFD
- Morphing / Optimization
- Eπilysis / Kinetics tool
- SPDRM / ANSA & μETA Data Management
- ANSA & μETA – all subjects

Our Customers Service and Software Development engineers will be waiting to meet you at our gallery **throughout the conference,** and
especially **during the coffee breaks** and the **sessions dedicated** to technical discussions and demonstrations that will take place on:
**Wednesday June 10 and Thursday June 11 at 17:30 to 18:30.**

THE STANDS

## SPDRM / Data Management & Model Build

Which is the right Simulation Data and Model Management solution for you?
The constellation of software solutions and optimal practices offered by BETA CAE Systems are showcased here. This comprises **ANSA DM**, **SPDRM** and **κOMVOS**, the new SDM console, which streamlines model data from SDM to CAE environments. Along with our Data Management solutions, we will demonstrate the best practices for compete model-build, for complex product models, with numerous variants and study versions.

*"I work in an engineering office or in a small team in an OEM and I need a data management system"*

**ANSA DM** is the right solution.
- For pre-processing, it covers data management needs related to meshing, assembly, and model update
- During post-processing, it automates the extraction of key-results
- It provides a concise view of the data, where the results are directly associated with the model data they relate to
- It enables the easy comparison of models, on geometry, FE-model and simulation results basis
- It's available out-of-the-box in ANSA and μETA

*"I'm looking into an enterprise solution for CAE data management"*

**SPDRM** is ideal.
- It offers fine-grained data access control
- It guarantees high performance for vast amounts of data and under high load
- It delivers out-of-the-box direct integration with ANSA and μETA, which then can be used as a data pool for the ANSA DM functionality
- It integrates an interface for direct data I/O through 3rd party programs

*"We already use an SDM system. ANSA DM, SPDRM or other. However, we need lightweight, straightforward software for browsing and managing CAE data, which understands inherently the engineering content"*

**κOMVOS - the SDM Console** is what you need.
- It offers a standalone Simulation Data Management workspace for browsing CAE data
- It enables the association of user-defined actions with certain data types, with the aid of user-scripts
- It doesn't require CAE nor PDM systems expertise to find and view data, and feed and initiate data processing tasks

## Επilysis solver / Kinetics Tool

Be introduced to **Επilysis,** the new structural analysis solver, the new part of the ANSA/μETA suite. This member of the analysis-tools-family of BETA CAE Systems offers an easy-to-learn, cost effective option for an accurate and high performance solver.
It covers a range of needs for a general purpose solver, as it offers solutions for Structural Linear, Dynamic and Non-Linear problems. For increased performance, special methods are followed for the analysis of large scale models, such as Guyan and Component Mode Synthesis methods.
In the same stand, get closer to the latest developments in **ANSA Kinetics** solver. This MultiBody Dynamics analysis tool is totally integrated within ANSA, offering reduced cost and complexity in the modeling and analysis process. It allows the study of kinematic/dynamic behavior of mechanical systems that undergo large displacements and manipulates simple or complex mechanisms efficiently, according to their kinematics. Don't miss the latest features for Tire and contact modelling, and the capabilities for parametric simulations.

## CFD

We are looking forward to demonstrate to you our latest achievements in CFD pre- and post-processing.
Higher performance and more fine-tuned functionality is now offered within ANSA, with new watertight creating capabilities and more accurate layers capturing.
We also invite you to have a closer look to the numerous advancements in post-processing with μETA. A broader range of supported results files, with increased input performance, and new calculation and visualization capabilities, for streamlines and particles, are among the highlights to be shown.

## Durability

The new pre- and post-processing capabilities that increase the performance of Durability simulation are among those that can't be missed.
Modelling automation tools such as the Contact and Pretension Assistants and the support of Submodeling for Abaqus and ANSYS are some of the ANSA features in this field.
The new Strain Gauges Tool, Stress Linearization and the critical areas post-processing functionality are only some of the μETA capabilities that enhance our portfolio.
The integrated laminated composites modelling and analysis process is now more enhanced, with the addition of the support of solid composite elements, the incorporation of the Draping tool and the extension of the composites toolbar. Visit this stand to have a closer experience of the most effective toolset in this domain.

## Crash / Safety

We invite you to experience the latest pre- and post-processing capabilities for Crash and Safety, which constitute the most rapidly developed, advanced and complete toolkit for this discipline.
Among the latest offerings, don't miss the new seat-positioning wizard, and the extended list of injury criteria and safety protocols supported. New features for the video tracking and automated tools such as the CORA analysis and DiffCrash toolbars complement the advanced CFD post-processing environment of μETA.

## NVH

Our commitment to accelerate modelling, the computations and results analysis for NVH simulation delivers to you the new **NVH Console**. The highly automated and intuitive functionality of this tool offers:

- Streamlined assembly and modelling reduction
- Fast conducting numerous "what-if" studies
- Easy identification of root causes of poor NVH performance

This incorporates and complements the pre- and post-processing features from the rich portfolio always present in ANSA and μETA.
Notable meshing algorithms for exterior wrapping and cavity meshing and other software features such as the Correlation of Modal & FRF results, the ASAM ODS Browser to directly connect to a database with test results, are among those that can't be missed.

## Morphing / Optimization

Visit us to see how ANSA pre-processor and μETA post-processor in combination with all popular optimization codes, provide a complete tool for optimization applications.
From concept design to final testing, ANSA & μETA package brings enormous performance and versatility to the optimization problem set-up.
The ability to control the model shape using the ANSA Morphing Tool, ANSA model values and even complicated tasks such as batch meshing and model checking, makes the tool unique. The ANSA functionality for geometric features creation and handling, along with μETA topometry optimization capabilities are among this year's highlights.

**ANSA / µETA**

Our engineers are looking forward to host you at the ANSA/µETA suite stands to demonstrate and discuss with you any topic regarding all the capabilities of our software.
Don't hesitate to approach us and let us know about your questions and requests for development that will enhance our co-operation and products further.

PRIVATE MEETINGS

Ask on site from our Customers Service and Software Development engineers to have a private meeting about your confidential topics.

Our staff will be pleased to make the appropriate arrangements.

Meeting rooms subject to availability..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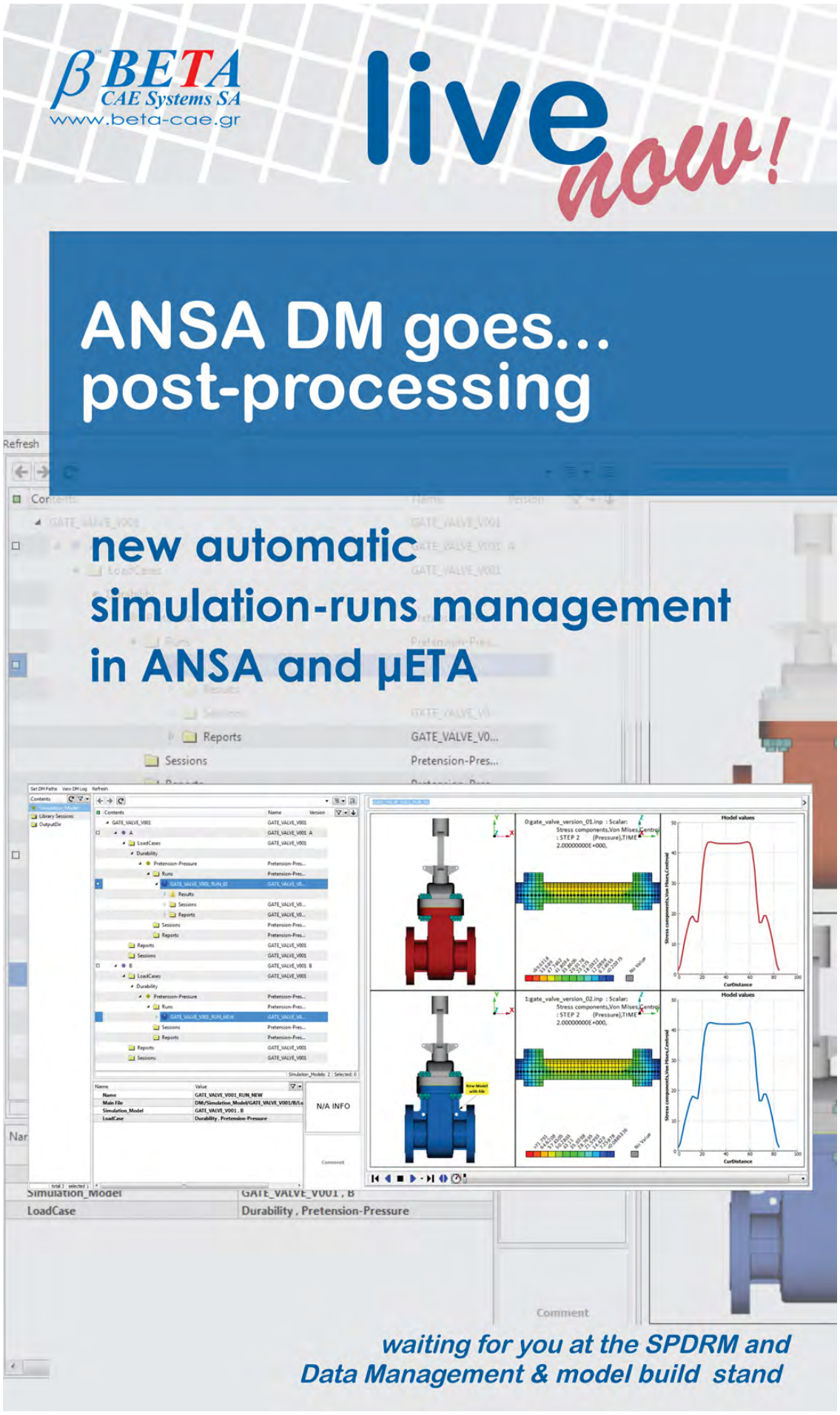
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live now!
ANSA DM goes...
post-processing
new automatic
simulation-runs management
in ANSA and μETA
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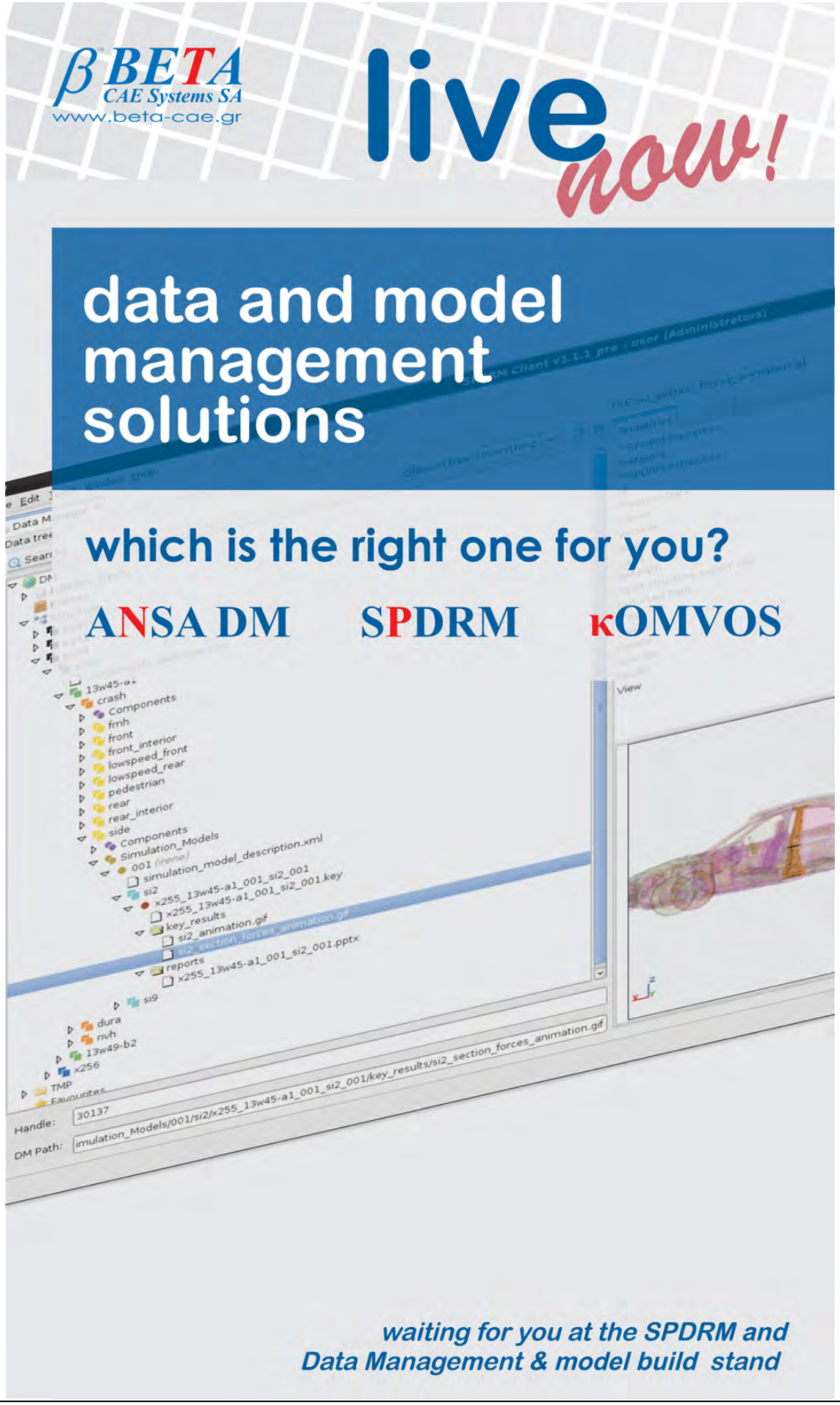
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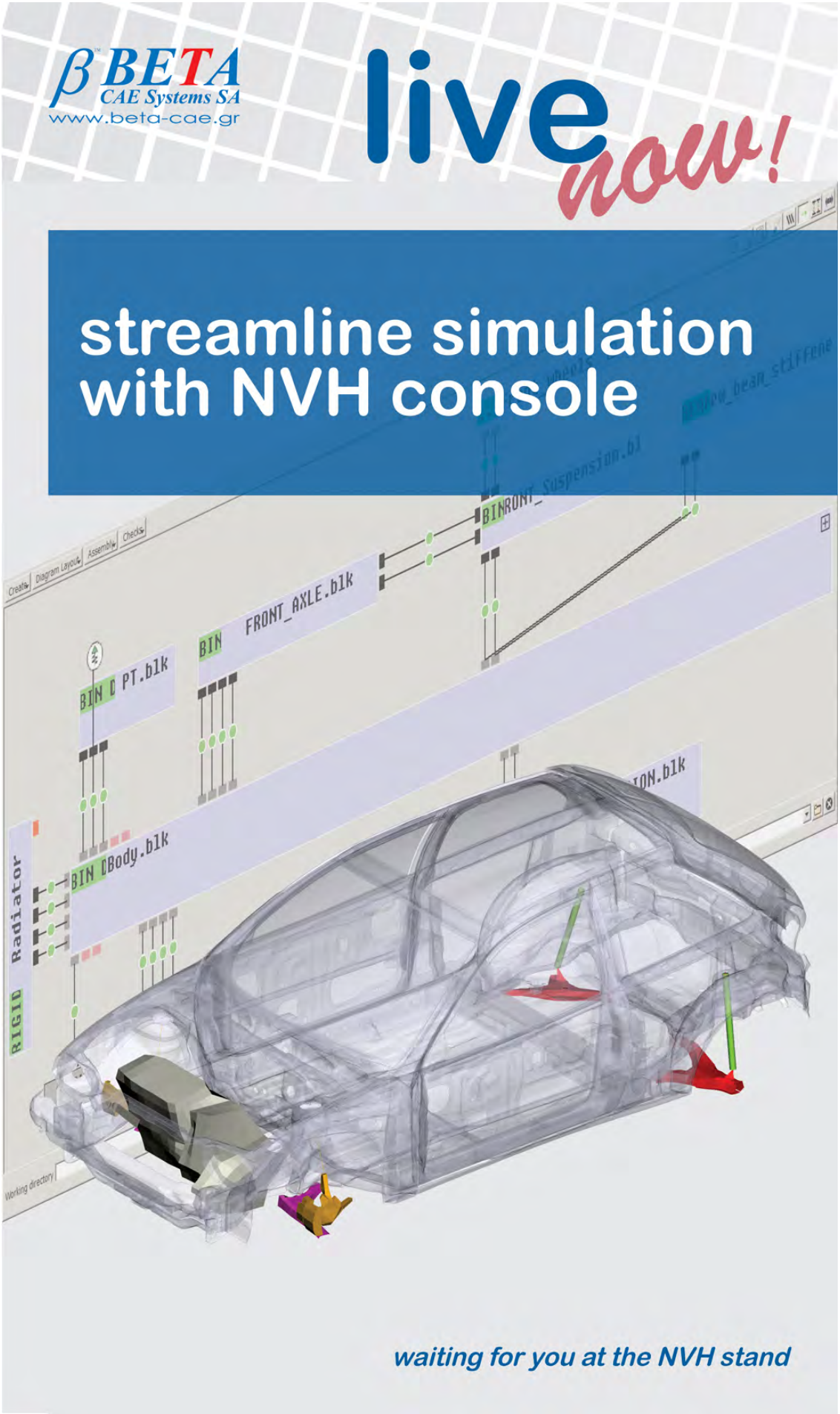
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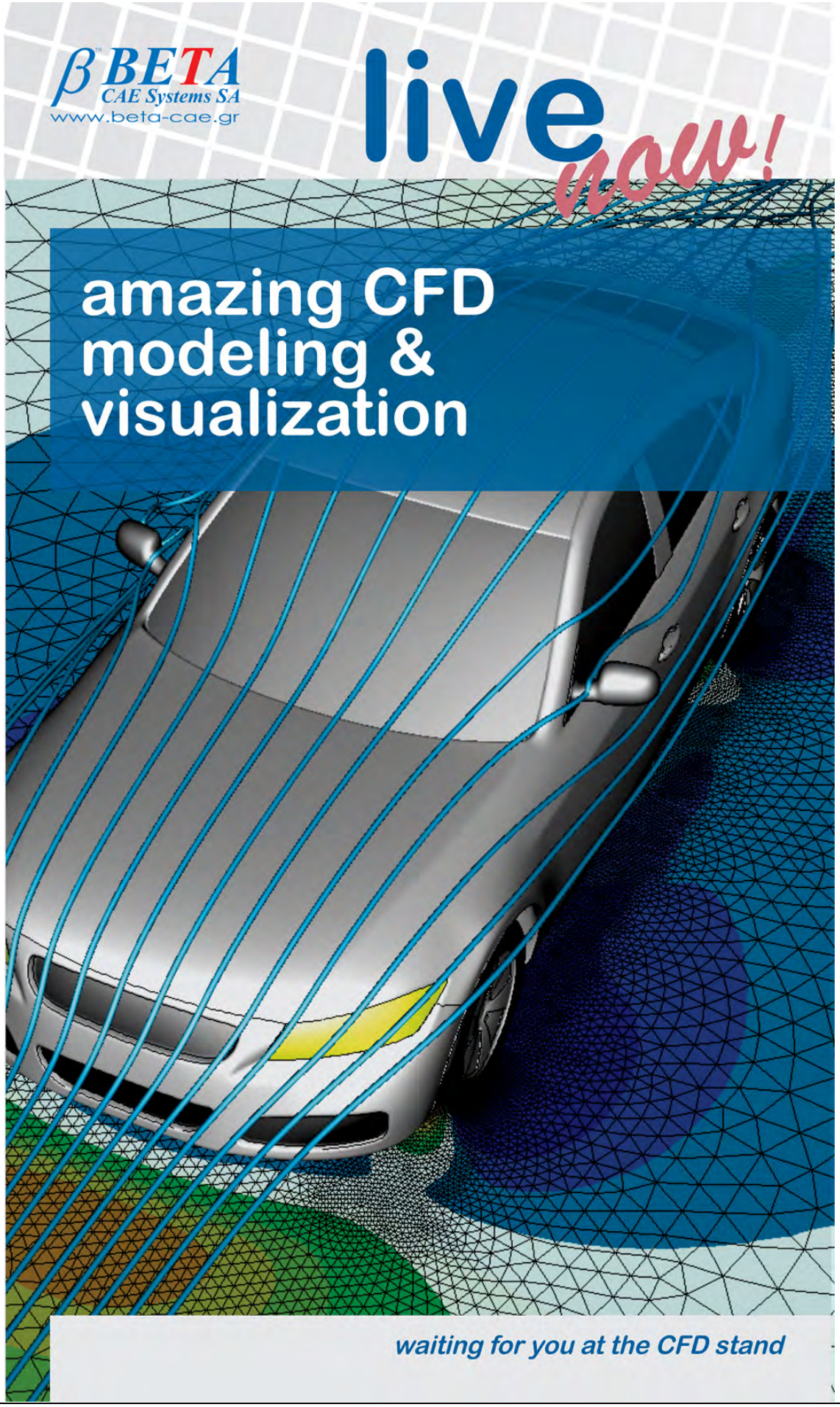
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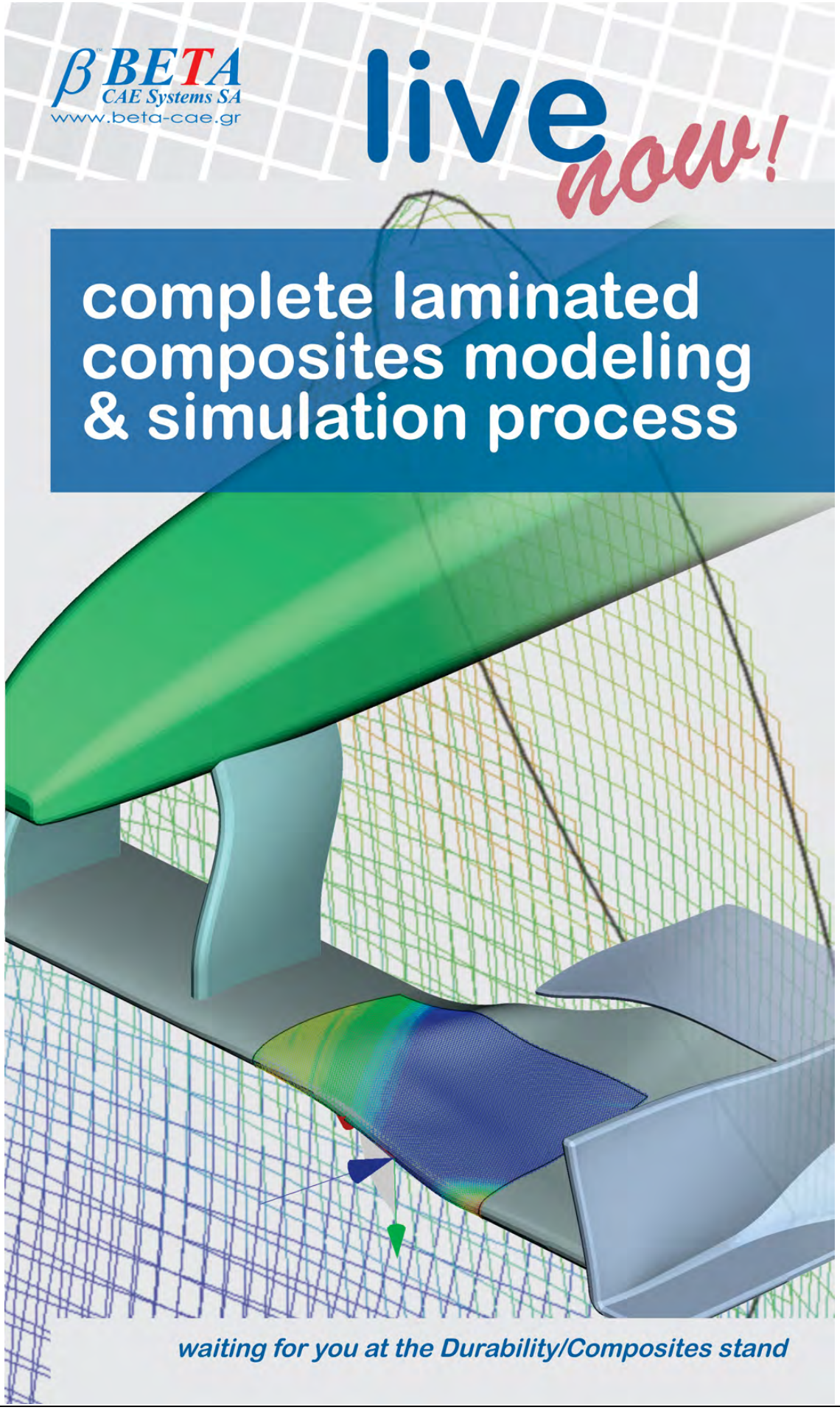
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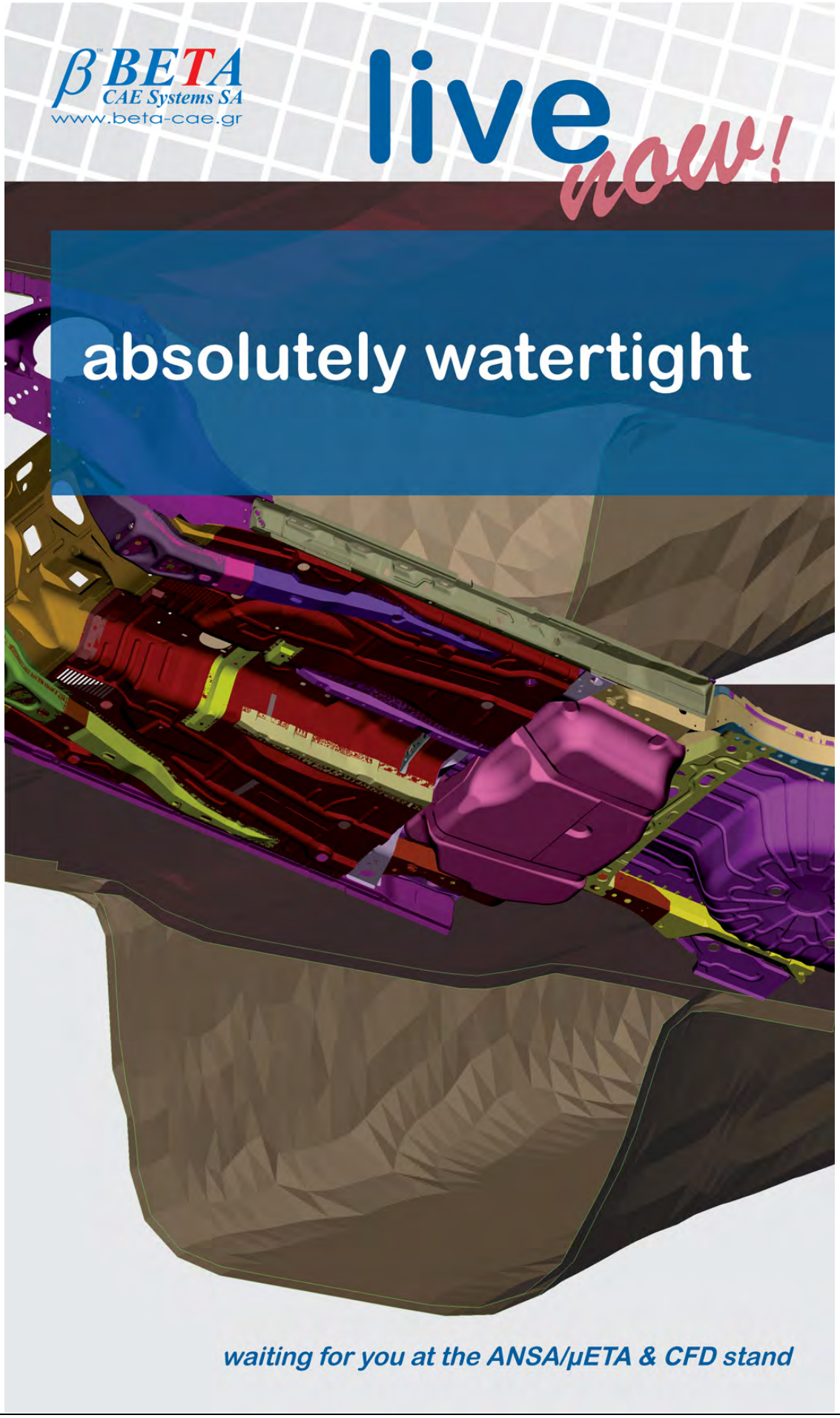
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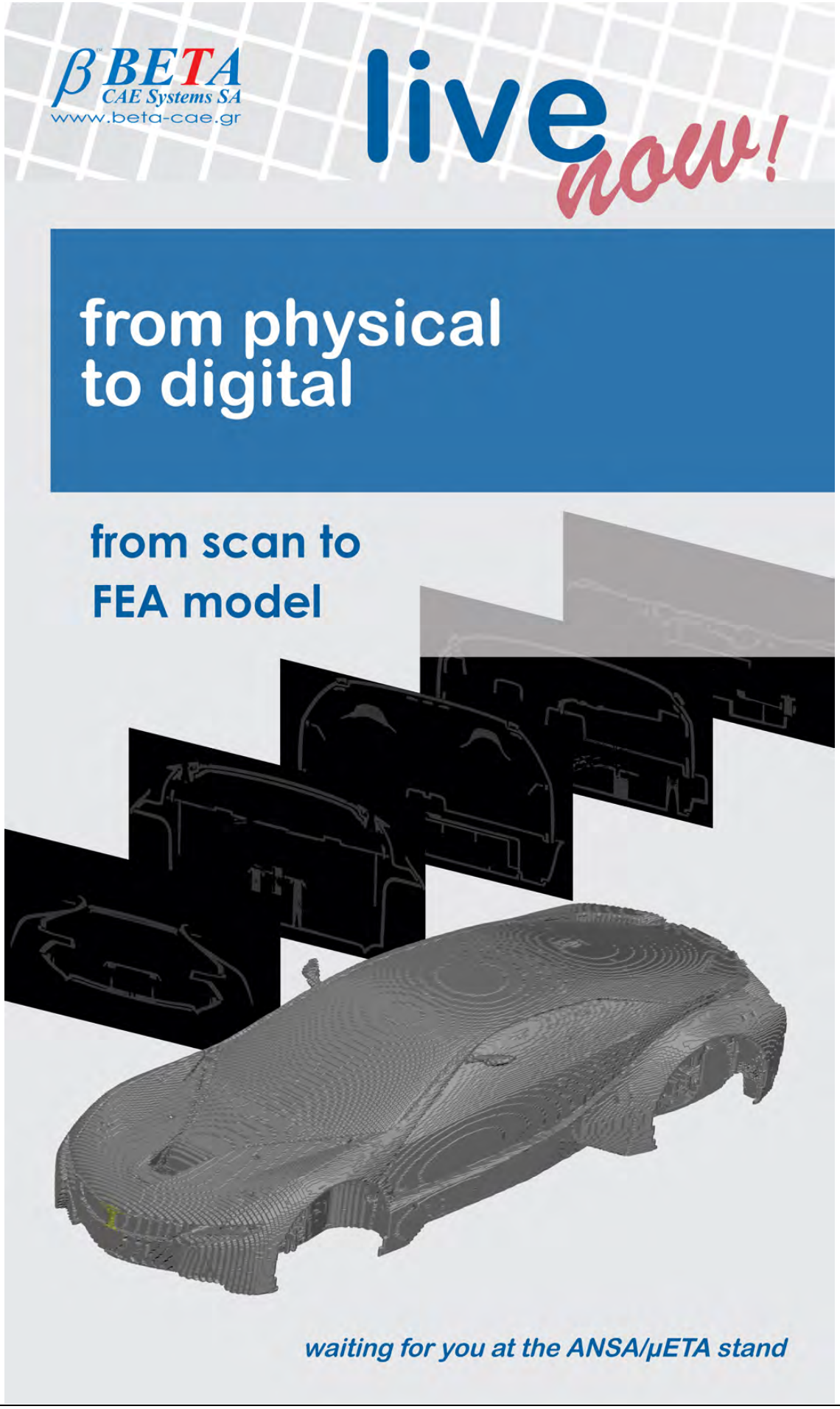
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# Greek night

## THE "GREEK NIGHT"

As in our previous conferences, the social event "Greek Night" will further boost the interaction among the conference participants.

A music band will introduce you to the Greek tradition and the delicious buffet will travel you to the world of local gastronomy.

The event will take place on the **June 11th, 2015** at **8:00 pm.**

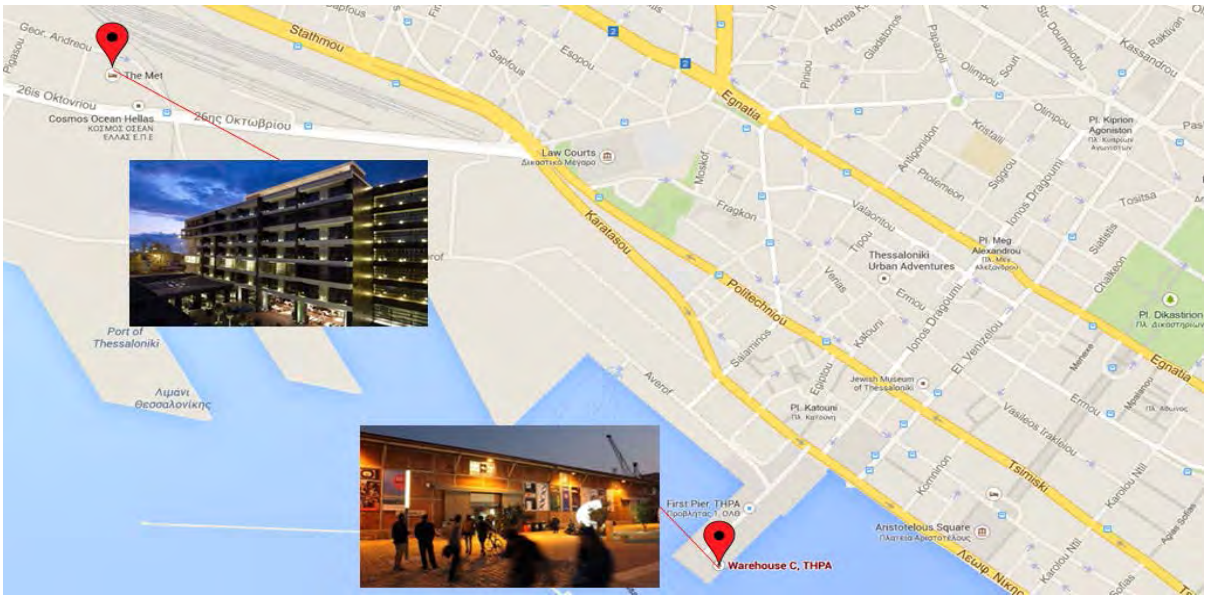
Being considerate about your enjoyment, we arranged so that child care experts will look after the children on site.

## LOCATION & TRANSPOR-TATION

The location of the "Greek night" will be the

**Warehouse C, THPA (Port of Thessaloniki)**

A bus will pick the participants up from the MET hotel to Warehouse C.
The departure time will be announced.
Shuttle buses will depart from the venue, at regular intervals, for your return to the hotel.



# Guided tour

## OPTIONAL GUIDED TOUR

The optional guided tour will start on **Friday, June 12th** at **4:30pm.**
This tour offers a unique opportunity for the conference participants and their families to visit the burial site of the kings of Macedon, including the tomb of Philip II, father of Alexander the Great.

## REGISTRATION

Transportation tour guide and the entrance fee to the museum are courtesy of BETA CAE Systems S.A..
To register for the guided tour simply tick the "yes" option under the*:*

*"I would like to participate to the guided tour of the burial site of the kings of Macedon which includes the tomb of Philip II, father of Alexander the Great."*
question, during the registration through our website.

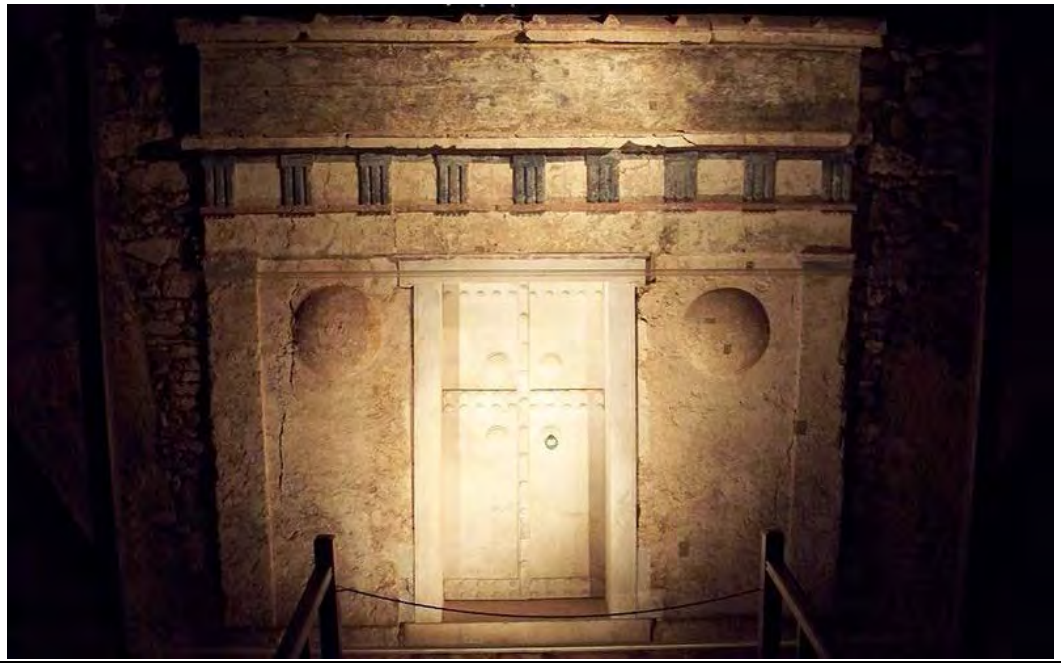
In case you have registered before this option was available, please contact our agent on:

Theodossiadou Travel
Tel.: +30 231 0225 214, Fax: +30 231 0284 372
Email: theodossiadou-travel@theodossiadou-travel.gr

## DEPARTURE

The bus will **depart** on **Friday, June 12th** at **4:30pm** from the MET hotel.

Participants should gather in the Hotel's reception **no later than 4:15pm.**



# Abstracts

Session 1

# HOW CAN CAE SUPPORT INNOVATION

**Dr. Vasilios Bakolas**
Schaeffler Technologies AG & Co. KG

KEYWORDS –
Innovation, new product development, technical evaluation, CAE

ABSTRACT –
The road to new innovative products has always hindered obstacles that in many cases make new, creative, and useful ideas to be halted. The main reason for this is the high costs realized during the evaluation and development stages. The new ideas should be first screened and then technically evaluated. For these stages, CAE can play an important role in reducing not only costs but also the duration of the technical evaluation, and development stages. This presentation will discuss the pathways to drive innovation forward through employing CAE as a catalyst to speed up the development of new innovative products.

Session 2A

# A NEW APPROACH ON DATA MANAGEMENT FOR THE CAE MODEL-BUILDING PROCESS AT BMW: DCM-GUI

**[1]Michael Tryfonidis[*], [2]Hans-Peter Daunhert, [2]Marcel Meder**
[1]BETA CAE Systems, Greece,
[2]BMW Group, Germany

KEYWORDS –
ANSA, ANSA-DM, SDM, DCM-GUI

ABSTRACT –
A new tool in the software palette of BETA CAE Systems will be presented: DCM-GUI. It is the result of the cooperation between BETA and BMW Group towards a software solution for managing the FE-model building process. It bridges the gap between the PDM-world and the OEM's current SDM environment. Among the motivation that lead to this cooperation, the concept of the new software will also be shown as well as an introduction to it's basic capabilities. Finally, the tangible merits of the new FE-model building process as applied at BMW will be shown, as well as a brief look at what will follow as future developments.

# COMPLETE SOLUTIONS FOR MODEL BUILD-UP

**Irene Makropoulou*, George Nikolaidis**
BETA CAE Systems, Greece

KEYWORDS –
Common model, data management, model assembly, model browsing, model comparison

ABSTRACT –
It has been more than 10 years since BETA CAE Systems introduced the concept of the “Common Model” as a revolutionary approach for the pre-processing of CAE models. The main idea was to consolidate all the pre-processing tasks that were traditionally repeated for each discipline model into a single process, the so-called “common model build-up”. Once the common model was in place, all discipline-specific models could be derived with minimum effort. The ANSA data management, the Connection Manager and the Batch Meshing tool have played a key role in turning this concept into reality.

Since then, the common model concept has evolved and expanded towards the support of multi-variant models, built and maintained within a collaborative environment. The Model Configurations and the Compare Tool were introduced to serve this purpose and have been well received by the CAE teams worldwide, which integrated the new technologies into their production workflows.

In the last couple of years, BETA CAE Systems has focused on making the CAE model build-up functionality accessible to a larger group of users and applicable to environments with different data management infrastructures. This presentation addresses these latest developments that empower the engineer to do more, faster and with less effort.

# ANSA DM: SIMULATION DATA MANAGEMENT IN PRE AND POST PROCESSING

**Dimitrios Katramados*, Athanasios Roubies, Dimitrios Krontsos**
BETA CAE Systems S.A, Greece

KEYWORDS –
ANSA DM, data management, simulation model, simulation run

ABSTRACT –
A key aspect of CAE activities is related to managing the vast amount of related data both in the pre processing as well as in the post processing phase. Failing to address this efficiently constitutes probably the most significant bottleneck that disorients engineers from the core of their work and consequently results in time cost and quality penalties. Available solutions involve the introduction of a third party software that undertakes the management of data fed to the pre- or the post-processor and in most cases the pre and the post phase are facilitated either completely separately or they are served in an unbalanced way in favor of one of the two.
BETA CAE Systems being active in data management for more than nine years, perceives the aforementioned problem as a key challenge for CAE, hence, has proceeded with extending its pre-processing data management system, known as ANSA DM, to post-processing. The new ANSA DM, is embedded both in ANSA (pre-processing) and μETA (post-processing). As its predecessor, it is still a file-based tree structured system. Added to the part level, it has also introduced two more levels, the simulation model and the simulation run, thus allowing for the effortless association of part versioning with each model and run. Loadcases and post-processing sessions can be parameterised and thus, stored as library items and can be applied easily to different models / runs. Automated post-processing actions can be initiated from within the tool and the outcome (curves, tables/spreadsheets, videos, images) is automatically placed under the corresponding simulation run and can be readily displayed through a viewer in either ANSA or μETA. Overlaying and comparing results stemming from respective runs is also streamlined, based on associations that are built intrinsically between the different model runs and their results.
Through its simple architecture (file system -based) that does not involve any extra infrastructure or a third party software, ANSA DM constitutes a simple solution for efficient managements of data related to CAE activities. The fact that it is embedded in ANSA and μETA makes it easy to adopt and implement since it is not related to any additional cost or does not necessitate any pre-configuration. At the same time, it is perfectly scalable and can be used from a single engineer up to a multi-member team or an enterprise. The most considerable merit, however, derives from the fact that this tool addresses equally data related to pre and post processing. Through the provided automated archiving and the association between respective data, the user is exempted from spending time with non-engineering activities, hence the model development cycle (modification-calculation-new modification) can be further improved by conducting more simulation runs and evaluating results faster and more accurately. Previous runs are more easily traceable by any user and the engineering experience is better captured and maintained. The tool is also linked to SDM Console, the new product of BETA CAE Systems, which serves as a higher level and light front-end handler of certain predefined CAE tasks while providing a quick overview of the model and its current status.

# DATA PROCESS FOR CAE – STRUCTURAL ANALYSIS FROM DATA HUNTING TO DRAG & DROP

**Uwe Krempels**
Daimler AG, Germany

KEYWORDS –
data management, automation, PDM, JT, ANSA

ABSTRACT –
System-based CAE data management was introduced at Daimler 15 year ago. A brief overview of milestones, different approaches and challenges is given.
The main topic of this paper is the current process of data management starting with the PDM system SMARAGD and resulting in the FE-Models for structural computation.

The company wide switch from the CAD system CATIA to NX enforced major changes in the type, format and contents of the CAD data. Hence adaptations of the interface and CAE tools have been necessary. Using this opportunity the CAE processes as well have been reassessed and reimplemented leading to a lean and highly automated process based on ANSA and ANSA-DM.

This could only be achieved by using a CAD design boosting CAE automation.
Some of the effects of the new CAD design methodologies on CAE data management and the reasonable limits of automated processes are addressed.

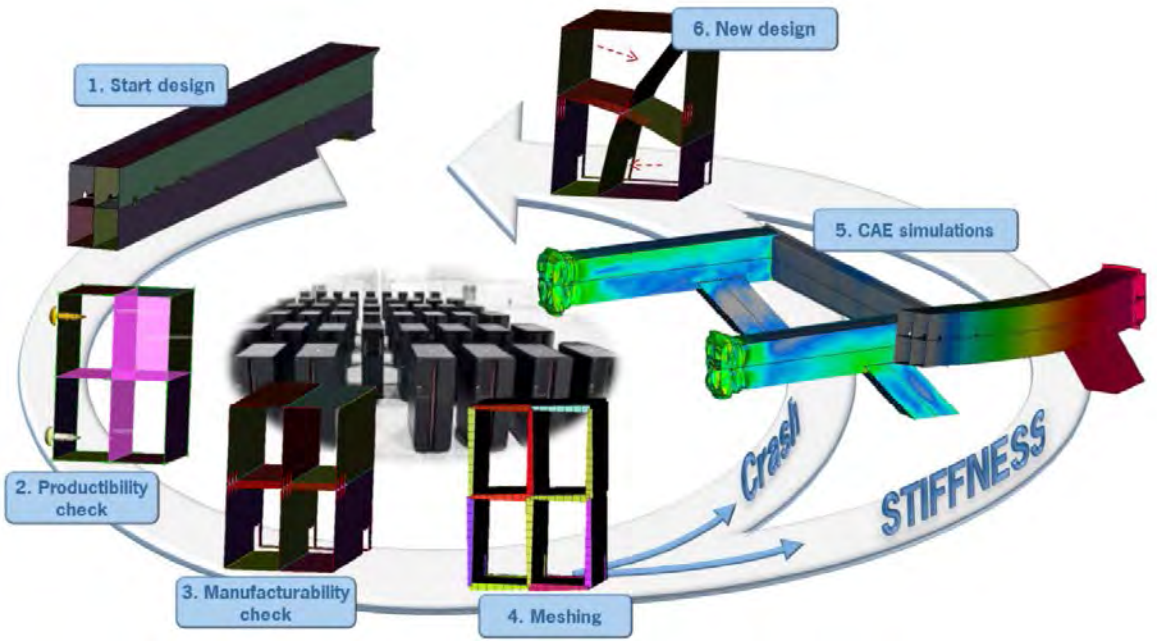
Session 2B

# GEOMETRY PARAMETRISATION WITH MORPHING BOX AND INTEGRATION INTO A MULTIDISCIPLINARY OPTIMIZATION

**Paul-Edouard MUNCH**
Dr. Ing. h.c. F. PORSCHE AG, EVD4 DPT Aufbaumanagement, GERMANY

KEYWORDS –
Geometry Morphing, Task Manger, Part Manager, Batch Meshing, Multi-disciplinary Design Optimizazion (MDO)

ABSTRACT –
The complexity of the development of the BIW's parts increase year after year. The material mix, the introduction of platforms, the different fabrication processes, the weight, the constant increase of load cases are all factors that a mechanical engineer today have to take into account. The amount of parameters is so huge that is almost impossible to find an optimum. Getting a working solution is most of the time a real challenge itself.
The use of part design optimization based on CAE simulation is nowadays very common and widely spread. Those simulation results are of course essential and should be a great help for the mechanical engineer. The drawbacks are often on one side the time delay between the emergence of a new design and its evaluation and on another side the complexity of the preparation of a full automatic optimization process.
This paper will describe a new approach of the way to implement a full automatic optimization process. The focus will be put on the reduction of the complexity and the regular analogy to real processes.



# MORPHING STRATEGIES LIBRARY PRESENTATION

**Joshua Sims*, Sunil Earla, Ravi Nimbalkar, Yatin Kumbhar**
BETA CAE Systems USA, Inc., USA

KEYWORDS –
Morphing, SPDRM, ANSA, Optimization, Parameterization

ABSTRACT –
Engineers often repeat design shape changes across multiple vehicle programs and platforms. Differing methodologies often lead to disorganized data and repeated work.We have developed the Morphing Strategies Library to store, organize, manage, and automate morphing strategies and related design data. By coupling the SPDRM and ANSA software, the tool offers users a simple, elegant interface to organize, store and reuse their morphing strategies. A custom ANSA interface allows users to organize, assign attributes, and upload the strategies into SPDRM through a simple work flow. The Morphing Strategies Library automatically preserves the links, relationships and organization of all morphing strategies within a model, allowing for easy reuse in a different program. When the user would like to conduct a morphing action on a new or legacy vehicle, they select the saved morphing strategies from a custom SPDRM interface, along with the base model they wish to morph. The Morphing Strategies Library assembles all selected files in ANSA and automatically creates an execution ready Optimization Task. Currently the user must manually ensure the proper fit of morphing boxes, however future plans are to automate the fitting process. The Morphing Library allows a larger number of engineers to include morphing and parameterization in their everyday work without necessarily being experts in the field.

# OPTIMISATION OF MORPHING PARAMETERS USING ANSA AND VR&D GENESIS

**Nick Kalargeros*, Dr Roger Darlington, Mark McNally**
Jaguar Land Rover Ltd, UK

KEYWORDS –
Conceptual Vehicle Design, PDP Decision Making, ANSA Morphing, ANSA parameterisation methods, VR&D Genesis optimisation, Reinforcement Derivation Method (RDM)

ABSTRACT –
Conceptual design studies usually consider a high dimensional design space of variables. These variables can be optimised to yield a defined solution space which can be used to decipher the most promising design configuration. A conceptual design can have a mixture of regular, irregular and complex geometrical shapes. As such they can expand or restrict the design space accordingly.
The process to formulate these shapes can be attained via ANSA parameterisation modelling processes. They can then be exported in Nastran format for optimisation within Genesis.
This paper summarises the assimilation of relevant ANSA & Genesis processes in order to establish an interdependent CAE framework capable of conceptual evaluation, development and optimisation. More so it facilitates the interactive design space evaluation. The effectiveness of this approach is evaluated within a BEV (Battery Electric Vehicle) battery pack design study which has shown significant success in physically realizable designs.

Session 2C

# PERFORMANCE-ORIENTED PARTNERS IN SIMULATION – ENGINE DEVELOPMENT AS AN EXAMPLE

**Dr.-Ing. Michael Klein*, Dr.-Ing. Reinhard Helfrich**
INTES GmbH, Germany

KEYWORDS –
Contact Analysis, Optimization, High performance computing, Engine, Permas

ABSTRACT –
Simulation and optimization of structures is an essential part of virtual engine development. In engine development, nonlinear structural analysis is a fundamental simulation method which now needs a coupled optimization process for high performance engines with lightweight design. The optimization process has a high demand for short run times of nonlinear engine analysis, because the size of today's typical nonlinear engine models with their long run times meets a certain number iterations in optimization. The resulting run times could easily reach weeks, which is often not acceptable for the engine development process.

First, only the best performance oriented tools will fulfill the needs of virtual engine development. A close collaboration of pre- and post-processor and solver is a prerequisite. ANSA and PERMAS are such tools, which both deliver state of the art features for today's simulation tasks in engine development. In particular, PERMAS provides an integrated nonlinear solution with an appropriate optimization process.

The presentation will show the typical model setup of an engine for PERMAS with ANSA. It also will discuss the various nonlinearities of the engine model followed by high performance aspects of solver run times including additional speed-ups for a sequence of only slightly modified models. This feature leads to the optimization process, where a freeform optimization is used to reduce the weight of an engine under stress and stiffness constraints.

# FEM ANALYSIS OF A BELT CONVEYOR DRIVING DRUM

**A. Mihailidis, E. Bouras*, E. Athanasopoulos**
Aristotle University of Thessaloniki, Greece

KEYWORDS –
FE method, belt conveyor, driving drum, thin walled structure, welded structure

ABSTRACT –
Large scale belt conveyor systems have a lot of unique characteristics, such as long conveying distance, large capacity and high efficiency, continuous transportation of bulk materials as well as central control and management. Figure 1 shows the opencast mine in Amyntaion, Greece, where such systems are employed to transport the overlying soil and lignite.

**Figure 1: Opencast mine in Amyntaion, Macedonia, Greece**

In its current configuration, the conveyor system covers a total distance of 22 km and consists of 50 independent belt drives. Each one of them features two driving and one pre-tensioning drum. Drums are highly loaded thin walled structures with 1500 mm outside diameter and 32 mm wall thickness. They are driven by two motors rated at 1250 kW each. Due to their continuous operation under high load in harsh environmental conditions they have to be designed accordingly.

**Figure 2: Drum failure**

In the current study, a parametrically designed driving drum is modeled in the ANSA environment. The model features a finer mesh in the heat effected zone near the welding. Assuming a variety of static load cases, the stress field is obtained. Using scripting, results are visualized in the post-processor μETA and the critical spots are identified. Several versions are analyzed and finally, a new improved design is proposed.

# DEVELOPMENT OF AN AUTOMATIC PROCEDURE FOR SAFETY ANALYSIS OF ELEVATOR FRAMES FOLLOWING THE EN-81 REGULATION

**Dr. Ioannis Zyganitidis**
BLAU EI O.E., Greece

KEYWORDS –
elevator car frame, overspeed protection means, ANSA task manager, EN-81

ABSTRACT –
According to EN 81-1 and EN 81-2 standards for the safety of construction and installation of lifts, all hydraulic and specially high speed traction lift must be equipped with overspeed protection means. These means, comprising speed monitoring and speed reducing elements, shall detect uncontrolled movement of an ascending or descending passenger car and shall stop or at least reduce the speed of the car to an acceptable level.

To assess the mechanical behaviour of a full loaded elevator car frame subject to intense deceleration BLAU EI engineers created detailed finite element models of the complete construction. ANSA was crucial for this purpose due to its ability to build detailed models of complicated assemblies mixing bolt and weld connections but most importantly due to its scripting functionality.

In this work we present a new automatic process build up to perform a number of simulations of a complete passenger elevator. The process allowed the engineers to optimize the design through a number of iterative runs and analysis by taking into account a large number of independent design, safety and cost factors. The whole simulation approach resulted in a remarkable reduction of time, a high quality and very accurate model and finally in a process less prone to human errors.

# DESIGN AND TOPOLOGY OPTIMIZATION FOR ADDITIVELY MANUFACTURED STRUCTURAL PARTS: A FORMULA STUDENT CASE STUDY

**H. Bikas*, J. Stavridis, P. Stavropoulos, G. Chryssolouris****
Laboratory for Manufacturing Systems and Automation, Department of Mechanical Engineering and Aeronautics, University of Patras, Patras, 26500, Greece,
** Corresponding author. Tel.: +30 2610 997262; fax: +30 2610 997744. *E-mail address*: xrisol@lms.mech.upatras.gr

KEYWORDS –
Formula Student, AM simulation, Topology Optimization, Case study, Design for manufacturing

ABSTRACT –
Formula Student is a worldwide project for engineering students to design, build and race a small single seater racing car. The teams have to cope with rules and restrictions which concern specifications of the car such the frame, the engine and safety. Motorsport sector demands lightweight vehicle concepts without sacrificing performance. In that direction, high stiffness-to-weight ratio must be accomplished to almost every component of the car. Consequently, the design for manufacturing is crucial to Formula Student teams. Additive Manufacturing (AM) is a technology that can effectively meet the requirements for reduced weight and high stiffness components, in contrast with convectional manufacturing processes such as milling or turning. In this work, the main guidelines for designing an Additively Manufactured part are presented and optimization techniques using ANSA and Tosca software tools are analysed, in order to propose a redesign for a structural part of a Formula Student racecar based on AM. The AM process advantages and the flexibility offered in designing and manufacturing of complex components lead to a lighter structural part, achieving equivalent stiffness validated following extensive FEA analysis. Finally, this work tries to overcome implications of current CAD programs that are considered inadequate for designing for AM and explore the design freedoms of AM in order to get the most out of it.

Session 3A

# ANALYZING SCATTER OF CRASH SIMULATION RESULTS USING THE DIFFCRASH PLUG-IN WITHIN METAPOST

**[1]Dominik Borsotto[*], [2]Antonios Perifanis, [2]Dimitrios Siskos**
[1]SIDACT GmbH, Germany,
[2]BETA CAE Systems SA, Greece

KEYWORDS –
Robust Design, Stability Analysis, Scatter, Production Tolerances

ABSTRACT –
The investigations described here are related to the unstable behaviour of crash-simulations due to minor changes in the model. As a consequence the received simulation results become in some way unpredictable, whereby the causes can be various: e.g. modelling failure, contact issues, numerical instabilities, physical instabilities, etc..

To identify and separate these scatter sources the results are analyzed by means of visualizing the standard deviation of scatter itself and computing scatter-modes for selected parts of interest. Latter computations are based on the principle component analysis (PCA), and deliver new virtual crash results representing the most extreme geometrical shapes of the scatter-modes. This improves and speeds up the process of identifying scatter causes.

For illustration a realistic application case based on the freely available Chevrolet Silverado from the National Crash Analysis Center (NCAC) of The George Washington University is analyzed by means of robust design of the crash model. Therefore 25 simulation runs were performed based on small random part thickness changes (representing production tolerances). Part of interest for the investigations is the variance at the fire-wall. As an outcome major scatter sources in the interaction of power-brake and suspension as well as at the longitudinal rail are found which are strongly correlated to the firewall scatter. Approving the software based prediction exemplary design adaptations lead to a significant reduction of scatter on the firewall. The described mathematical methods are part of the software DIFFCRASH.

Based up on a newly integrated plugin of DIFFCRASH the interactive analysis was driven from within Metapost.

# CRASH CAE IN THE ALL NEW VOLVO XC90 AND SPA PLATFORM

**Domenico Macri*, Anders Sandahl, Johan Jergeus, Oscar Centeno, Anders Ericsson, Weijia Wu, Emil Claesson, Per Anders Eggertsen, Mathias Retzlaff, Michelle Khoo**
Volvo Car Corporation, Sweden

KEYWORDS –
-

ABSTRACT –
The all new XC 90 is the first car built on Volvo's new SPA platform (Scalable Platform Architecture).
The development has been highly CAE oriented. No complete car prototypes have been built during the development phase.
The crash team has worked with 7 complete car CAE loops during the development phase.
Several new challenges has been faced during the development , such as, extensive material failure predictions, multi-cell extruded crash boxes, new IIHS small-overlap rating and optimized crash pulses.
The complete car structure crash model has now been merged with the detailed interior model, giving a model with more than 10milj elements. This model is used for extracting rating/dummy criteria's directly.

Session 3B

# HIGH END SOLUTIONS FOR CFD WITH ANSA/META

**Vangelis Skaperdas**
BETA CAE Systems S.A., Greece

KEYWORDS –
ANSA, μETA, CFD, pre-processing, post-processing

ABSTRACT –
This presentation highlights the major features of the ANSA / μETA pre- and post- processing suite, that have established it as the go to solution for advanced CFD simulations pre- and post-processing. Features including: batch meshing and surface wrapping, scripting automation, model creation, maintenance and update, and automatic post-processing are presented with real case examples from the automotive and the aerospace industry. Additionally, enhancements in the latest version will also be presented.

# THE INFLUENCE OF MESH CHARACTERISTICS ON OPENFOAM SIMULATIONS OF THE DRIVAER MODEL

**Grigoris Fotiadis*, Vangelis Skaperdas, Aristotelis Iordanidis**
BETA CAE Systems S.A., Greece

KEYWORDS –
ANSA, μETA, meshing, pre-processing, post-processing, CFD, OpenFOAM, automotive aerodynamics

ABSTRACT –
In this study external aerodynamics CFD simulations are performed using OpenFOAM on the three variants of the DrivAer model, a realistic geometry with details representative of current automotive designs. A thorough examination of the effect of different meshes on the solution convergence and accuracy is performed. These meshes differ in terms of generation process and time involved, their density and their quality. Different meshing approaches are followed using the pre-processor ANSA, ranging from standard hybrid penta and tetra meshes to hexa dominant and polyhedral ones. Other factors considered are the steady or transient approaches, as well as the importance of including the wind tunnel in the simulations to exactly match CFD and experimental results. All post-processing steps are performed in μETA fully automatically in order to identify the differences in the above simulations. Conclusions are derived with respect to the importance of the mesh, and the optimum pre-processing strategy that ensures robust automation as well as high fidelity CFD simulations with OpenFOAM.

Session 3C

# SHEET METAL FORMING OPTIMIZATION USING ANSA AND LS-DYNA

**Simone Ferrero*, Caterina Tribuzi**
Nova Analysis, Italy,

KEYWORDS –
Metal forming, Ls-Dyna, Optimization, ANSA

ABSTRACT –
Setup of a LS-Dyna four components sheet metal forming benchmark was conducted using ANSA. Tools for meshing and process setup, like material constituting the elements, output to be determined and the way contacts are treated, were exploited.
With the purpose of matching the experimental data provided by the benchmark, the file input deck was conveniently arranged to run in LSOpt for optimizing Lankfords parameters, which define the anisotropy of the blank in the material model.

# AUTOMATION TOOL FOR SHEET METAL STAMPING USING ANSA

**Ramesh Venkatesan*, Jithesh Erancheri, Nanda Kumar**
Kaizenat Technologies Private Limited, India

KEYWORDS –
Sheet-metal, Process manager, Automation, Residual stress, Macro/Scripts

ABSTRACT –
**Sheet metal forming** involves a wide range of processes that manufacture parts for a vast amount of purposes. Carrying forward the initial stresses and strains from the forming results to crash have been established as a standard in CAE industry. There are many tools dedicated for Sheet metal forming simulations, however, very few provides seamless interface for sheet metal forming and crash simulations. As ANSA is very widely used in CAE for Crashworthiness studies using multi-physics solver like LS-DYNA, we found building a automation tool for sheet metal stamping can help very help to the users.
And more over sheet metal forming being a domain specific application where users are focused more on real physics rather than CAE aspects, it is highly recommended to have such automation tool. They find very difficult to control CAE parameters like element formulation, number integration points. This tool will enable the tooling engineers to focus on real engineering rather than spending time on CAE model building in which they are not good at. In this tool, users are expected to have only few clicks to set up the entire input file for solvers like LS-DYNA carrying terminologies of manufacturing industries. And this will be a bridge between manufacturing & CAE expertise to get better results from different analysis like Crash, NVH & durability etc.

Session 4A

# NEW TECHNOLOGIES FOR OCCUPANT SAFETY MODEL SET UP AND ANALYSIS

**Athanasios Fokylidis*, Athanasios Lioras**
BETA CAE Systems SA, Greece

KEYWORDS –
Occupant Safety, Side Impact, Front Impact, Dummy, Seat, Positioning, OIC

ABSTRACT –
During the development and design process of a vehicle, occupant protection in impact studies has become a standard analysis. One of the most important issues that crash analysts face is how the passenger's seat and the dummy will be adjusted for the laboratory tests. This makes the application of numerical simulations inevitable. Simultaneously, as new legal tests and regulations are continuously introduced, the amount of relative load cases has been increased dramatically.

In order to set up standardized processes that will minimize the complexity and lead time of the numerous crash simulations, automated and efficient tools are continuously being developed by CAE software providers. The positioning of the seat and the dummy is a demanding process in CAE simulations. From the import of the model in the pre-processor, till the output of the solver files, a lot of complicated steps, in a strict hierarchy, have to be followed. BETA CAE Systems has implemented some special tools in ANSA pre-processor for setting up, with the minimum human interaction, all the load cases of a dummy and seat system, according the current regulations and protocols.

For each loadcase a standardized report is usually required. For the generation of such reports all the followed post-processing actions are always the same. In addition, the use of different dummies per test, adds more similar post-processing actions. Therefore, in order to overcome this time consuming and prone to errors repetition, the automation of the execution of those actions and the subsequent report generation is required. Apart from automating the repeated post-processing actions another problem is to compare the results of the simulated tests with the results of the physical tests. For this reason the Occupant Injury Criteria tool has been developed in μETA, the post-processor of BETA CAE Systems. Different dummy types can be processed simultaneously from many simulations and physical tests and the results are overlaid in order to be compared. The tool provides an efficient and easy manipulation of the created results for better inspection and comparison of them.

# ANSA SCRIPTING FOR AUTOMATED PEDESTRIAN MARKING AND SIMULATION INPUT

**[1]Yogesh Upreti*** **[1]Matthias Erzgraeber** **[2]Thanassis Fokylidis**
[1]Adam Opel AG, Germany,
[2]BETA CAE Systems S.A., Greece

KEYWORDS –
EuroNCAP pedestrian marking, ANSA python scripting, ANSA PedSafety module, Automated transformation creation

ABSTRACT –
For fast project framing to production process in automotive industry, there is a huge requirement to reach from CAD design release of particular vehicle to respective simulation results as soon as possible. Reaching this goal efficiently requires converting manual work involved in this process to automated work to a large extent.
Current EuroNCAP 8.0 pedestrian protection testing protocols requires up to five different type of load-case simulation done, on same vehicle, at each development stage. This means, for a typical small size vehicle, to prepare approximately 160 head (child and adult), 11-13 upper leg and same amount of lower leg simulation to be prepared.
This paper discusses an example of how to use ANSA python scripting module for highly automating the process to go from vehicle outer surface information over to pedestrian related field marking and then to transformations for each testing location based on test type. Further on this paper present an example toolbox for pedestrian marking and transformation creation based on ANSA python programming module (specially PedSafety module).

# PEDESTRIAN PROTECTION HEAD IMPACTS IN GLASS CORRELATION FEM TEST IN THE NEW SEAT LEON.

**Angel Segura Santillana*, Carlos Arregui Dalmases, Benito-Javier Luzón Narro.**
Seat Centro Técnico, Spain

KEYWORDS –
FEM TEST Correlation, Pedestrian Protection, Finite model, HIC, Euro NCAP, glass model.

ABSTRACT –
Many factors should be considered in order to understand properly how a mechanical input to the head can result in a determined type of head injury: the severity, the nature of the mechanical input, the impact location, the direction of this input, the age of the patient, his gender, anthropometrics and previous state, and also the treatment and recovery of the patient.

Head injuries are either the most or second most commonly reported injuries to pedestrians struck by vehicles. Furthermore, among serious or life-threatening head and brain injuries far outnumber injuries to all other body regions. Around 40% of the adult head injuries are due to windshield impact.

Windshield modeling is currently a challenge in head pedestrian protection, the way the windshield breaks introduces a significant change in the Head Injury Criteria, and this is due to the non-lineal fracture that the glass is presenting during the headform collision. In this paper a new model for windshield pedestrian impact is presented for optimizing experimental-simulation correlation.

In this research a total of 90 experimental windshield test were performed, the head impacts were simulated using the software ANSA pre-processor PAMCRASH solver and META post-processor. The model was optimized through parametric adjustment methods.

With this present model the average HIC deviation between testing and simulation has been reduced in average below 10%.

Session 4B

# FEMZIP COMPRESSION AND FASTER META VISUALIZATION OF CFD RESULTS

[1]Pinaki Banerjee*,[1]Stefan Müller, [2]George Kalaitzidis, [2]Dimitrios Siskos
[1]SIDACT GmbH, Germany,
[2]BETA CAE Systems SA, Greece

KEYWORDS –
Compression, Simulation Results, Reduced Data Storage, Faster Post-Processing

ABSTRACT –
Computer simulations, as commonly used for product development in various industries, generate a vast and growing amount of data. The growth in data is a result of larger, more detailed models and an increase in the volume of simulations performed to improve engineering design. Simulation data has to be analysed, exchanged among engineers and archived for future reference and reanalysis. Network connections and storage space can become bottlenecks in workflows used by engineers. The challenge is to handle large amounts of data in time and storage saving manner in order to eliminate these bottlenecks.

The difficulties can be approached by using FEMZIP compression methods. These tools are specifically designed for the compression of Finite Element Method and Computational Fluid Dynamics (CFD) based simulation results and thus achieves high compression factors. The significant reduction in data volumes leads to a reduction in the requirements for storage and faster data exchange over networks.

To improve the usability of compressed datasets, FEMZIP compressed output format is always designed based on the original format structure. Thus resulting in easy integration into post-processors and on-the-fly access of data subsets without the requirements of original data reconstruction

As a part of our latest developments we have implemented our first generation of CFD data compression for OpenFOAM format. The post-processing of compressed data have been already integrated into MetaPost and the results will be illustrated as a part of the talk.

# THERMAL SIMULATIONS WITH THESEUS-FE AND ANSA: OPTIMIZING THERMAL COMFORT IN AN OFFICE BUILDING ENVIRONMENT

**Dr. Daniel Köster**
P+Z Engineering GmbH, Munich, Germany

KEYWORDS –
THESEUS-FE, ANSA, thermal simulations, thermal comfort, manikin

ABSTRACT –
THESEUS-FE is a thermal simulation package developed by P+Z Engineering GmbH, a leading supplier of engineering consultancy services in the automotive, aerospace, and general industry sectors. THESEUS-FE offers models for heat conduction, surface-to-surface radiation, simplified air zone and fluid volumes, as well as the human physiology and thermal comfort model FIALA-FE. For pre-processing tasks during the THESEUS-FE model creation process our customers and colleagues have long relied on the powerful features of ANSA. The recent development of a dedicated THESEUS-FE deck in ANSA has enabled new streamlined workflows where models can be transferred freely between ANSA and the THESEUS-FE graphical user interface without loss of information.
ANSA, with its strong focus on efficient mesh generation and numerous import and export functionality, has long been the strategic tool of choice in the THESEUS-FE community for preparing material and shell composite definitions, generating high-quality meshes, and defining sets for boundary conditions or thermal loads. Ideally, one single ANSA case serves as the basis for thermal simulations in THESEUS-FE, conjugate heat transfer simulations using OpenFOAM, or structural mechanics simulations for analysing thermomechanical problems using Abaqus.
In this paper we shall study an exemplary use case: quantifying and optimizing the thermal comfort of staff members working in an office building under intense solar loads. We will make heave use of ANSA features for generating meshes, demonstrate the THESEUS-FE export feature, and completing the thermal simulation model in the THESEUS-FE GUI.

# DESIGN OPTIMIZATION WITH ANSA MORPH

**Tobias Eidevåg*, David Tarazona Ramos*, Mohammad El-Alti**
Alten AB, Sweden

KEYWORDS –
Morphing, CAE workflow, Optimization, Automation, DOE, Regression, CFD, FEM, Python

ABSTRACT –
During the last decades, the use of FEA for solving mechanical problems has experienced an exponential growth, both in the fields of fluid and solid mechanics. A broad range of FEA tools can be found nowadays out in the market for modelling, analysing and processing the results. In this work, an optimization workflow for product design was developed, based on connecting ANSA, a CAE modelling tool and the postprocessor µETA together, concretely taking advantage of ANSA feature MORPH. By generating Design of Experiments a response surface can be calculated and the optimal values of the design variables can be decided. The presentation is divided into two parts each will show the method applied to different industrial applications. The first part is in the field of fluid dynamics and is in collaboration with AB Volvo Penta. The design of a turbo inlet pipe is optimized using a CFD code connected with ANSA and µETA. The second part is within the field of solid mechanics where a cable drum for off shore operations designed by Svensson Group is optimized regarding geometrical parameters in order to provide a more robust and sustainable design. ANSA MORPH presents a very useful tool for improving design performance in a wide range of modelling approaches.

Session 4C

# THE EFFECT OF MASTICATORY LOADING ON THE CERVICAL LOOP REGION OF THE INCISOR IN RODENTS

**[1]Thimios Mitsiadis[*], [2]Alexander Tsouknidas, [3]Vagelis Karatsis, [2]Nikolaos Michailidis**
[1]Institute of Oral Biology, University of Zurich, Switzerland,
[2]Department of Mechanical Engineering, Aristotle University of Thessaloniki,
[3]BETA CAE Systems S.A., Thessaloniki, Greece.

KEYWORDS –
Finite Element Modelling, Stem Cell mechanosensitivity, Craniofacial Evolution, Dental Biomechanics.

ABSTRACT –
Rodents are arguably the dominant model organism for studies investigating the effect of genetic traits on the pathways to mammalian skull development, thus being integral in exploring their craniofacial evolution. Mice mandibles exhibit unique characteristics associated, among others, to the cervical loop region of their incisor hosting a high concentration of epithelial stem cells. As these cells are highly mechanosensitive, it stands to reason that their differentiation could considerably affect the postnatal mandibular growth. The aim of this study was to analyse the functional significance of masticatory loads on the mouse mandible and identify critical stress accumulations that could trigger phenotypic differentiations in their skull morphology.
A 3D model of a rodent's skull was reverse engineered and the main components of the model's mandible segmented. Two masticatory scenarios were identified, incisal biting (gnawing) and chewing at the molars and both of them examined at two load intensities (corresponding to soft and hard pellets). The biting force was countered by a muscle architecture and the temporomandibular joint.
Biting type (incisal or molar) was found to have a dominant effect on the stress variations experienced by the mandible, with biting intensity resulting in an almost linear stress increase. The simulation provided refined insight on the mechanobiology of the cervical loop of the incisor in mice, indicating that food consistency could exert a dominant role on the endemic stem cell proliferation and differentiation. The results suggest that extracellular forces developing during mastication can influence micro evolutionary divergence patterns in the mouse mandible.

# MFAT – A BASIC FATIGUE MODULE FOR µETA-POST

[1]Anders Jonsson*, [2]Martin Sjöberg, [2]Johnny Grenwald
[1]DynaMORE Nordic AB, Sweden,
[2]BAE Systems, Sweden

KEYWORDS –
Fatigue, Python, rain flow count, S-N-curve

ABSTRACT –
A basic fatigue post-processing module for µETA-Post has been developed, consisting of Python scripts and an easy-to-use interface in the form of a User toolbar. The current implementation works for Abaqus and LS-DYNA. Only visible elements will be analysed, making it easy for the user to reduce the analysis time for big models. The fatigue analysis is basaed on a simplified critical plane approach, where the critical direction is taken as the direction of the absolute maximum principal stress. The stress tensor is projected on the corresponding principal direction to obtain a scalar measure of stress. Alternatively, the user may specify a projection direction. The stress history can be obtained either from a sequence of states, or by superposition based on load curves scaling different states. A standard routine for rain flow count is used for obtaining amplitude and mean stresses, and cycle counts. Fatigue strength data is input in the form of S-N-curves, in an easy-to-edit text-file-format. The fatigue material data is assigned to the elements via the property definitions of the corresponding keyword file. Linear damage accumulation (Miner's rule) is used for computing the fatigue damage. For each processed element, the maximum principal stress and amplitude stress, and calculated fatigue damage, are stored as scalar results, which can be visualized as fringe plots. This means that further post-processing of the fatigue analysis results is easily performed using the other built-in tools of µETA-Post. The module was developed using the built-in scripting tools of µETA-Post, which with it's online help and powerful script editor offers an efficient programming environment.

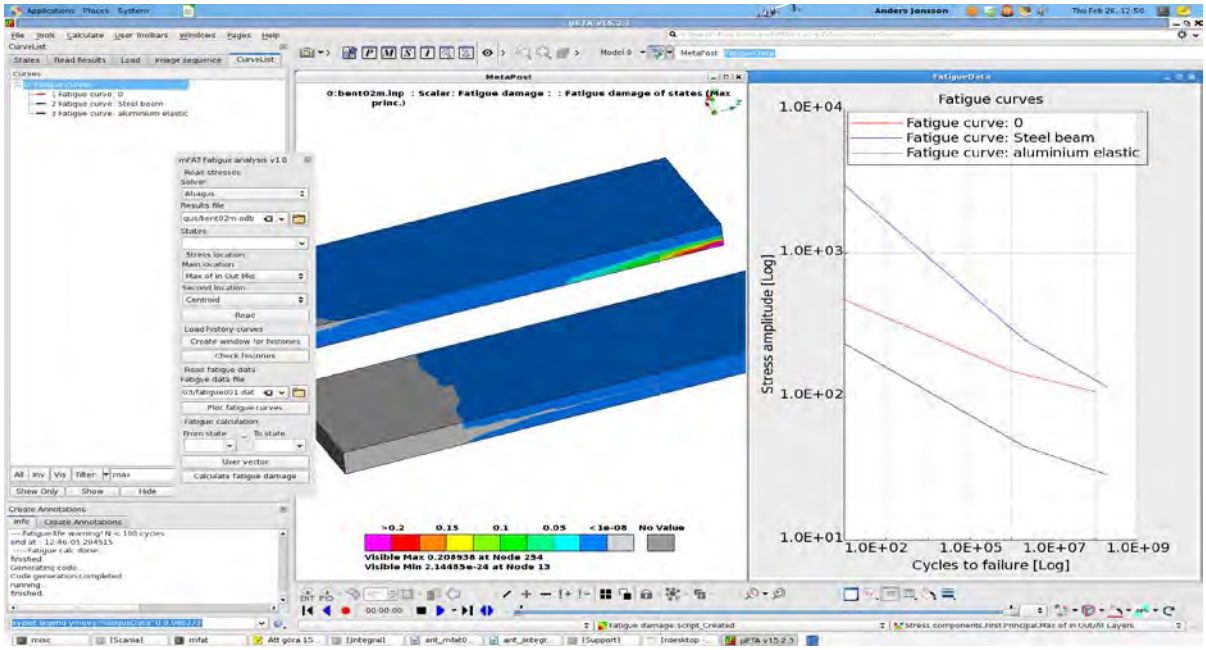



**Figure 1. The mFAT fatigue post-processing module.**

Session 6

# SPDRM IMPLEMENTATION IN A EUROPEAN AUTOMOTIVE OEM

**[1]Irene Makropoulou[*], [2]Niclas Dagson, [1]Menelaos Pappas**
[1]BETA CAE Systems, Greece,
[2]ALTEN AB, Sweden

KEYWORDS –
SDM, process automation, load-case set-up

ABSTRACT –
Contemporary CAE environments include a multitude of software tools that are used within the context of numerous processes. These processes, carried-out by several engineers, generate a great number of data in a daily basis. Within such an environment, a European OEM conducted a study on the lead time of the CAE-process at the time. The study concluded that the CAE-process was, at a large extent, based on manual, repetitive operations, and the level of transparency and traceability made the task of finding the right set of data difficult and time consuming.

In this context, BETA CAE System's SPDRM (Simulation Process Data and Resources Manager) was selected as a process and data management system for CAE. Process-wise, SPDRM had to establish a basic infrastructure for the CAE-process with integrated process chains from geometry to reporting, offering an interface to the OEM's PLM-system and flexible integration of various CAE-applications used in the CAE-process. From the data-perspective, SPDRM had to store data in a structured, efficient and quick-accessible way.

This paper describes this first implementation of SPDRM for process and data management for Crash, NVH and Durability, starting from the requirements, going through the implementation steps and concluding with the description of the deliverables: A unified platform for the management of data and processes with more automated tasks, where reusability of partial models across the simulation disciplines is natural.

Session 7A

# A NEW APPROACH ON PROCESSING LARGE SCALE COMPUTER TOMOGRAPHY DATA IN CONJUNCTION WITH HIGH END CAE PRE-PROCESSING

**[1]Daniel Heiserer[*], [2]Michael Tryfonidis**
[1]BMW Group, Germany
[2]BETA CAE Systems, Greece,

KEYWORDS –
ANSA, Computer tomography (CT), 3D-Image processing, CT reconstruction

ABSTRACT –
Simulating “reality” is a key motive behind all CAE activities and a typical slogan for advertising simulation software. The expert knows this implies two assumptions: First of all we have to know how “reality” looks like in detail. The general process defines the product via CAD and then a) a CAE model is derived and b) via the built to print process a physical model is manufactured. Naturally there are differences due to tolerances or even mistakes between the simulation model and the physical model.
Second, beside producing simulation results in any geometrical detail there is in general a geometrically limited feedback from physical testing. Differences in the global correlation between physical and virtual test (simulation) can only be fully explained and finally resolved when being able to correlate the simulation and physical model before test and after test on every desired geometrical and material level.
In order to finally add this capability to improve CAE based design BMW started to add computer tomography (CT) to the correlation process. Not focusing only on micro CT resolving material structures we also focus on parts and assemblies up to our final product -full vehicle systems.
As hardware was recently developed to resolve these issues the crucial task to process CT data in correlation with CAE and CAD data is the crucial bottleneck. This is due to different data defintions, it’s immense amount of data and it’s complexity to interpret material and geometry. In order to apply such methods and read, process, reduce, reconstructe and visualize the CT for the engineer new features have been developed by BETA CAE Systems in ANSA, with the challenges given by BMW.

# DESIGN IMPROVEMENT THROUGH ENHANCED PROCESSES AVAILABLE WITHIN NVH CONSOLE

**Tassos Sarridis*, Vasileios Pavlidis**
BETA CAE Systems, Greece,

KEYWORDS –
TPA, NVH Console, Sensitivity, Superelements, NASTRAN

ABSTRACT –
Motivation:
The challenges faced by an analyst during the procedure of improving a design with respect to NVH are multiple. As many as possible "what-if" studies need to be conducted and when these are related to a complicated and large model as the full vehicle is, then the time needed is considerable. Reduced modelling is a means to increase performance but this in turn, adds complexity and the process becomes more prone to errors. On the other hand, it is often the case that the outcome / conclusions of these studies are not easy to fully comprehend or to materialise them by applying a modification to the model. For example, the result of a Transfer Path Analysis could indicate that a particular Noise Transfer Function is mostly contributing to the total noise but this information is difficult to exploit. It would be more beneficial if there is an indication of which structural transfer function that can be easily changed (i.e.: by adding a rib) is the one that will bring improvement to the total response.

Solution:
The above considerations led BETA CAE Systems to the development of the NVH Console, an integrated suite for multi-component NVH analyses which is embedded in ANSA and allows rapid design improvements as “what-if” analyses with respect to NVH modelling techniques by minimal computational efforts. Functionality of this tool is now further extended towards providing more tangible feedback to the analyst who can be easily realized as a design modification. Moreover, the easy creation and handling of superelements along with the direct output / submission of the full assembly enable the usage of Nastran for "what-if" studies as an alternative to the FRF Assembly methodology of μETA.
The new capabilities of the NVH Console will be described through a case scenario that involves the implementation of targeted countermeasures for NVH issues. The “what-if” study capabilities of the NVH Console and especially the TPA analysis in combination with the innovative path stiffness analysis method provided by μETA helps to isolate first the most contributing component and then to identify the transfer path that should be modified. Based on those findings, the analyst can apply reinforcement methods, which are provided in NVH Console and re-assess quickly the results without the need to run the solver again. In a next step, those proposals can be translated in targeted FE design modifications directly in ANSA, this being the direct result of the tangible indication provided by the path stiffness analysis.
After validating that design improvement, the respective component is reduced to a superelement. In this way, its footprint to the solving time is minimised and therefore, the analyst can focus on other components for further improving the behaviour of the full assembly but this time by running Nastran itself. However, in this case the handling of the superelements and the output / submission of the full assembly to Nastran is automated and streamlined by the NVH Console. Run-time checks are conducted (i.e.: dependency checks, entities integrity, etc.) and in cases where problems are encountered these are either solved real-time or, if this is not possible, the process stops and the user is notified. Thus, significant time saving is achieved and errors are avoided, enabling at the same time the conductance of more "what-if" studies.
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# PLEASURE VESSEL VIBRATION AND NOISE FINITE ELEMENT ANALYSIS

**[1]Macchiavello, Sergio[*], [2]Tonelli, Angelo**
[1]D'Appolonia S.p.A., Italy,
[2]Rina Services S.p.A., Italy

KEYWORDS –
pleasure vessel, vibration analysis, resonance, structural components

ABSTRACT –
Resonance within pleasure vessels structures are cause of noise and vibrations conflicting with the high standard of acoustic comfort requested by this kind of ships.
D'Appolonia S.p.A. and Rina Services S.p.A. were involved in carrying out noise and vibration numerical analyses on a pleasure vessel design, aiming at identifying the natural frequencies and mode shapes of its structural components, to ensure that external excitation sources do not lead to resonances.
The analyzed pleasure vessel has a total length of 54.6 m and a maximum beam length of 10.2 m; it is composed by main, upper and sun decks. All structural components are made of aluminium.
The creation of the discretized model, starting from the 3D CAD model of the ship, was entirely developed using ANSA pre-processing software. In particular, each ship "block" was handled according to the following approach:

- repair and clean up of the model;
- extraction of middle surfaces and creations of connections between them;
- creation of shell and, where allowed, beam elements for meshing the structural parts;
- creation of .nas file, to be imported by Nastran solver.

Due to symmetry considerations, only the left half of the ship was modelled. The element length adopted was 200 mm for hull structures and 300 mm for super-structures.
The finite element (FE) model was produced in several .nas files, which were subsequently merged within the solver environment.
The analysis allowed identifying the natural frequencies of the structural components of the pleasure vessel: a comparison was made among them and the frequencies of the external excitation sources, in particular propeller shaft and propeller blades rotation frequencies. This comparison allowed identifying critical components and suggesting necessary modifications to the pleasure vessel design.

# GLOBAL DAMPING VALIDATION AND A NEW MODAL CONTRIBUTION FEATURE FOR SQUEAK & RATTLE SIMULATION

**Samy Bazine, Jens Weber***
Volvo Car Corporation, Sweden

KEYWORDS –
Squeak&Rattle simulation, modal contribution, E-line, relative displacement, correlation in time domain, modal transient, damping validation, 3D Laser Vibrometer

ABSTRACT –
Squeak&Rattle simulation is based on calculating the relative displacement by running an analysis in time domain (modal transient). The simulation method is described in the SAE paper 2012-01-1553. The results of this type of analysis are very sensitive to the damping value. This paper presents a correlation approach in time domain which allows the validation of a global damping value. In the first part the theory behind this approach is shown more in detail.
In the second part a new modal contribution feature is presented which can be used to perform an engineering assessment on the relative displacement. This feature can be applied on three levels, a single peak, a “time average value” and a “topology average value”.
The modal contribution feature was applied on the results of a correlation work on both an exterior and an interior assembly. For the correlation in time domain a 3D Laser Vibrometer (Polytec) has been used. The application of the modal contribution feature on the test results confirms also the validation of the global damping value of the first part on the one hand, and on the other hand it shows the benefit when using the feature as an engineering assessment tool.
Moreover it is shown that the modal contribution feature can be used to identify whether the response of the modal transient analysis is quasi static or dynamic.

Samy Bazine, M.Sc.
CAE Development Engineer
T +46 3 159 87 38
M +46 76 76 228 00 45
sbazine@volvocars.com

Volvo Car Corporation
Safety Centre
Dept. 91431
SE-405 31 Göteborg, Sweden

Jens Weber, M.Sc.
Technical Specialist
T +46 3 159 58 19
M +46 70 76 30 125
jens.weber@volvocars.com

Volvo Car Corporation
CAE Solidity
Dept. 91340
SE-405 31 Göteborg, Sweden

Session 7B

# THE BENEFIT OF ANSA TOOLS IN THE DALLARA CFD PROCESS

**Simona Invernizzi**
Dallara Engineering, Italy

KEYWORDS –
automatic tools, batch mesh, DFM, morphing, ride height maps

ABSTRACT –
In the last few years, Dallara has seen a strong increase in external consultancies. The Customer's needs and satisfactions are our target, therefore our CFD engineers have to work with different types of cars, from high performance road cars to formula and racing cars and face a variety of problems. In order to be competitive in the Motorsport world it is essential to speed up different phases of the CFD process, saving human time and
preserving the accuracy and the reliability of the results. The present paper aims at highlighting the key role that the ANSA "mesher" has played in our process by increasing the flexibility of working on the topology and reducing the human time spent for the surface mesh generation, using the "batch mesh mode".
Furthermore, the DFM tool has given Dallara the opportunity to reproduce, through CFD, automatic ride height maps as is done in wind tunnel testing. By changing the ride heights it is possible to analyse the car behaviour on a track in different configurations during the entire lap, from straight lines to cornering with also the assessment of the pitch sensitivity during braking manoeuvres. The human time has been reduced dramatically with a fully automated process based on Ansa scripts and the CFD Engineers are able to investigate the effect of
aerodynamic solutions at different configurations of the car. Finally, these tools have increased the efficiency of the whole CFD process, boosting our competitiveness and throughput.

# AUTOMATED OPTIMIZATION OF A CAR EXTERNAL AERODYNAMICS FOR AERO-DRAG REDUCTION.

**[1]Andrea Serra[*], [1]Massimiliana Carello, [2]Marco di Nonno**
[1]Politecnico di Torino, Italy
[2]BETA CAE Italy Srl, Italy.

KEYWORDS –
CFD, aerodynamics, optimization, morphing, DrivAer.

ABSTRACT –
The study of the external aerodynamics is a crucial topic during the design process of each car model. Good aerodynamics means good vehicle performances and low fuel consumption. In particular, the last issue is very important nowaday because it is strictly tied with pollution and environment depletion.
In order to reduce vehicle fuel consumption, aerodynamic resistance has to be reduced. Computational Fluid Dynamics (CFD) is widely adopted in vehicle aerodynamics development today, but typically used to study one vehicle shape at a time. In order to be used for aerodynamic shape optimization the CFD simulation process has to be able to study a large set of design alternatives, within the short period of time available in the design stage.
A study was carried out to establish an automated optimization process applied to external aerodynamics of a real-life vehicle model, particularly focusing on the methodology. The aim of the research is to obtain a performance improvement in terms of drag reduction through the definition and variation of specific vehicle shape parameters, using ANSA pre-processor mesh morphing techniques. Several parameters configurations are obtained based on the design of experiments (DOE) matrix purposely created by OPTIMUS. Within the simulation loop, vehicle shape variants are generated by ANSA and analysed by Star CCM+. Then, an interpolating model is defined and optimized in order to find the parameters configuration allowing the minimum drag. Through this process it is possible to explore in a small period of time a large number of shape variants to evaluate the influence of different parameters of the vehicle on overall resistance to motion. So, it constitutes a predictive tool in the design phase of a new vehicle.

# NUMERICAL SIMULATIONS OF FLOW THROUGH S-DUCT

**[1]Pravin Peddiraju, [1]Arthur Papadopoulos, [2]Vangelis Skaperdas, [3]Linda Hedges***
[1]BETA CAE Systems USA, Inc., USA,
[2]BETA CAE Systems SA, Greece,
[3]CFD Consultant, USA

KEYWORDS –
S-DUCTS, CFD, Propulsion, Aerodynamics

ABSTRACT –
Diffusing S-DUCTS are critical components in certain military and civilian aircraft, primarily employed in directing airflow to the engine. Air flow through an s-duct is complex in nature, involving boundary layer separation, secondary flow, and total pressure loss effects that often impact engine performance. thus, it is very important to accurately capture these effects in CFD simulations through a computational grid of appropriate resolution. This presentation describes how ANSA, BETA CAE Systems' pre-processing software, was used to generate high fidelity grid for an S-DUCTS model that was used in 1st propulsion aerodynamics workshop (paw), along with numerical simulation results of flow through the s-duct. Metacomp technologies' CFD solver, CFD++, was used for numerical simulations and BETA CAE Systems' software, μETA, was used for post-processing.

# CUSTOMIZATION OF META POST FOR DISPLAY OF RESULTS FROM A MOLDING SIMULATION

**[1]Prasanna Kondapalli[*], [1]James McGuire, [1]Damiano LaRosa, [2] Deepak Lokesha, [2]Joshua Sims**
[1] BASF Corp., U.S.A
[2] BETA CAE Systems Inc., USA

KEYWORDS –
Molding, MetaPost, Python, Customization, Plastics

ABSTRACT –
MetaPost is a versatile post processor for viewing results from different types of analyses. One of the key strengths of MetaPost is its ability to be customized to suite one's needs. The introduction of embedded Python compiler in MetaPost has further enhanced the ease of customization of complex numerical calculations. We have used this feature of MetaPost to develop a Molding Post-Processing Toolbar with specialized functions to calculate user – defined results from a molding simulation.
The Molding Post-Processing Toolbar uses a Python script to provide a standardized post-processing method for molding simulation. Some of the features of the toolbar are:
Automatic calculation of shrinkage and warpage based on the decomposition
Creation contour plot for shrinkage and warpage components of results.
Ability to analyze shrinkage and warpage results across user – defined sections.
Ability to create PPTX reports.
Numerical examples showing shrinkage and warpage contour plots are given. Procedure describing creation and analysis of sections through various examples are shown. In summary, customization capability within metapost is used to depict the results of a molding simulation in various forms.

Session 8A

# INCREASED ACCURACY IN SQUEAK & RATTLE SIMULATIONS BY ENHANCED MATERIAL PROPERTIES, DAMPING VALUES AND ALIGNED EVALUATION DIRECTIONS

**[1]Mehrdad Moridnejad[*], [1,2]Casper Wickman, [1]Jens Weber, [2]Lars Lindqvist, [2]Rikard Söderberg**
[1]Volvo Car Corporation,
[2]Chalmers University of Technology, Sweden

KEYWORDS –
Squeak&Rattle simulation, E-line, Surface stripe, Relative displacement, time domain, modal transient, dimensioning and tolerancing, damping validation, 3D Laser Vibrometer

ABSTRACT –
Squeak and rattle (S&R) are two undesired phenomena that can affect the quality perception of cars. The main reason of S&R is the relative displacement between parts. One means to identify the critical area for S&R at Volvo Cars during the virtual phase is the E-line method. This method, which was presented in a SAE paper 2012-01-1553, is used to calculate the relative displacement along a line/gap. The application of the method at Volvo Car Corporation was shown in a Beta paper 2013.
Relative displacement calculation along the closure gaps such as tailgate closure gap has shown sensitivity to damping value and sealing stiffness. Therefore, a correlation work in time domain has been performed to update the damping value and sealing stiffness. The object is a body in white (BIW) including some assembly parts. The relative displacement along the tailgate closure gap has been both tested and simulated. Based on the correlation between test and simulation results the sealing stiffness value (all three directions) and the damping value has been updated. The received damping value is only valid for the BIW according to the chosen test setup. Therefore an advanced test procedure using a robot mounted 3D Laser Vibrometer (Polytec) is presented to validate the damping value for a complete vehicle.
Moreover, in order to increase the precision of the E-line method, a new principle to align measurement directions of the simulated dynamic displacement with measurement directions of calculated geometrical variation has been developed. Geometrical variation or static displacement must be considered when assessing rattle, because the minimum size of a gap is one of the assessment parameters. Definition of measurement direction is based on a surface strip that is generated in the CAT (Computer Aided Tolerancing) tool RD&T. The combination of E-line with the surface strip shows a higher accuracy in the simulation method, which is shown in an industrial case.
These results improve the capability of simulating the relative displacement significantly.

Mehrdad Moridnejad, M.Sc.
CAE Development Engineer
T +46 31 596746
M +46 76 632 24 22
Mehrdad.moridnejad@volvocars.com

Volvo Car Corporation
Safety Centre
Dept. 91431
SE-405 31 Göteborg, Sweden

Casper Wickman, Ph.D.
Technical Leader
T +46 31 32 56655
M +46 31 32 256655
casper.wickman@volvocars.com

Volvo Car Corporation
Craftsmanship & Ergonomics Centre
Dept. 91300
SE-405 31 Göteborg, Sweden

# IMPROVING EFFICIENCY OF ACMS AND AMLS DOMAIN COMPOSITION METHODS FOR LARGE VIBRATORY SYSTEMS USING RE-ANALYSIS CONCEPTS

**[1]Mourelatos, Zissimos[*], [2]Patil, Santosh, [2]Skarakis, John**
[1]Oakland University, Rochester MI, USA,
[2]BETA CAE Systems USA, Inc.

KEYWORDS –
Design optimization, NVH, vibration, re-analysis, reduced-order modelling

ABSTRACT –
For structural dynamics problems, optimization of large-scale finite element (FE) models can be prohibitively expensive because it requires repeated FE analyses. We have developed and demonstrated in previous conferences, various single-level re-analysis methods such as the Parametric Reduced-Order Modelling (PROM), the Combined Approximations (CA), and the Modified Combined Approximations (MCA), for gauge (thickness), shape, and topology changes with the premise to effectively calculate the dynamic response of a structure after a baseline design has been modified, without recalculating the new response. In this presentation, we will build on previous developments. We will present computationally efficient substructuring methods using re-analysis for multi-level Craig-Bampton CMS (Component Mode Synthesis) with interface modes. The developed methods improve the efficiency of the currently available ACMS (Automated Component Mode Synthesis) and AMLS (Automated Multi-Level Substructuring) multi-domain methods for both global and local changes. Preliminary results indicate that the proposed multi-level substructuring method with re-analysis can be 3-5 times faster than ACMS. Both the ACMS and AMLS are essentially multi-level fixed interface Craig-Bampton methods. The only difference between them is that ACMS uses a binary partition tree, while AMLS uses a more general partition tree. An example using a large-scale vehicle finite-element model, will demonstrate all developments. The proposed approach can provide substantial computational savings in optimization and NVH studies of large vibratory systems.

Session 8B

# IMPORTANCE OF ACCURACY IN CFD SIMULATIONS

**Vedat Akdag**
Metacomp Technologies, USA

KEYWORDS –
Accuracy, CFD, Convergence, validation, verification

ABSTRACT –
The application of CFD is rapidly expanding with the growth in computational resources. It is becoming essential for CFD solvers to provide validation and verification. From a CFD solver company perspective mesh related issues on accuracy and convergence will be presented. Topics will cover quality measures such as cell skewness and cell size variations relating to convergence and solution accuracy.

# CFD ANALYSIS OF SUPERSONIC AND HYPERSONIC WINGS USING ANSA AND META TOOLS.

**Kaleeswaran Balasubramaniam*, Shivakumar Biradar**
Xitadel CAE Technologies, India

KEYWORDS –
Supersonic, Hypersonic, Aerodynamics, Heat generation, Stability.

ABSTRACT –
The study features the design of supersonic and hypersonic wings and their significance in aerospace and automotive industries alike. Supersonic wings and aerofoil designs are already well in use in the present world. Various Computational Fluid Dynamics (CFD) studies have already been conducted analysing various wing designs for future aerospace and automotive applications. But very less work has been done on the concept of “Swept front wings”. In this study ANSA, Fluent and Meta software tools were used to analyse heat generation of these wings during high velocity regimes. Findings revealed that the swept front wings were capable of attaining more stability at higher altitude than normal swept back wings. The heat resistance capabilities and stability characteristics of these wings were also noted to be efficient. Similarly in hypersonic wing analysis, modified diamond wedge wings were analysed to understand the flow at such Mach regimes and was found to be supportive. The results indicate the feasibility of swept front wings in aerospace industries. The possibility of its inclusion in formula one race is a case for future research.

Session 8C

# LAMINATED COMPOSITE PRODUCTS: SIMULATION PROCESS MADE EASY

**Ioannis Nerantzis**
BETA CAE Systems SA, Greece

KEYWORDS –
laminated composites, draping, pre-process, post-process, CAE simulation

ABSTRACT –
A composites modelling workflow often requires the use of a multitude of software tools, each aiming at diversifying fields concerning design, manufacturing and CAE. This increases modelling time, process complexity, and the risk of making mistakes.

BETA CAE Systems continuously develops tools to address Composite simulation issues. Taking into consideration the current requirements of engineers and the practices applied, ANSA and μETA offer a powerful, self-contained, composites modelling environment. A composite model can be created or imported in ANSA and handled with the Laminate tool. The built-in support of various file formats, CAE oriented modelling tools and the introduction of new draping algorithms, allows for significant reduction of processing time and overall workflow complexity. Layup data can be created, imported, and modified using sophisticated tools that extend to various concepts. Digital mock-up, draping simulation, mapping of laminate data originating from other tools and merging of zones, are some of the composites oriented tools that ANSA offers.

In the post-processing phase, μETA allows a great deal of model insight and verification. Results can be calculated at multiple section points through the thickness of each layer, providing a detailed overview of the structure's behaviour. A dedicated Composites toolbar in μETA, consolidates all needed tools to post process laminated results, capturing industry standard practices and criteria. Failure indices and reserve factors, derived from these methodologies can be calculated directly by μETA. This makes possible the re-evaluation of the results for different material limits without the need to solve the model again thus reducing time, effort and disk space.

# ANALYSIS OF A PRESSED COMPOSITE AUTOMOTIVE TAILGATE USING ANSA & µETA

**Andy Ngai, Mark Arnold**
PENSO, UK

KEYWORDS –
Composites, Design Optimization, Failure, Finite Element Analysis, Laminate

ABSTRACT –
Composite materials utilised within the automotive industry have increased in recent times, due to the demand to reduce weight and vehicle C02 emissions. Penso were commissioned by a European automotive OEM to design and manufacture a prototype continuous fibre reinforced composite tailgate. The main objective for the composite design was to minimise mass, whilst meeting all strength and stiffness targets of the production SMC tailgate. Three main parts of the tailgate considered for light weighting were the tailgate inner panel, tailgate outer panel and spoiler mechanism carrier. The laminate tool function within the pre-processor ANSA was utilised for ease of building, handling and modifying the composite model. A laminate design was developed using non-linear static FE analysis. Results were plotted using the post-processor µETA, with the Tsai-Wu failure criterion and a user defined inter-laminar failure criterion used as design metrics. The laminate design was then assessed by Penso's composite manufacturing team to develop overlap joint locations and preliminary ply shapes appropriate for processing utilising Penso's pressed composite technology. Ply shapes and draped material directions were updated in the FE model for further refinement and prediction of finalised mass/performance. The final composite design resulted in a combined mass save of over 65% whilst having comparable structural performance to the SMC production design.

Session 9A

# 3D SHAPE RECOGNITION USING ANSA SCRIPTS

**Koji Otani**
Integral Technology Co., Ltd., Japan

KEYWORDS –
Feature recognition, ANSA script, automation, mesh control, pre processing

ABSTRACT –
Creating adequate mesh according to the mesh rules is important in order to assure the quality of simulation results since simulation results may vary depending on mesh. Not only simple features such as fillets, flanges, chamfers, and emboss but also other features and complex features such as thin planes, tapered tubes, ribs, and grooves can matter. Recognizing features and controlling mesh for them automatically help to reduce time spent on manual mesh modifying work dramatically.
In this paper, ANSA scripts are used to develop algorithms to recognize the various specific features from shapes of input CAD models automatically in order to control mesh for fulfilling the need in creating mesh with detailed mesh rules for the specific features.
The goal of the feature recognition with ANSA scripts described in this paper is to automate mesh creation procedures according to specific mesh rules.
we plan to use the algorithms developed with ANSA scripts for our entrusted analysis operations as well.

# AUTOMATIC GENERATION OF MULTIBODY SIMULATIONS IN ANSA BY USAGE OF GRAPH-BASED DESIGN LANGUAGES

**Constantin Diez**
Adam Opel AG, Germany

KEYWORDS –

ABSTRACT –
Automation is nowadays a crudential part in engineering since automation of manual processes increases the speed by a very high factor and thus saves a lot of money. The challenge lies in the automation of creative high level tasks in which the structure of the problem itself is changing strongly and thus knowledge modelling is necessary.

One of these difficult tasks is the design of engineering structures. This task can be automated by graph-based knowledge libraries in which an engineer can lay down his knowledge to solve a task [2].

In the progress of construction many questions arise which can be answered by either tests or simulation. In general one uses a detailed geometry as basis and builds up a simulation model from it. In this process the engineer uses his existing knowledge to determine boundary conditions etc. This task can be automated by laying down the knowledge about this process into a design language which can cope with changing architectures.

In overall it is more appropriate to use a graph as meta-model from which other models like geometry and multibody simulation can be derived by a mere model-to-text transformation. Geometry is not an appropriate form of a central data model since it is lacking a lot of information.

This paper concentrates on the automatic generation of multibody simulations by usage of graph-based design languages. Therefore a previous design language creates a graph with geometry information [3] which will be extended to multibody physics. As a result this graph can be transformed to either ADAMS or ANSA automatically [1]. In the end the design language itself returns result data for further analysis and possible decisions.

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# DESIGN AND STUDY OF DOOR COMPONENTS FOR A TWO-SEATER ELECTRIC VEHICLE IN SIDE IMPACT CONDITIONS

**Panagiotis Bazios*, Polychronis Spanoudakis, Nikolaos Tsourveloudis**
School of Production Engineering and Management, Technical University of Crete, Greece

KEYWORDS –
FEM modelling, side impact, crashworthiness, ANSA, μETA,

ABSTRACT –
Crash simulation is extensively used by the automobile industry for the development of vehicles with regard to their passive safety – known as crashworthiness. This paper presents the use of Finite Element Method (FEM) modeling under side impact conditions (Euro NCAP) and design optimization of various components for a prototype two-seater electric vehicle, investigated with the aid of ANSA and μETA software. Considering an existing chassis, doors, side panels, door hinges and impact bars, are designed and evaluated targeting: 1)simplicity in manufacturing, 2)lower weight depending on use of materials and 3)security provided to occupants. The mentioned structural parts were modeled and analyzed given the restrictions of materials mechanical and physical properties. Moreover, the extensive use of impact analysis targeted on reducing the number of experiments, thus minimizing cost and development time of the components. Specifically, the effect of geometry modelling (parameters and elements) on simulation time was considered and used to provide adequate results in reduced time. Thus, the capabilities offered by ANSA in meshing of different geometries of the vehicle, giving us the ability to export realistic and reliable results are discussed and presented. Final results present the effect of impact tests towards components redesign, leading to a significant reduction of weight.

Session 9B

# MULTIOBJECTIVE DUCT OPTIMIZATION WITH OPEN SOURCE CFD SOLVER

[1]Fabio Vicenza*, [1]Daniele Obiso, [2]Stamatina Petropoulou, [1]Daniele Speziani
[1]Phitec IngegneriaSrl, Italy,
[2]ICON Technology & Process Consulting Ltd, United Kingdom

KEYWORDS –
Multiobjective – Adjoint Optimization – Open source - CFD

ABSTRACT –
During the development of duct systems, engineers often face various geometry and performance constraints forcing them towards non-optimal designs.
Efficiency in duct performance can be measured in various ways. Minimizing the pressure loss between the inlet and the outlet of the channel is the most important requirement but improvements in other areas may be equally important. Further requirements could be the mass flow balance for multiple outlets or flow uniformity on the outlet.
The adjoint solver of iconCFD has been used for the topology optimisation of the individual aspect described above [1-4]. A new multi-objective approach has been developed integrating the latest features of iconCFD Optimize software suite and Beta CAE ANSA. Multiple objectives can be treated according to importance by the use of weighting factors. The automation of the geometry extraction has been handled by a developed method based on Beta CAE ANSA. Various examples of industrial applications have been studied to prove the effectiveness of this solution.

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# ON VORTEX SHEDDING FROM TRAILING EDGE OF A FULL-SCALE MARINE PROPELLER BLADE

**Saeed Javdani*, Nicholas Mitroglou, John S. Carlton**
City University London, School of Engineering and Mathematical Sciences, UK

KEYWORDS –
Marine Propeller, Vortex shedding, Blades' Trailing Edge, Pure Hexa Mesh, Turbulence Model

ABSTRACT –
This paper discusses influential aspects of modelling vortex shedding from trailing edge of a full scale propeller. A cyclic pure hexa mesh was generated on flow passage around a single blade of the propeller in this study, using ANSA meshing package, to assure a node to node connection of periodic boundaries. A suitable Reynolds-Averaged Navier-Stokes (RANS) unsteady method was employed in CFX Solver package to resolve the turbulent flow, boundary layer on surface of blades and trailing edge flow separation. Vortex shedding was observed at trailing edge of blades from 0.7 R to 0.9 radial lengths. To support the 3D simulation of the propeller, a comparison was made of the results with those obtained from 2D simulations of blades' hydrofoil sections and a good agreement was seen. In this study, steady simulations are also performed for DTNSRDC propeller 4382 (36° skew) under ahead condition and the open water characteristics compared with available experimental data to prove the accuracy of the employed methodology..

Session 9C

# SIMULATION OF CARBON-ROVING-STRUCTURES – EXTREME LIGHT AND STRONG BY FILAMENT WOUND REINFORCEMENT

**[1]Dirk Dreißig[*], [2]Peter Faßbänder, [1]Ulrich Hindenlang**
[1]Lasso Ingenieurgesellschaft mbH, Germany,
[2]FS Software & Konstruktionen GmbH, Germany

KEYWORDS –
CFRP, rovings, high strength, flux of forces, filament wound reinforcement, ANSA-scripting

ABSTRACT –
Actual high-tech carbon fiber technology using 24k and 48k rovings allow high performing structures of optimal weight and strength in tracing directly main fluxes of forces.
The application of local forces is managed by using metallic socket inserts embedded into loops of rovings.
A new strategy of filament wound reinforcement of endless rovings, represented by a path of beam elements, is presented, using ANSA's scripting capabilities to automatically generate a cohesive composite, ready to use for FE-analysis. This modelling technique is based on the traces (curves) of the winding.
The bonding between the rovings is performed using a statistically distributed mesh of short beams that represent the resin characteristics.
With a prior optimisation step, using a simple truss-based structure, the needed minimal amount of rovings can be estimated.
An estimation of the limit load of each roving is performed using a set of natural generalized beam forces as yielding surface.

# EXECUTION AND EVALUATION OF THE OPTIMIZATION PROCESS FOR A MULTI-MATERIAL DAMPING TREATMENT

**Jaber Mariam*, Schneeweiss Helmut**

BMW Group, Germany

KEYWORDS –
Damping Patches, Topology Optimization, NVH Performance, Multi-Material Optimization

ABSTRACT –
The automobile industry often aims to reduce any structure-borne noise radiation resulting from external forces placed upon the vehicle during operation in the early stages of the design process, thus reducing the design and development expenses. A cost-efficient mean of testing for and reducing these structure-borne radiation issues is through the use of a finite element method (FEM) for an optimization process, and can be carried out in a numerical calculation program. The optimization procedure allows several different design variables, of which: 1) layer sequence, 2) laminate layer thickness, 3) laminate material properties, 4) viscoelastic material thickness, and 5) fiber orientation are used. The analysis resulting from this FEM can be assumed to have de-coupled the structural and acoustic responses, allowing the results to help in determining the best location and orientation, topology, of multiple-composite damping treatments from the optimization procedure. This paper aims to find the best topology, as well as to evaluate the optimization process used in this procedure.

# SIZE AND SHAPE OPTIMIZATION OF OVERMOLDED CONTINUOUS GLASS FIBER LAMINATE WITH SHORT GLASS FIBER REINFORCED POLYAMIDE FOR MAXIMUM IMPACT RESISTANCE USING ANSA, LS-OPT, AND LS-DYNA COUPLED WITH ULTRASIM®.

**Praphulla Chandra*, Rodrigo Orozco**
BASF Performance Materials, USA

KEYWORDS –
Optimization, ULTRASIM®, impact, glass fiber, plastic

ABSTRACT –
The drive in modern automotive engineering to increase performance while reducing mass make high demands on the materials used. This, coupled with the desire to reduce cost by reducing the number of prototypes made only highlights the importance of rapid and accurate predictions and design optimization in Computer Aided Engineering (CAE).
This paper studies size and shape optimization of plastic composites using ANSA for morphing the initial orientation of the continuous fibre laminate, height of over-molded ribs, and the shape of the mold. A draping simulation is then run to obtain the final orientation of the continuous fibers from the manufacturing process. ULTRASIM® is used to map the fiber orientation and BASF material law to the structural mesh, and the model is then run through an impact simulation in LS-DYNA. The energy to failure is extracted from the simulation using μETA and returned to LS-OPT to maximize the energy absorption of the plaque. The optimum shape is of utmost interest in automotive powertrain components, such as oil pan components which are subject to stone impact requirements.
BASF ULTRASIM® generates an advanced numerical material description that integrates the manufacturing process into the structural simulation, creating a unique material definition for every finite element of the structural model based on the fibre orientation and strain-rate effects. This advanced numerical material description takes into account the typical characteristics of plastics in the simulation for an integrated approach with the manufacturing process that can lead to the ideal component.

Session 11

# INTRODUCTION OF ACTIVE SAFETY TECHNOLOGY INTO NEW CAR ASSESSMENT PROGRAMMES

**Prof. Sadayuki Ujihashi***
Chair of JNCAP, Professor Emeritus at Tokyo Institute of Technology, TOPCAE Corporation, Japan

KEYWORDS –
Automobile, Active Safety, NCAP, Automated Driving

ABSTRACT –
Fatality of traffic accidents in Japan has been significantly decreased in the aid of the development of automobile and road safety, introduction of NCAP, the arrangement of traffic laws etc.
However recently it is considered for farther reduction of traffic fatality that new technology of active safety such as autonomous emergency braking system should be introduced into JNCAP continuously in step with the development of active safety related technology. This will result that the incidence of traffic accident itself will be able to be reduced and then fatality of traffic accidents can be reduced accordingly. It can be considered that the active safety technology will lead to the automated driving in the future.
This paper describes the introduction of active safety into JNCAP so far together with the concept of the introduction and also the future plans in comparison with other NCAPs, Euro, America, Asia, etc.

# THE EVOLUTION OF BETA CAE SYSTEMS SUITE SCRIPTING CAPABILITIES INTO A FULL CAE DEVELOPMENT PLATFORM

**Yianni Kolokythas*, Michael Giannakidis**
BETA CAE Systems SA, Greece

KEYWORDS –
Scripting, Python, API, SDK, IDE

ABSTRACT –
Computer Aided Engineering is a highly technical field that demands continuous innovations and breakthroughs. In many cases, in order for innovations to take place, there is a need to jump ahead of the functionality that is currently available. The CAE tools need to provide advanced open programming capabilities were specialists can provide rapid solutions. These engineering specialists should not need to reinvent the wheel, instead APIs (Application Programming Interface) based on the latest IT industry standards should be available to them.

The APIs of BETA CAE Systems suite of products provide the user/programmer with a vast amount of capabilities. Great access to the core functionality and full access to the interface APIs. A greater access to the core functionality will be available in the near future enhancing the programming option for the user. In addition using Python as a programming language the user has a wide availability of functionality from Python's standard library and 3rd party libraries such as NumPy, Scipy etc.

As we move forward, the scripting capabilities will become a programming interface. An ecosystem will be provided such that developers will be able to create tools inside ANSA or μETA. They will be able to control the lifecycle of their tool. Hooks will exist for key application actions, and user intervention will be feasible for both the core data and the User Interface. The goal is to make the software a CAE Development Kit, that makes it possible to create your own tools and continue innovating. In addition a distribution and a licensing systems will be provided to make the Intellectual Property handling easy and secure.

Giving users and third party developer access to a CAE development platform unleashes unlimited capabilities. The user/programmer being the technical specialist can develop a tool that suits the specific needs of his/her organization and safe guard the organization's intellectual property. In addition third party companies with technical domain expertise can develop solutions on the BETA CAE Systems Platform and license them to end users.

# PROCESS AUTOMATION TOOLS FOR ACCELERATING CAE PROCESSES IN ANSA ENVIRONMENT

**Umesh Mallikarjunaiah*, Mrityunjaya Yeli, Prakash Krishnaswamy**
Xitadel Group, India

KEYWORDS –
Process automation, CAE Modeling, Productivity Improvement

ABSTRACT –
CAE is a key technology component in the product development process for automotive, consumer goods, aerospace and other manufacturing industries. In full vehicle CAE, Process Automation has the potential to reduce modeling and assembly time between 50% - 70% for metal and plastic components respectively. The technical approach includes feature recognition, element quality and mesh flow optimization etc. Benefits of this approach apply to Rocker, Closures, BiW, Door Trims, IP Assembly, Battery Tray, HVAC, Bumpers. In addition, Process Automation can be applied to the acceleration of CAE simulation for such sub-systems as Seats. Illustrative examples will be presented

Session 12A

# MULTISTAGE OPTIMIZATION OF AUTOMOTIVE CONTROL ARM THROUGH TOPOLOGY AND SHAPE OPTIMIZATION.

**[1]Duane Detwiler, [2]Emily Nutwell[*], [3]Deepak Lokesha**
[1]Honda R&D Americas, USA,
[2]Ohio State University SIMCenter, USA,
[3]BETA CAE SYSTEMS USA Inc., USA

KEYWORDS –
Optimization, Topology, Shape, Multi-stage, Morphing,

ABSTRACT –
The global automotive industry as ever – evolving as it is, bring about exciting challenges for the new age designers. The trends in the overall production costs, fuel costs and the awareness of environmental effects are some of the many factors that drive today's automotive design strategies. Use of optimization methodologies early on in design process has been adopted widely to achieve low cost and efficient component designs.

This paper discusses a multi-stage optimization methodology to reduce time in identifying optimized concept design for a chassis component. As a first stage, a topology optimization was performed on a vehicle control arm design, using LSTaSC™ (LSTC). The loading condition applied to the design space represented a highly nonlinear load scenario similar to that seen during a crash event in the vehicle. The _topology-optimized design_ was then subjected to a shape optimization. ANSA™_s (BETA CAE) morphing technology was used to define the shape change parameters on a LS DYNA™ load case model. An ANSA™ _ LSOPT™ link was then created through ANSA™ Task Manager. This allows for easy creation linkages between the LSOPT™ design variables and ANSA™ morphing parameters. A minimization objective was selected for overall reduction in mass while maintaining necessary performance targets. The paper will present results and highlight the benefits of multi-stage optimization strategy.

# APPLICATION OF NON-PARAMETRIC SIZING OPTIMIZATION FOR CAR BODY PARTS USING SIMULIA TOSCA STRUCTURE AND ANSA

**[1]Georgi Chakmakov[*], [2]Serafim Chatzimoisiadis**
[1]Dassault Systemes, Bulgaria, [2]BETA CAE Systems, Greece

KEYWORDS –
Optimization, sizing, weight reduction, shell thickness, car body

ABSTRACT –
Weight reduction in the automotive industry is an essential measure to increase the vehicle efficiency and reduce material, manufacturing costs and emissions. The topology optimization has established itself as an innovative way for weight reduction, especially for casting parts, already in an early product development stage. In a similar manner, the sizing optimization facilitates efficient designing of sheet metal parts by variation of their thickness. The non-parametric sizing approach in SIMULIA Tosca Structure offers various possibilities for optimization of shell structures with respect to their weight, stiffness and dynamic behavior which makes it notably suitable for designing of car body parts. In the ANSA Task Manager, the Tosca sizing task is fully integrated with its complete pre- and post-processing capabilities which enables fast and reliable handling of optimization setup and results. This paper presents a sizing optimization procedure for car body components using the pre-processing performance of ANSA and Tosca, showing the possibility of weight reduction.

# CONNECTING ROD OPTIMIZATION INTEGRATING MODEFRONTIER WITH ANSA

**[1]Alberto Clarich[*], [1]Marco Carriglio, [2]Giulio Bertulin, [2]Günther Pessl**
[1]ESTECO SpA, Italy,
[2]BMW Motoren GmbH, Austria

KEYWORDS –
Multi-Objective Optimization, Fatigue Analysis

ABSTRACT –
This paper describes the integration of multi-objective optimization software modeFRONTIER from ESTECO with ANSA mesh morphing, and the application to a fatigue analysis case of industrial relevance.
In modeFRONTIER environment, any CAE software can be easily integrated in the process flow through the available direct interface nodes, including ANSA and ☐ETA, allowing update of parameters and execution of the CAE simulations.
The available multi-objective optimization algorithms (including Game Theory MOGT, Genetic Algorithm MOGA-II and FAST algorithms - based on Genetic Algorithm and Response Surfaces) can be used to drive the automatic simulations until the optimal design solutions are found, accordingly to the specified objectives. In addition, several tools for pre, post and statistical analysis are available in order to support the engineers in the complete design process.
In this paper it is illustrated an application of modeFRONTIER combined with ANSA for the optimization of a diesel engine connecting rod from BMW Motoren. The objective of the optimization is the mass minimization with the satisfaction of prescribed safety factors (fatigue analysis by FEMFAT software).

# MORPHING, OPTIMIZATION AND AUTOMATION STRATEGIES IN ANSA – THE EFFICIENT WAY TO OPTIMIZATION

**Onkar Mande*, Ravi Nimbalkar**
BETA CAE Systems USA, Inc., USA

KEYWORDS –
Optimization Strategies, Automation, Shape Optimization, Discrete Optimization Libraries, Ribs parameterization

ABSTRACT –
We present efficient morphing, optimization and process automation strategies by unitizing ANSA's powerful Pre-processing capabilities, superior FE and Geometry Morphing Tools and insights gained by working on various client processes. With various end user case studies, we demonstrate that these capabilities provide a robust, easy to use, time and cost effective platform for multidisciplinary process automation and design optimization.

Morphing is a process of smoothly transforming topology as well as cross-sectional properties of CAE components. It has become an integral part of the process of structural design optimization in various CAE disciplines. The morphing requirements can vary from simple transformation of design feature to very complex interaction of various design optimization parameters. ANSA provides powerful pre-processing tools along with the superior FE and geometry morphing capabilities. Unique combination of ANSA functionalities and strategies developed using insights gained by working on various client processes provide a robust platform for design optimization applications in various fields. Automation and morphing tools last mile usability has been further extended to provide easy to use and simple to understand techniques. These advanced techniques allow engineers to gain better insight for improving product design. Many of such solutions have been provided for setting up complex optimization model set-ups and are being used by major automotive OEM's.

We present some of the successful end user case studies, which include:

1. Strategies used in Powertrain Optimization.
2. Accommodating stringent parameters involved while optimizing Tailor Welded Blanks.
3. Automatic Volume compensation for Piston Morphing and Optimization
4. Ribs parameterization and use of the discrete library items in the regular model built and optimization process.
5. Robust Volume and layers morphing strategies for Aerodynamic CFD Application.
6. Automated Post processing Of Optimization results.

Session 12B

# CFD COMPARISON OF THE SARM ROTARY ENGINE WITH A CONVENTIONAL RECIPROCATING OTTO CYCLE ENGINE

**[1] Gkoutzamanis Vasileios*, [2] Dimitris Mertzis, [1] Savvas Nikolaidis, [1]Savvas Savvakis**
[1] the SARM Project (www.thesarmproject.com), Greece
[2]Laboratory of Applied Thermodynamics, Department of Mechanical Engineering, Aristotle University of Thessaloniki, Greece

KEYWORDS –
SARM, engine, Otto, rotary engine, fuel-air cycle, CFD, 2D, 3D

ABSTRACT –
A new concept rotary engine – the SARM engine – is compared to the conventional reciprocating Otto cycle engine in terms of thermodynamic efficiency and power output. A pseudo-1D fuel-air cycle analysis is performed which is supported by detailed 2D and 3D CFD analyses of both engines.
A pseudo-1D approach of the thermodynamic engine cycle is adopted in order to estimate the thermal efficiency and compare the PV diagrams of the two engines. The generated tool, which is enriched with data from CFD models, offers rapid sensitivity analysis on the major engine characteristics with minimum time and effort.
The 3D study work's target was the in-depth understanding of the combustion process inside the SARM engine and its comparison with an Otto cycle engine. Both engines were studied with identical initial conditions (engine capacity, max pressure, fuel-air ratio).
The analysis results are promising since the SARM engine presents an increase so in thermodynamic efficiency as in the produced torque. The next step is to optimise the design using the developed tools and proceed to the SARM engine prototype manufacture.
The 2D & 3D geometry model and finite element analysis have been created with the pre-processor ANSA. The CFD analysis has been carried out with ANSYS Fluent and the results are utilised via the μETA post-processor.

# PREDICTION OF RESISTIVE SOOT SENSOR BEHAVIOR IN DIESEL EXHAUST VIA 3D SIMULATION OF SOOT DEPOSITION

**Pavlos Fragkiadoulakis*, Dimitris Mertzis, Savas Geivanidis, Zissis Samaras**
Laboratory of Applied Thermodynamics, Dept. of Mechanical Engineering, Faculty of Engineering, Aristotle University of Thessaloniki, Greece

KEYWORDS –
Soot sensor, OBD, diesel particulate filter, CFD, physical model

ABSTRACT –
Soot sensors are the latest tool developed in order to track diesel particulate filter (DPF) failure, which may result in excess PM emissions, the acceptable limits of which become stricter for new vehicles according to regulations. Resistive electrode/accumulating sensors are a cost-effective approach to accurately estimate soot concentration in diesel engine exhaust. Understanding the soot deposition mechanisms of a resistive sensor is a necessary step to predict and interpret the soot sensor behavior.
In this direction, a 1D transient model of has been developed in order to simulate the deposition mechanisms efficiently. The exhaust gas flow field around the soot sensor is an input for the model and it is calculated through a 3D CFD model. Through this coupling, accurate data on mass flow, velocity and turbulence characteristics at the soot sensor are calculated and enhance the model's predictive capability.
According to the simulations, Brownian diffusion, thermophoresis and electrophoresis seem to primarily affect the soot accumulating rate on the sensor element. In addition, the model results agree with measurements on actual diesel engine exhaust system. The developed model correctly predicts the behavior of the sensor for a set of exhaust flow conditions and sensor properties, such as its geometry. This way, experiment costs related to the calibration process of the sensor signal are minimized and moreover the application of similar sensors on modern diesel vehicles is accelerated.
The 3D model geometry and finite element analysis have been created with the pre-processor ANSA. The CFD analysis has been carried out with ANSYS Fluent and the results are analyzed via the μETA post-processor.

# A NUMERICAL SIMULATION OF SINGLE AND TWO-PHASE FLOW IN POROUS MEDIA; A PORE-SCALE OBSERVATION OF EFFECTIVE MICROSCOPIC FORCES

**M. Aboukhedr*, Dr K Vogiatzaki, Prof M Gavaises, Dr N Mitroglou**
City University London, UK

KEYWORDS –
(Numerical simulation, Porous media, Ergun equation, CT reconstruction Hydraulic conductivity)

ABSTRACT –
Modelling fluid flow in rock porous medium is a challenging physical problem which affects oil/gas extraction. Simplified macroscopic flow models, such as the well-known Darcy's law, fail to adequately predict the pressure drop occurring not only because many flow parameters are not considered but also due to the numerical simplifications made for the multi-scale structure of such rocks. In order to improve our understanding for these flows we need access to data relevant to 3D realistic geometries. However experimental access can be gained on 2D “slices” of the geometry and then complicated algorithms need to be followed in order to accurately reconstruct the 3D geometry. The suggested work describes a methodology to simulate these challenging flows based on numerical grids that result from reconstruction of 2D images found in the open literature. A number of pore-scale geometries with varying complexity of the internal structure have been reconstructed and refined using ANSA®. The results in terms of pressure drop vs flow rate in porous arrangements at low Reynolds numbers are compared with experiments. Following, multiphase flow models have been utilised at the pore space. Particular focus is given in this study on associating the effect of an accurate grid representation and resolution on the final predications as well as the sensitivity suggested multiphase numerical algorithms to the grid quality. It is concluded that the multi-scale flow development at complex porous rock can be simulated but there is high grid dependency. It is envisioned that from these studies, more accurate description for the pressure drop considering multi-scale flow effects, currently missing from the literature.

# MESH CURVING TECHNIQUES AND PARALLEL SIMULATIONS OF HIGH ORDER DISCONTINUOUS GALERKIN SCHEMES ON UNSTRUCTURED MESHES

**[1]F. Hindenlang, [2]G. Gassner, [3]C.-D. Munz**
[1]Max-Planck Institute for Plasma Physics, Garching
[2]Mathematical Institute, University of Cologne
[3]Institute for Aero- and Gasdynamics, University of Stuttgart

KEYWORDS –

ABSTRACT –
In this talk, the application of the high order Discontinuous Galerkin scheme for computationalfluid dynamics is presented. In the _rst part, techniques to generate high order mesh information at curved domain boundaries are discussed and in the second part, the parallel concept and strong scaling of the simulation software is shown.

Meshes with linear edges are the standard of today's state-of-the-art meshing software. Industrial applications typically imply geometrically complex domains, mostly described by curved domain boundaries. To apply high order methods in this context, the geometry - in contrast to classical low order methods - has to be represented with a high order approximation, too. Therefore, a high order element mapping has to be used for the discretization of curved domain boundaries. The main idea here is to rely on existing linear mesh generation and provide additional information to produce high order curved elements, where several techniques also involving the ANSA mesh generator are shown. A very promising candidate for future numerical solvers in computational fluid dynamics is the family of high order discontinuous Galerkin (DG) schemes. They are locally conservative schemes, with a continuous polynomial representation within each element and allow a discontinuous solution across element faces. Elements couple only to direct face neighbors, and the discontinuity is resolved via numerical flux functions. One of the reasons making high order DG schemes attractive for the simulation of fluid dynamics is their parallel efficiency.As future applications in fluid dynamics comprise the resolution of three-dimensional unsteady e_ects and are increasingly complex, the simulations require more and more computing resources, and weak and strong scalability of the numerical method becomes extremely important.

Therefore, the parallelization concept of the DG code FLEXI is described. A new domain decomposition strategy based on space-filling curves is introduced, and is shown to be simple and flexible. A thorough parallel performance analysis conforms that the overall implementation scales perfectly. Ideal speed-up is maintained for high polynomial degrees, up to the limit of one element per core. As the DG scheme only communicates with direct neighbors, the same parallel efficiency is found on both cartesian meshes as well as fully unstructured meshes. The findings underline that the proposed Discontinuous Galerkin scheme exhibit a great potential for highly resolved simulations on current and future large scale parallel computer systems.

**BETA CAE Systems S.A.**
Kato Scholari, Thessaloniki, GR-57500 Epanomi, Greece
Tel: +30-2392-021420, +30-2311-993300, Fax: +30-2392-021828
Email: ansa@beta-cae.gr, URL: http://www.beta-cae.gr