# 5th ANSA & μETA INTERNATIONAL CONFERENCE

5-7 JUNE 2013, THE MET HOTEL
THESSALONIKI, GREECE

## Programme & Abstracts

BETA CAE Systems SA

# 5th ANSA & µETA INTERNATIONAL CONFERENCE

June 5-7, 2013, The MET HOTEL, Thessaloniki, Greece

# PROGRAMME & ABSTRACTS

# Contents

# Welcome

Dear Attendees,

BETA CAE Systems S.A. welcomes you to our biannual ANSA & µETA International Conference. Currently in our 5th appointment, we are proud that this tradition has been a recognized event in the CAE industry calendar, and that through our conferences we contribute in bringing the CAE community closer.

This conference is a part of our efforts to be close to our customers and partners in order to continue to provide you with products that meet your expectations in offering solutions that are innovative, technically advanced, user friendly, and easy to implement in your working ways. It is also our aim to communicate our company's identity and help you discover the competitive advantages that can be realized by using our products.

During the three days of the Conference, more than 45 technical papers will be presented outlining the latest advances in CAE strategy, methodology, techniques, and applications related to our products. Additionally, in our technical -focused on numerous CAE disciplines- gallery, you will have the opportunity to engage in private or open technical discussions and demonstrations, to interact with our executive, development, and service engineers, and to promote your interests and requests for future developments.

We would like to express our gratitude to all those who contributed with technical papers and presentations, and especially to the Keynote Speakers: Toshiro Araki from Nissan Motor Co., Frank Sautter from Dr. Ing. h.c. Porsche AG, and Josef Fuerfanger from BMW Group, who all have distinguished careers and positions in their organizations.

Loyal to our traditions, the "Greek night" social event will be hosted in day two and will offer the opportunity to get to know each other better.

We would like to thank you all for attending our conference. We wish you a pleasant stay and we look forward to seeing you in our next conference in 2015.

Please feel free to contact us for any issue regarding your stay and we will do all we can to assist you.

# Programme

## Tuesday, June 4

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

## Wednesday, June 5

| | | |
|---|---|---|
| 8:30 - 9:00 | **Registration** \| Foyer | |
| | **Session 1** \| Maistros A<br>chair: C. Sferidou | |
| 9:00 - 9:30 | **Opening Speech**<br>D. Angelis, President<br>BETA CAE Systems S.A., Greece | |
| 9:30 - 10:00 | **An insight to applications based on ANSA to the BMW CAE processes**<br>Josef Fuerfanger[1]*, Marcel Meder[1], David Becherer[1], Michael Tryfonidis[2]<br>[1]BMW Group, Germany<br>[2]BETA CAE Systems S.A., Greece | |
| 10:00 - 10:30 | **Latest developments in ANSA**<br>K. Kiouptsidis<br>BETA CAE Systems S.A., Greece | |
| 10:30 - 11:00 | **Coffee Break & Technical discussions** \| Foyer & Zephyros | |
| | **Session 2A** \| Maistros A<br>chair: I. Makropoulou | **Session 2B** \| Maistros B<br>chair: N. Drivakos |
| 11:00 - 11:30 | **Spotweld modeling with implemented rupture criteria**<br>Jan Morawski[1]*, Beate Lauterbach[1], Ilka Schwarzer[1], Laia Ramon-Villalonga[1], Michael Tryfonidis[2]<br>[1]Adam OPEL AG, Germany<br>[2]BETA CAE Systems S.A., Greece | **Mapping of pressure distributions and displacements using ANSA and µETA**<br>Reinhard Wersching[1] (presented by Stavros Kleidarias[2])<br>[1]Audi AG Neckarsulm, Germany<br>[2]BETA CAE Systems S.A., Greece |
| 11:30 - 12:00 | **Validate simulation techniques of a mobile explosive containment vessel**<br>David Karlsson<br>DYNAmore Nordic AB, Sweden | **Shape optimization for life cycle increase and weight reduction of engine components using TOSCA Structure and ANSA**<br>Georgi Chakmakov<br>FE-DESIGN Bulgaria OOD, Bulgaria |
| 12:00 - 12:30 | **Introduction of JNCAP and the comparison with Euro NCAP**<br>Sadayuki Ujihashi<br>Tokyo Institute of Technology, Japan | **Research on turbine blade strength and steady state response by Finite Element Method**<br>Jian Sun, Rong Tang, Wei Liu (presented by He Gexue)<br>Beijing FEAonline Engineering Co., Ltd, China |
| 12:30 - 13:00 | **Development of automatic or efficient tool for checking crash analysis models by using ANSA**<br>Yoshikazu Nakagawa<br>Honda R&D Co., Ltd. Automobile R&D Center, Japan | **A light commercial vehicle wheel design optimization for weight, NVH and durability considerations**<br>Muslum Yaman*, Burak Yegin<br>FORD OTOSAN, Turkey |
| 13:00 - 14:30 | **Lunch** \| The MET Hotel Restaurant | |
| | **Session 3A** \| Maistros A<br>chair: G. Korbetis | **Session 3B** \| Maistros B<br>chair: Y. Kolokythas |
| 14:30 - 15:00 | **ANSA kinematic tool & morphing - enabling conceptual vehicle frontal design for pedestrian safety**<br>Nick Kalargeros*, Jack Perry<br>Jaguar Land Rover Ltd, UK | **Model checks and results evaluation for strength and durability analysis through automated reports with ANSA & µETA**<br>Ryota Nishioka[1]*, Antonios Perifanis[2]*<br>[1]HONDA R&D Co., Ltd., Japan<br>[2]BETA CAE Systems S.A., Greece |
| 15:00 - 15:30 | **Multi-objective optimization in crash safety analysis using modeFRONTIER interfaces for ANSA and µETA**<br>Alberto Clarich[1], Zhongli Wen[1]*, Dimitris Georgoulas[2], George Korbetis[2]<br>[1]ESTECO SpA, Trieste, Italy<br>[2]BETA CAE Systems S.A., Greece | **Composite model building for automotive CAE**<br>Stuart Davies<br>Penso Consulting Ltd, UK |
| 15:30 - 16:00 | **Coffee Break & Technical discussions** \| Foyer & Zephyros | |
| | **Session 4A** \| Maistros A<br>chair: S. Chatzimoysiadis | **Session 4B** \| Maistros B<br>chair: A. Perifanis |
| 16:00 - 16:30 | **Driving multidisciplinary optimization using ANSA - End user case studies**<br>Ravi Nimbalkar[1]*, Robert Lietz[2], Christina Nguyen[2], Rodolfo Palma[2]<br>[1]BETA CAE Systems USA Inc., USA<br>[2]Ford Motor Company, USA | **Concept BiW development using new CAE tools**<br>Wajid Mohammed[1], Trivikram Nanjangud[2]*<br>[1]Satyam Venture Engineering Services India Pvt. Ltd, India<br>[2]Xitadel CAE Technologies India Pvt. Ltd, India |
| 16:30 - 17:00 | **Important aspects in parametric shape optimization**<br>Christine Schwarz<br>ISKO engineers, Germany | **Streamlined process for creating a results-based optimised mesh**<br>Emmanouil Kastrinakis<br>BETA CAE Systems S.A., Greece |
| 17:00 - 17:30 | **A vacuum vessel's optimization with ANSA and ISIGHT**<br>Rong Tang, Xing Hao (presented by He Gexue)<br>Beijing FEAonline Engineering Co., Ltd, China | **Addressing multiple contact modelling in reducers**<br>A. Mihailidis[1], I. Neratzis[2], E. Athanasopoulos[1]*, C. Tegos[1]<br>[1]Aristotle University of Thessaloniki, Greece<br>[2] BETA CAE Systems S.A., Greece |
| 17:30 - 18:30 | **Session 5** \| Zephyros | |
| | Technical discussions, demonstrations and meetings | |
| 20:00 - 21:00 | **Dinner** \| The MET Hotel Restaurant | |

## Thursday, June 6

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|---|---|---|
| | **Session 6** \| Maistros A<br>chair: V. Pavlidis | |
| 9:00 - 9:30 | **Virtual Prototyping**<br>Frank Sautter<br>Dr. Ing. h.c. F. Porsche Aktiengesellschaft, Germany | |
| 9:30 - 10:00 | **Latest developments in µETA**<br>D. Katramados<br>BETA CAE Systems S.A., Greece | |
| 10:00 - 10:30 | **SPDRM v1.0: CAE Workflow Management becomes a reality**<br>Irene Makropoulou<br>BETA CAE Systems S.A., Greece | |
| 10:30 - 11:00 | **Coffee Break & Technical discussions** \| Foyer & Zephyros | |
| | **Session 7A** \| Maistros A<br>chair: S. Chatziangelidis | **Session 7B** \| Maistros B<br>chair: V. Skaperdas |
| 11:00 - 11:30 | **Advanced interior head impact analyses at Volvo Cars Safety Centre**<br>Anneli Högberg[1]*, Choo Yin Khoo[1 2]<br>[1]Volvo Car Corporation, Sweden<br>[2]XDIN, Sweden | **Deployment of optimization techniques in the Aero/Thermo development at FORD**<br>Burkhard Hupertz<br>Ford Werke GmbH, Germany |
| 11:30 - 12:00 | **Positioning of car seat structures with ANSA**<br>S. Sinne*, F. Richter<br>Brose Fahrzeugteile GmbH & Co. KG, Coburg, Germany | **VSAERO Implementation within the ANSA Environment**<br>Yash Khandhia[1]*, Anna Robinson[2]<br>[1]Applied Computing & Engineering Ltd., England<br>[2]Stark Aerospace, Inc. Analytical Methods Division, USA |
| 12:00 - 12:30 | **Bird Impact Analysis**<br>Frédérick Jegou<br>Safran Engineering Services, France | **Investigation of mesh influence for heat transfer in pipe flow**<br>Björn Jedvik<br>Semcon Caran AB, Sweden |
| 12:30 - 13:00 | **R66 ANSA Toolbox for bus body development**<br>Magnus Hult<br>SCANIA CV AB, Sweden | **Applications of ANSA in the Aerodynamic and Aerothermal Development of new models: Experiences at CRF and FGA**<br>Enrico Ribaldone<br>Centro Ricerche Fiat S.C.p.A., Italy |
| 13:00 - 13:10 | **Group Photo** | |
| 13:10 - 14:30 | **Lunch** \| The MET Hotel Restaurant | |
| | **Session 8A** \| Maistros A<br>chair: S. Seitanis | **Session 8B** \| Maistros B<br>chair: K. Haliskos |
| 14:30 - 15:00 | **Safety Model Build Process using Teamcenter-ANSA Integration**<br>Zoran Petrovic[1]*, Ioannis Charalampidis[2]<br>[1]SIEMENS PLM, Germany<br>[2] BETA CAE Systems S.A., Greece | **The CFD simulation of the flow around the aircraft using OpenFOAM and ANSA**<br>Adam Kosík<br>Evektor s.r.o., Czech Republic |
| 15:00 - 15:30 | **CAE Data & Process management with ANSA**<br>Srikanth Raghotham<br>Volvo India Private Limited, Volvo Group Trucks Technology, India | **Fluid-solid-heat coupling simulation of a furnace**<br>Zimin Zhan, Rongbo Bai (presented by He Gexue)<br>Beijing FEAonline Engineering Co., Ltd, China |
| 15:30 - 16:00 | **Coffee Break & Technical discussions** \| Foyer & Zephyros | |
| | **Session 9A** \| Maistros A<br>chair: K. Kiouptsidis | **Session 9B** \| Maistros B<br>chair: E. Chatzivasiloglou |
| 16:00 - 16:30 | **Creation and evaluation of part envelopes through an automated process**<br>Apostolis Paraschoudis<br>BETA CAE Systems S.A., Greece | **Adaptive finite element method for Aerospace and Aeroacoustic applications**<br>Rodrigo Vilela de Abreu*, Niclas Jansson, Johan Hoffman, Johan Jansson<br>Royal Institute of Technology, Sweden |
| 16:30 - 17:00 | **A pre-processing interface embedded in ANSA for acoustic radiation analyses with RADACT**<br>Chryssa Sferidou*, Tassos Sarridis<br>BETA CAE Systems S.A., Greece | **Numerical simulation of the BETA car cabin thermal comfort achieved by HVAC and/or open windows at cruising speeds**<br>Mahmoud Abokhedr, Nicholas Mitroglou*, Manolis Gavaises<br>School of Engineering and Mathematical Sciences City University London, UK |
| 17:00 - 17:30 | **ANSA and µETA as a CAE software development platform**<br>Michael Giannakidis*, Yianni Kolokythas<br>BETA CAE Systems S.A., Greece | **CFD simulation of a bubbling fluidized bed biomass gasifier using ANSA meshing and ANSYS FLUENT**<br>Dimitrios Mertzis[1], Savvas Savvakis[2]*, Zissis Samaras[1]<br>[1]Laboratory of Applied Thermodynamics, Mechanical Engineering Dpt., Aristotle University of Thessaloniki, Greece<br>[2]BETA CAE Systems S.A., Greece |
| 17:30 - 18:30 | **Session 10** \| Zephyros | |
| | Technical discussions, demonstrations and meetings | |
| 20:00 - | **Dinner - Social Event: "Greek Night"** \| The MET Hotel Roof Pool Bar | |

## Friday, June 7

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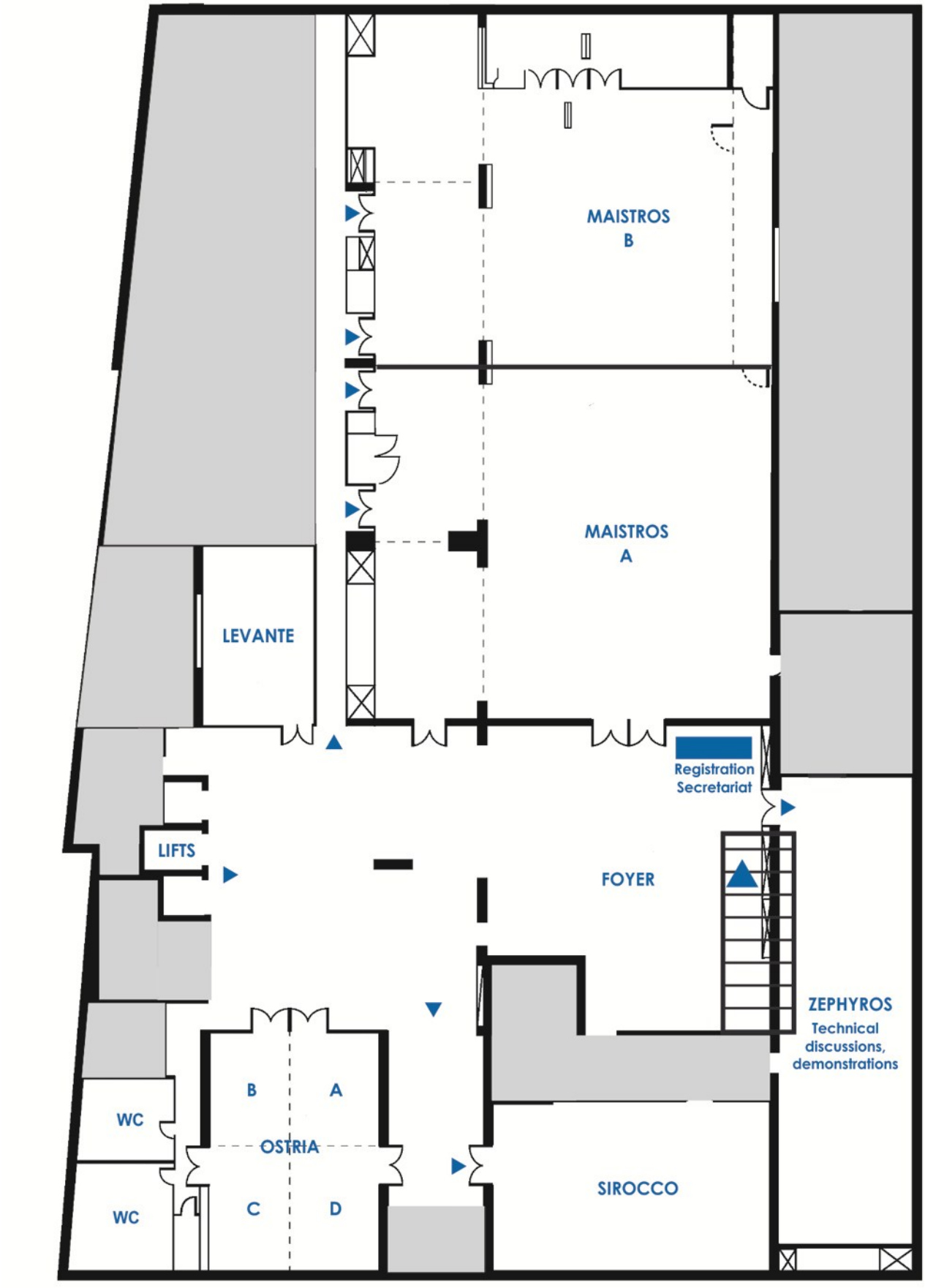
| | **Session 11** \| Maistros A<br>chair: M. Tryfonidis | |
| 9:00 - 9:30 | **CAE contribution to the mid-term plan named "NISSAN POWER 88"**<br>Toshihiro Araki<br>Nissan Motor Co., Ltd, Japan | |
| | **Session 12A** \| Maistros A<br>chair: M. Tryfonidis | **Session 12B** \| Maistros B<br>chair: I. Charalampidis |
| 9:30 - 10:00 | **Vehicle dynamics and durability simulations using ANSA and Abaqus**<br>Harish Surendranath<br>Dassault Systèmes SIMULIA Corp., USA | **Modelling and design optimization of a formula student race car**<br>K. Arvanitopoulos-Darginis[1]*, L. Ntziachristos[1,2], A. Pouchias[1], K. Zisis[1], C. Mantelakis[1], K.-E. Karyotakis[1], N. Michailidis[1,3]<br>[1] Aristotle Racing Team<br>[2] Laboratory of Applied Thermodynamics, Mechanical Engineering Dpt.<br>[3] Physical Metallurgy Laboratory, Mechanical Engineering Dpt.<br>Aristotle University of Thessaloniki, Greece |
| 10:00 - 10:30 | **Following nature's lead for ultimate design efficiency – The ACP process as applied to FSV**<br>Akbar Farahani[1]*, Jody Shaw[2]<br>[1] ETA Inc., USA<br>[2] U. S. Steel, USA | **New techniques to improve modelling, design and optimization of complex thermoplastic components**<br>Marios Lambi*, Daniel Dubiel, Jim McGuire<br>BASF Engineering Plastics, North America |
| 10:30 - 11:00 | **Coffee Break & Technical discussions** \| Foyer & Zephyros | |
| | **Session 13A** \| Maistros A<br>chair: T. Sarridis | **Session 13B** \| Maistros B<br>chair: S. Savvakis |
| 11:00 - 11:30 | **Recent advances in re-analysis methods for NVH including shape and topology optimization**<br>Zissimos Mourelatos[1]*, Santosh Patil[2], John Skarakis[2]<br>[1]Oakland University, Rochester MI, USA<br>[2]BETA CAE Systems USA, Inc., USA | **Numerical simulation of blood flow in lad models with different degrees and location of stenosis**<br>Konstantinos Papadopoulos*, Nicholas Mitroglou, Manolis Gavaises<br>School of Engineering and Mathematical Sciences City University London, UK |
| 11:30 - 12:00 | **NVH Model integrating and configuration complexity handling tool using ANSA**<br>Sundar Chanduri[1], Anil Kumar[1], Santosh Patil[2]*<br>[1]Chrysler Group LLC, USA<br>[2]BETA CAE Systems USA, Inc., USA | **Finite element modelling of a total wrist implant**<br>M. K. Gislason*, D. H. Nash<br>University of Strathclyde, Department of Mechanical and Aerospace Engineering, Glasgow, UK |
| 12:00 - 12:30 | **Conceptual car design at BMW with focus on NVH performance**<br>M. Kroiss[1]*, L. Cremers[2], V. Evangelou[3]<br>[1] IABG mbH, Strength, Simulation, Method Development, Germany<br>[2] BMW Group, Vehicle NVH Department, Germany<br>[3] BETA CAE Systems S.A., Greece | **Finite element based implant optimization and preoperative preparation**<br>Alexander Tsouknidas[1]*, Savvas Savvakis[2], Kleovoulos Anagnostidis[3], Ioannis Asaniotis[2], Antonios Londos[4], Nikolaos Michailidis[1]<br>[1]Mechanical Engineering Dpt., Aristotle University Thessaloniki, Greece<br>[2]BETA CAE Systems S.A., Greece<br>[3]Cardiff Spine Unit, University Hospital of Wales, University Hospital Llandough, UK<br>[4]Department of Mechanical Engineering, Frederick University, Cyprus |
| 12:30 - 13:00 | **Squeak & Rattle simulation at VOLVO Car Corporation using the E-LINE™ method**<br>Jens Weber[1]*, Casper Wickman[2]<br>[1]ÅF, Technical Analysis, Sweden<br>[2]Volvo Car Corporation, Sweden | |
| | **Session 14** \| Maistros A<br>chair: S. Saltiel | |
| 13:00 - 13:20 | **Future developments in ANSA and µETA**<br>C. Kolovos, Vice President<br>BETA CAE Systems S.A., Greece | |
| 13:20 - 13:30 | **Closing Remarks** | |
| 13:30 - 14:30 | **Lunch** \| The MET Hotel Restaurant | |

# Venue Plan

# THE MET HOTEL, site map



# Abstracts

Session 1

# AN INSIGHT TO APPLICATIONS BASED ON ANSA TO THE BMW CAE PROCESSES

**[1]Josef Fuerfanger*, [1]Marcel Meder, [1]David Becherer, [2]Michael Tryfonidis**
[1]BMW Group, Germany
[2]BETA CAE Systems S.A., Greece

ABSTRACT –
Mr. Josef Fuerfanger is heading the Simulation Concepts and Architecture deparment at BMW in Munich.
The presentation includes a walkthrough on the CAE-processes in BMW that involve ANSA and µETA software tools so far: From CAD conversion up to batch meshing as well assembly procedures, composites post processing, results mapping techniques, cfk-automatic post processing routines, comparisons in pre- and post- processing level any many more...
Special reference will be made on the import of the kinematic information of mechanisms into ANSA, for assembly as well as positioning purposes.

Session 2A

# SPOTWELD MODELING WITH IMPLEMENTED RUPTURE CRITERIA

**[1]Jan Morawski*, [1]Beate Lauterbach, [1]Ilka Schwarzer, [1]Laia Ramon-Villalonga, [2]Michael Tryfonidis**
[1]Adam OPEL AG, Germany
[2]BETA CAE Systems S.A., Greece

KEYWORDS –
Spotweld, Rupture, Heat affected zone, Automated Spotweld realisation

ABSTRACT –
In today's automotive cae models spotweld failure prediction is crucial for vehicle performance assessments. Coming from single coupon tests ANSA is utilized to bring all necessary information around the spotwelds definition (e.g. weld partners, nugget diameter, sheet and nugget material properties and heat affected zones) together in the full vehicle CAE model.
The necessity of this very detailed modelling is shown exemplarily with seat console weld rupture within the FMVSS207/210 test regulation. Different approaches of modelling techniques where investigated.
This process is implemented efficiently in an automated way by means of ANSA scripting functionality.

# VALIDATE SIMULATION TECHNIQUES OF A MOBILE EXPLOSIVE CONTAINMENT VESSEL

**David Karlsson**
DYNAmore Nordic AB, Sweden

KEYWORDS –
Hexa, Map, Explosive, LS-DYNA

ABSTRACT –
A Mobile Explosive Containment Vessel (MECV) is a chamber for protection against effects caused by explosions and is used to safely secure, contain, transport, store or test explosive materials. The MECV has been tested for an 8 kg TNT equivalent and strain levels at several positions were measured. These test data was used for comparison and validation of two simulation techniques and if necessary improve the simulation models.

The detailed geometry was simplified and volume meshed with nearly one million hexa elements in ANSA using several functions for structured mesh. The simulations were performed with the nonlinear dynamic finite element software LS-DYNA. The first well-applied technique using an axisymmetric model for the explosive blast load and then a script to map the blast load to a 3D structure simulation showed after some small modifications good agreement to the test. The second much more time-consuming technique with the blast load and the structure in the same analysis using fluid-structure interaction lead to significant lower strain levels compared to the test. A more detailed parameter study was performed to improve the simulation results.

As conclusion we now have two validated simulation techniques and procedures to make realistic explosive simulations of containment vessels.

# INTRODUCTION OF JNCAP AND THE COMPARISON WITH EURO NCAP

**Sadayuki Ujihashi**
Tokyo Institute of Technology, Japan

KEYWORDS –
New Car Assessment Program, JNCAP, Euro NCAP, Passive Safety, Frontal Impact, Side Impact, Rear Impact, Active Safety

ABSTRACT –
NCAP was launched in 1995 by conduction the full wrap frontal impact. Since then various tests including side impact, offset frontal impact and etc. have been added into the program. In this presentation the progress in the past 18 years and the concept of JNCAP and also the foresight of JNCAP will be introduced in detail.
JNCAP has been watching the movement of Euro NCAP and other countries. Particularly this time Euro NCAP is focused and the difference between JNCAP and Euro NCAP will be shown for European delegates. In the presentation not only passive impact but also active safety will be emphasized according to the recent worldwide trends.

# DEVELOPMENT OF AUTOMATIC OR EFFICIENT TOOL FOR CHECKING CRASH ANALYSIS MODELS BY USING ANSA

**Yoshikazu Nakagawa**
Honda R&D Co., Ltd. Automobile R&D Center, Japan

KEYWORDS –
Crash analysis, Model check, ANSA Script, ANSA Task Manager

ABSTRACT –
Recently, full vehicle model for crash analysis become more detailed and more complex to improve analysis accuracy. Especially, faithful reproduction of suspension behavior in crash analysis is expected.
There are two problems in above situation. 1st one is the way how we can prevent defect which is hardly found through conventional check. 2nd one is that the man-hour of model checking increases as the number of modeled parts increases.
To address the problems, first we made new procedure to compute some mechanism of each parts and developed a tool to increase efficiency of the procedure. Additionally, we developed another tool to automate model checking and cut down the man-hour of it.

Session 2B

# MAPPING OF PRESSURE DISTRIBUTIONS & DISPLACEMENTS USING ANSA & µETA

**Reinhard Wersching[1] (presented by Stavros Kleidarias[2])**
[1]Audi AG Neckarsulm, Germany
[2]BETA CAE Systems S.A., Greece

KEYWORDS –
crankshaft strength analysis, results mapping, mode shapes, ADAMS/Flex

ABSTRACT –
In strength analyses of multi-cylinder engine crankshafts, in which each crankshaft-pin is examined separately, the workload can be reduced by using the same initial conditions for each pin. In this particular case the initial conditions - pressure distribution - are taken from a discrete run of an Elasto-Hydro-Dynamic (EHD) strength calculation and are mapped, using ANSA, on the FE model of the crankshaft for static analysis only.
Going into further details, dynamic analyses are necessary. The output of an ADAMS analysis with flexible bodies is used to generate static loadcases for stress calculation based on enforced displacements. Mode shape output from ADAMS/Flex plus modal coordinates from ADAMS are processed with Unix and MATLAB scripts which create the Nastran deck to run. The shortcoming of using 1st order elements in the Nastran deck can be overcome by introducing META in the process: META can map the nodal displacements of the 1st order model to a 2nd order FE model which yields a much more accurate analysis result.

# SHAPE OPTIMIZATION FOR LIFE CYCLE INCREASE AND WEIGHT REDUCTION OF ENGINE COMPONENTS USING TOSCA STRUCTURE AND ANSA

**Georgi Chakmakov**
FE-DESIGN Bulgaria OOD, Bulgaria

KEYWORDS –
shape optimization, plastic strain, mass reduction, exhaust manifold

ABSTRACT –
Attempting to provide more efficient vehicles and because of emission laws, lots of car manufacturers develop engine downsizing. As a result, thermomechanical failure of exhaust manifolds and turbocharger housings is getting more and more critical. A good optimization strategy is necessary to significantly increase the number of cycles until cracks occur while simultaneously, the possibility of mass reductions is also pursued. For high temperature applications like gasoline engines, one main effect that influences the fatigue behavior is the plastic strain amplitude in the material. This effect can be taken into account in a low cycle fatigue analysis and thus be integrated directly into a shape optimization loop with the optimization software TOSCA Structure. Setting up such complex optimization task requires lots of considerations during its pre-processing. The fully integration of the TOSCA Structure optimization task in ANSA allows fast and reliable pre-processing of the optimization setup and has thereby established as standard pre-processing tool for TOSCA optimization tasks. This presentation shows a typical optimization procedure for thermomechanical applications on engine components using the performance of ANSA as pre-processor and TOSCA Structure. As a result, the possibility of life cycle increase and mass reduction of an exhaust manifold and turbocharger housing by means of non-parametric shape optimization is shown.

# RESEARCH ON TURBINE BLADE STRENGTH AND STEADY STATE RESPONSE BY FINITE ELEMENT METHOD

**Jian Sun*, Rong Tang, Wei Liu**
Beijing FEAonline Engineering Co., Ltd, Beijing, China

KEYWORDS –
Turbine Blade, Strength, Steady State Response, ANSA, ABAQUS

ABSTRACT –
The strength and steady state response analysis about a type of turbine blade was analyzed in this paper based on finite element method(FEM). In order to obtain the perfect simulation results the preprocess was conducted in ANSA software including geometry cleanup, meshing, loading and other solving settings, then the computational model was calculated in ABAQUS software. The simulation results show good agreement with the experimental results which indicated that the finite element analysis can provide a reference for turbine blade design and optimization.

# A LIGHT COMMERCIAL VEHICLE WHEEL DESIGN OPTIMIZATION for WEIGHT, NVH and DURABILITY CONSIDERATIONS

**Muslum Yaman*, Burak Yegin**
FORD OTOSAN, Turkey

KEYWORDS –
Modal Analysis, Weight Optimization of Wheel, FRF, Durability Simulations, Vibration

ABSTRACT –
In recent years, competition in the automobile market is getting increase with restpect to fuel economy, especially for the light commercial vehicles. Moreover, there is a significant necessity about reducing fuel consumption level for automobile companies. The weight of a vehicle is one of the most important factor that affecting the fuel economy.

The weight minimization of wheel has more effective than the weight minimization of elsewhere in a vehicle due to the rotational moment of inertia effect during motion. Therefore, the wheel design should be optimized by considering fundamental attributes of a light commercial vehicle such as NVH, Durability and Weight.

In this study, the modal correlation between CAE simulations and tests is performed. For this purpose, mode shapes and their natural frequencies obtained from CAE simulations are compared with experimental modal analysis results. After the correlation is provided, wheel design optimization proposals are given by considering NVH and Durability criteria.

Session 3A

# ANSA KINEMATIC TOOL & MORPHING – ENABLING CONCEPTUAL VEHICLE FRONTAL DESIGN FOR PEDESTRIAN SAFETY

**Nick Kalargeros*, Jack Perry**
Jaguar Land Rover Ltd, UK

KEYWORDS –
Pedestrian Safety, Conceptual Vehicle Design, PDP Decision Making, ANSA Kinematic Tool, ANSA Morphing

ABSTRACT –
Over the last decade, the pedestrian safety requirement for vehicle design has become increasingly important via legal regulations and consumer evaluation testing. However a need for high pedestrian performance can have a significant influence on a vehicle's frontal design and structure.

Current reality is that PDP cycles get shorter, whilst the need to develop unique and sophisticated vehicle frontal design intensifies. A crucial enabler to address this is the ability to qualify and quantify pedestrian performance at the conceptual phase. To succeed in this, knowledge and understanding of vehicle frontal design and structure is necessary. However such an approach is demanding on two fronts. The first is in relation to the detailed performance in terms of external geometry and generic load paths. The second is in relation to the detailed kinematic understanding in terms of impact energy management characterization and implementation.

Vehicle frontal design knowledge acquisition and understanding at the conceptual phase can be problematic since detailed parts and assemblies are not readily available. However ANSA morphing and kinematic tools aid significantly this approach by providing some efficient and effective means to compile numerous conceptual studies. This paper reports initial experiences and findings from the application and use of ANSA kinematic tool and morphing to such pedestrian studies.

# MULTI-OBJECTIVE OPTIMIZATION IN CRASH SAFETY ANALYSIS USING MODEFRONTIER INTERFACES FOR ANSA AND META

**[1]Alberto Clarich, [1]Zhongli Wen*, [2]Dimitris Georgoulas, [2]George Korbetis**
[1]ESTECO SpA, Trieste, Italy
[2]BETA CAE Systems S.A., Greece

KEYWORDS –
Multi-Objective Optimization, Bezier Parameterization, Game Theory, Response Surfaces, Crash Simulation

ABSTRACT –
This paper describes the integration and application to an industrial case of the multi-objective design environment software modeFRONTIER with ANSA mesh morphing and µETA post processor.
In this environment, several common CAE software can be easily integrated in the process flow through the available direct interface nodes, including ANSA and µETA, allowing the automatic update of morphing parameters and execution of the CAE numerical simulations. The available multi-objective optimization algorithms 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 an application of modeFRONTIER combined with ANSA in Crash Safety Analysis is illustrated. In particular, the distribution of spotwelds on a b-pillar is optimized in order to reduce the maximum intrusion during a side impact, minimizing at the same time the number of spotwelds.
The paper will illustrate an efficient parameterization methodology based on Bezier curves, in order to parameterize the spotwelds distribution density curve with the lowest number as possible of parameters and with the highest regularity.
In addition, one of the most efficient multi-objective optimization algorithms available in modeFRONTIER will be used, in order to obtain the optimal results with the lowest number of design simulations: these include Game Theory (MOGT), Genetic Algorithm (MOGA-II) and FAST algorithms (based on Genetic Algorithm and Response Surfaces).

Session 3B

# MODEL CHECKS AND RESULTS EVALUATION FOR STRENGTH AND DURABILITY ANALYSIS THROUGH AUTOMATED REPORTS WITH ANSA & µETA

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KEYWORDS –
Automatic report generation, reduction of human error, model check, results evaluation, time reduction

ABSTRACT –
CAE significance has gained ground in the recent years through the introduction of the No Prototype car concept. Modern models consist of numerous components with different design variants and CAE needs to face the challenge of minimizing turnaround times and providing error-free processes that will allow engineers to go through simulation results in an effortless and efficient way.

To address these needs, an automated process was built-up to perform a number of model checks and results queries and present their output in PowerPoint reports. Target components are subframe, BiW and tailgate. Input of parameters is achieved through a spreadsheet file to provide a more user-friendly environment and reduce the chance of error. The procedure, driven by µETA, is executed in batch mode allowing the use of grid computing for the efficient utilization of resources, whereas ANSA is launched internally during execution. A series of actions take place in both software to extract modelling information, load and combine results to evaluate connections and regions of the model and display the above in report slides through images, tables and graphs.

The new approach resulted to a remarkable reduction of time, an augmentation in modelling quality, a more supervisory presentation of the results and a process less prone to human errors. Current functionality is planned to expand within HONDA for the implementation of similar processes for other components.

# COMPOSITE MODEL BUILDING FOR AUTOMOTIVE CAE

**Stuart Davies**
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KEYWORDS –
Composite, Pre/Post Processing, Modelling, Scripting, Optimisation

ABSTRACT –
Composite materials are being more heavily utilised in the automotive industry. These lightweight and durable materials are being used on a wider basis and are supporting advances in optimising structures.
It is clear that in the near future composite materials will be a common factor in automotive engineering.

Penso are at the forefront of this innovation, developing as a company and working together with major OEM's to deliver innovative and ground breaking ideas and projects.

CAE Model build plays a major part in the development of both design and engineering. Accurate analysis drives the development process forward, delivering performance with real world value. This is particularly crucial with an expensive resource such as carbon composites.

Using the correct tools for the procedure are essential, improving techniques and effective control of model data.

BETA CAE Systems software has played a key part in this process by helping with model build efficiency within both its pre and post processing capabilities. Handling all relevant model data during the process and maintaining run information is crucial.

Iterative runs and analysis are a major component of product development. The advanced scripting tools developed at Penso enable rapid model build which enhances productivity and allows a wider search envelope to fully validate designs and understand failure modes.

These advances help us to achieve results previously deemed to be unobtainable.

Session 4A

# DRIVING MULTIDISCIPLINARY OPTIMIZATION USING ANSA – END USER CASE STUDIES

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[2]Ford Motor Company, USA

KEYWORDS –
Shape optimization, Morphing, Multidisciplinary optimization, DOE studies

ABSTRACT –
This paper presents case studies from the automotive industry showcasing the latest developments in ANSA's morphing and optimization capabilities used to drive the multidisciplinary optimization in the product design and development process.

The automotive industry is a very dynamic and competitive environment which is perpetually driven to produce safer and more fuel efficient vehicles while keeping costs low. There are a lot of factors which drive the design of the vehicle and it becomes a very demanding task to optimize this design by taking into account all the variables which are interdependent and influence fuel economy, safety, and overall cost.

The latest developments in ANSA and computing capabilities have enabled engineers to perform complex simulations which were not possible earlier. The use of these advanced techniques allows engineers to gain better insight for improving product designs. In a complex setup to find a multidisciplinary optimization solution, one of the important variables is the shape and size of different components of the vehicle. Many automotive companies, including Volkswagen, Audi, BMW, and Ford have adopted morphing techniques to perform shape optimization.

## Key Enablers

The advancements in ANSA have provided engineers with a single integrated environment to perform all the necessary tasks including shape morphing. This makes automating the entire process seamless and eliminates the need to switch between multiple software packages which can reduce the robustness of the process and lead to errors.

Following are the latest state-of-the-art advancements in ANSA which are used by many automotive companies worldwide and are key enablers which make the automated shape optimization process work.

1. Efficient re-shaping of both FE and/or Geometry based models
2. Precise control over dimension changes
3. Parametric morphing for complex shape changes
4. Maintaining integrity of a variety of different weld types
5. Re-welding by following predefined welding guidelines
6. Adding/removing welds based on new dimensions
7. Maintaining smooth mesh on morphed surfaces for external aerodynamic applications
8. Full model build-up capability in an integrated environment
9. Automated mesh and model quality checks and fixes
10. Support for user scripts to perform additional actions
11. Ability to build different discipline models from same base model
12. Ability to create library of complete meshed models for DOE studies

13. Automated tasks to perform morphing and final FE model building
14. Robust process for performing DOE's and optimization studies
15. Batch mode for driving the model variants using the "design variable" ASCII file interface
16. Easy interface for coupling this process with commercial optimization software
17. Writing reports about the weight, welds, dimension changes, etc.

The ability to automate the construction of model variations from a single initial base model without additional input from the user is critical to the success of this process. All the above key enablers will be discussed with reference to the projects done with various clients.

# IMPORTANT ASPECTS IN PARAMETRIC SHAPE OPTIMIZATION

**Christine Schwarz**
ISKO engineers, Germany

KEYWORDS –
parametric shape optimization, morphing, design of experiments, response surface modelling, robust design

ABSTRACT –
An essential mission in virtual product development is to identify an optimal design with minimal weight that meets multiple and often conflicting requirements.

Beside the variation of material and physical properties, the challenge is to realize geometric modifications in an automated process with commercial software tools. This presentation gives an introduction to important aspects in parametric shape optimization and a realistic application example on efficient shape optimization methods based on finite element morphing.

In this paper the entire process chain ranging from choosing parameters and integrating the simulation in the optimization process to analyzing the results of a global optimization strategy are shown. As the requirements for each component constantly increase the use of multi objective optimization strategies in combination with response surface models becomes more and more important. This process also includes considering small perturbations in the geometrical shape and distributed parameters to evaluate the robustness and reliability of a given design or the determined optimum.

# A VACUUM VESSEL'S OPTIMIZATION WITH ANSA AND ISIGHT

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KEYWORDS –
ANSA, Task Manager, MORPH, optimization

ABSTRACT –
This paper discusses the design optimization process that was followed for a vacuum vessel structure. The ANSA software was used for the generation of the mesh and the set-up of the optimization task. The ABAQUS software was used to solve the model, and the µETA one to understand and analyze the results and identify areas to reduce the structures weight. Through the ANSA MORPH function, a parameterized model was established, the optimize interface was set in ANSA &µETA and the optimization task on the structure weight loss in ISIGHT.

Session 4B

# CONCEPT BiW DEVELOPMENT USING NEW CAE TOOLS

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KEYWORDS –
ANSA, µETA-Post, LS-DYNA, BiW Development

ABSTRACT –
We intend to present an unconventional CAE approach using new age CAE tools like ANSA and µETA, which can be applied from the concept stage of BiW in the design of lightweight, high-performance vehicle bodies.

With the advent in technologies the vehicle development time is reduced and hence the expectation to deliver faster.

This unique approach formulates an FE model directly from design lines and frame cross-sections, and enables analysis of body performance using the frame performance indicators, static characteristics, and dynamic characteristics.

Because this modeling strategy does not require CAD diagrams, designers can quickly employ numerous ideas and images in FE models and utilize CAE to predict performance and hence enabling the creation of new frame structures.

Comparison of analysis results with conventional high-accuracy large-scale models has confirmed correlation between the methods, and verified that it is possible to predict performance from the concept stage of BiW using the new technology.

We use ANSA and µETA primarily for various stages of Model build, pre and post processing and LS-Dyna for solving our problem.

# STREAMLINED PROCESS FOR CREATING A RESULTS-BASED OPTIMISED MESH

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KEYWORDS –
Mesh Refinement, h-adaptivity

ABSTRACT –
This paper describes an automatic, although fully controllable process of optimizing and refining the mesh in structural models or assemblies for small deformation analyses. The proposed approach is based on the need to control how the areas to be refined are identified and remeshed. In order for this to be achieved, the refinement cycle should be extended from the barriers set by a solver and include a pre and post processor with advanced automation capabilities like ANSA and µETA.

Setting up and driving the process through ANSA can result to the highest possible mesh quality but also to a better geometry description while minimizing the time needed for manual work. Additionally, areas containing boundary conditions or loads can be refined, in case these are parametrically defined. Including µETA in the process lets the engineer to freely choose the method on which the identification of the areas to be refined is based by computing and estimating errors due to coarse meshing, while ignoring inevitable errors in areas where results cannot converge, between runs.

Finally, apart from the identification of the areas to be refined, the use of a post-processor with reporting capabilities, integrated in the process, can be used to inform the analyst either at the end of each cycle or at the end of the process not only concerning the refinement process but also regarding the development of a final complete report about the study.

The process is easily set-up in ANSA through a dedicated interface and it is open to any supported solver. Moreover, refinement of the mesh is accomplished by taking advantage of all meshing capabilities of ANSA while the identification of areas that need to be refined utilizes the filtering functionalities of µETA which are based on multiple criteria and constraints. Thus, the refinement process becomes more robust and the final result is delivered easier and faster.

# ADDRESSING MULTIPLE CONTACT MODELLING IN REDUCERS

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KEYWORDS – FEM, REDUCERS, CONTACT, SCRIPTING

ABSTRACT –
In transmitting high torque with high ratio cycloid drives as well as Wolfrom gear drives are widely used. Cycloid reducers transfer torque through rollers, disks and cranks. Wolfrom-type gear planetary systems consist of a single sun gear, two ring gears and two sets of planetary gears, in most cases six planetary gears. It is evident that in both types of reducers, torque is transmitted by multiple contacts. Besides power rating, overload capacity and transmission accuracy are important parameters that have to be considered. They are affected mainly by the elastic deformations and load distribution. FEM calculations have to be repeated at several instances in order to gain an overview of the functional behaviour of the reducer. Therefore, meshing and scripting are particularly important for the analysis.

The current study presents the procedure followed in modelling and analysing two such reducers. The effect of rigidity/elasticity in specific areas of the models was investigated by building various models in 2D and 3D with different mesh densities in order to investigate the contact interactions and the integrity of the results. Scripts was used to pre-process simulation batches that animate the positions of the parts. The results were combined using also scripts that merged node output values from a series of output databases into a single file. It is concluded that with careful suggestions regarding contact interactions, mesh density and part stiffness the models can become robust in terms of solution stability and provide reliable results within limited solution time.

Session 6

# VIRTUAL PROTOTYPING

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Dr. Ing. h.c. F. Porsche Aktiengesellschaft, Germany

KEYWORDS –
"150% model", Variants, Car configurations, ANSA DM Configurator

ABSTRACT –
The trend to develop a wide range of variants in body design is still ongoing in automotive industry. These vehicle variants have to be defined and kept in separate digital models (multi-model approach) in the current CAE situation. This results in highly redundant model data as the variant models are identical or similar for most parts. Also the efforts for maintaining and changing these variants are time-consuming and error-prone. An efficient alternative to this traditional process is to build a "maximum model" (i.e. "150% model"), capturing multiple variants in one single digital model/file.

This paper presents an overview of how ANSA contributes in the execution of this modern process at Porsche, by helping:

i) build the "150% model",

ii) determine the multiple configurations in ANSA DM Configurator,

iii) handle the configurations,

iv) deal with the various connection elements (spot-welds, adhesives, etc.) of the configurations in more than one solver.

# SPDRM V1.0: CAE WORKFLOW MANAGEMENT BECOMES REALITY

**Irene Makropoulou*, Stylianos Seitanis, Georgia Margellou, Menelaos Pappas**
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KEYWORDS –
CAE workflow, Data Management, Resources Management

ABSTRACT –
In contemporary product R&D processes, the increasing number of requirements that the products must meet together with the need for the product development cost cut-down, send a clear message: All the links of the R&D process chain need to increase their productivity, using cost-effective solutions.

Modern CAE processes, as a link of this chain, need to adapt to these requirements as well, while mastering the inherent challenges of CAE originating from the number and diversity of the actors that need to come together in order to validate a product.

SPDRM, a new product by BETA CAE Systems S.A., is introduced to undertake the management of CAE workflows, orchestrating all involved actors and handling all related data.

SPDRM can handle CAE workflows that start from the porting of CAD data from PDM/PLM systems and finish with the archival of the final reports. Workflows can be set-up in a powerful process design environment. The designer of the process associates the right resources and data to each task of a workflow. The information of who will carry-out a task and with which software, is an integral part of the process.

Pre-processing data, result files, reports and library files are stored in the SPDRM vault and are organized according to the OEM-specific data model. Different projects, releases, product variants, load-cases, CAE loops and runs are presented in a rational manner, allowing the effortless identification of the right data.

Users and user groups can either be input directly from the Enterprise User Database system or can be created straight in the resources management console. In the end, individual user or group access rights are specified to system objects such as files or processes in the known form of read-write-execute.

In this presentation, the main features of the SPDRM will be demonstrated in the context of a CAE workflow, making evident that the management of such complex processes, with all the actors and the data involved, becomes reality.

Session 7A

# ADVANCED INTERIOR HEAD IMPACT ANALYSES AT VOLVO CARS SAFETY CENTRE

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KEYWORDS -
FMVSS201U, Interior Head Impact, Crash Analyses

ABSTRACT –
The occupant protection in a car crash is a key during the design of a car. To help protection of occupant safety during interior head impact, National Highway Traffic Safety Administration (NHTSA) revised the requirements of Federal Motor Vehicle Safety Standard 201 regarding upper interior head impact (FMVSS201U). The revised requirement FMVSS201U has to be fulfilled for each new vehicle program released year 2003, or later. In a certification report to NHTSA, the car manufacturer is required to document the status of each vehicle program that is to be sold in the US. The report is based on physical tests with a Free Motion Head Form (FMH) fired against different targets of the upper interior with a specified velocity.

At Volvo Cars Safety Centre, both laboratory tests and CAE (Computer Aided Engineering) simulations are used to provide compliance with this head impact regulation. In order to automate the CAE work, an automatic procedure was developed involving the pre-processing tool ANSA, and the post-processing tool µETA. The algorithm of the FMVSS201U positioning tool in ANSA works in consistency with the regulations. Furthermore, ANSA provides the user with automatically generated target points and automatic multi positioning of the FMH at the target points. In µETA the results can be analysed in many different ways. For instance, a huge amount of results can be presented as overviews, as well as results from a single target point can be shown with detailed information.

# POSITIONING OF CAR SEAT STRUCTURES WITH ANSA

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KEYWORDS –
Kinematics, Scripting, Model handling

ABSTRACT –
As a request for rising comfort, adjustment mechanisms of car seats are getting more and more complex. Furthermore requirements concerning occupant safety and lightweight design are increasing, too. Based on these demands seat structures have to be investigated in many load cases. To achieve a time-effective seat positioning and less error-prone model handling, this process needs to be automated.

Based on a modular model build up it is possible to handle all sub modules of a seat structure in design position. Before starting a simulation run, a predefined design state and load case setup is read into ANSA using LS-Dyna include files. Design States are comprised of sub modules of the seat structure, e.g. adjuster and backrest module. Boundary conditions, belt system and dummies are defined in load case setups. At the same time a kinematic model is read in also, which has to be built up in advance. Model assembly and seat adjustment is executed fully automated by ANSA-Scripting and an additional load case specific parameter file.

Standardization and automation reduces the effort of model handling. Therefore it is possible to generate model updates and design modifications in design position only. This approach assures a minimum of adjustment effort and FE model independent kinematic modules. These modules can be carried over to equivalent seat kinematics.

# BIRD IMPACT ANALYSIS

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KEYWORDS –
Bird impact, 3D meshing, LS-DYNA, µETA Visuals Resources, 2D-plots and automation

ABSTRACT –
SAFRAN ENGINEERING SERVICES BU-AEGT has a high experience in automotive crash analysis. In order to support our customers, those activities have been developed for yacht crashworthiness and aeronautic industry in particular on engine and Landing Gear.
This paper presents the use of BETA CAE softwares for bird impact explicit calculations performed with LS-DYNA. Indeed ANSA has been used for pre-processing (3D mesh using MAP based on .igs file format, LS-DYNA Deck for the modelling). µETA has been used for post-processing (LS-DYNA animations, overlay with tests results using Visuals resources, 2D-plots to compare test with calculations, session files to have an easier post-processing).

# R66 ANSA TOOLBOX FOR BUS BODY DEVELOPMENT

**Magnus Hult**
SCANIA CV AB, Sweden

KEYWORDS –
R66 rolover, Buses, ABAQUS, ANSA , TASK MANAGER

ABSTRACT –
SCANIA develops , produces and sells heavy trucks and buses worldwide. The bus program includes city and intercity buses and coaches.
ECE R66 are mandatory for passenger traffic buses in Europe and elsewhere. It demands that a bus to be tipped sideways from a shelf of 0.8 [m] height . The sides of the bus may not intrude into a certain specified volume, the residual/survival space (SUV).
The body design involves both fatigue , stiffness and maximum strength properties. They could be evaluated in fe-model environment. These calculations has been done by explicit code for rollover calculations and implicit code for stiffness and fatigue calculations.

My focus today is on the effort to use initially the same fe model for fatigue as for rollover calculations.
In particular I intend to use an upstanding bus model for the fatigue calculation and the same tipped for the rollover calculation. In the rollover calculation the bus is tipped to a close ground contact position to save computer time , thus differing from the CAD XYZ system.
ANSA Task Manager is a powerful tool which allows the completion of ready-to-run model in a repeatable,controllable and fast manner while it requires the minimum effort from the analyst .The tool exploits ANSA functionality so as to organize the modeling steps in a sequence for the development of R66 template.
The work scheme is to use a newly developed ANSA TASK “rolover” to create a ABAQUS EXPLICIT input file. The input file created is ready-to run with materials, beam cross sections , initial velocity and post processing demands.
The toolbar Crash-Safety with R66-Rollover task within META POST is used to establish the margins of safety for the SUV intrusion into the bus side members.

Session 7B

# DEPLOYMENT OF OPTIMIZATION TECHNIQUES IN THE AERO/THERMO DEVELOPMENT AT FORD

**Burkhard Hupertz**
Ford Werke GmbH, Germany

ABSTRACT –
Nowadays CAE is a fully accepted tool in all phases of the automotive aero- and thermal system engineering process. Since CAE became an integral part of the vehicle development process the expectation towards CAE and with that the role of CAE has changed significantly. While initially CAE was primarily used to assess the performance of a proposed design solutions CAE is now expected to drive the development of the vehicle design while considering a continuously growing number of design parameters. CAE based Design of Experiment (DoE) techniques seem to be very well suited to explore the dependency of the aero- and thermal system performance on a large number of design parameters and with that enable the optimization of these systems in context with other vehicle requirements. A key enabler for the successful deployment of DoE methods is the significant progress which has been made in parameterizing CAE models using advanced surface morphing techniques.
This presentation describes the overall DoE process which has been developed at Ford and how it is used in the aero- and thermal system engineering process at Ford.

# VSAERO IMPLEMENTATION WITHIN THE ANSA ENVIRONMENT

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KEYWORDS –
Preliminary aerodynamic design, Computational Fluid Dynamics

ABSTRACT –
This paper proposes the incorporation of the VSAERO software into the ANSA environment. VSAERO (Vortex-Surface AERODynamics) has been a widely accepted surface singularity panel method used for preliminary design in the aircraft, naval and automotive industries for the past 30 years. The method rapidly computes the nonlinear aerodynamic characteristics of arbitrary configurations in subsonic flow. The addition of this functionality to ANSA has the potential to increase the scope of ANSA's capabilities in the field of preliminary aerodynamic design.
The user will be able to run VSAERO simply by means of a mouse prompt within ANSA. They will then have the option to modify the basic data that controls the functionality of VSAERO. ANSA will internally generate the input file, execute VSAERO and display the final result in the ANSA post processor.
The integration will also involve adding wake creation capability in ANSA. Wake data is necessary for VSAERO to calculate the aerodynamic properties of lifting surfaces. These modeling features consist of thin sheets defined by quadrilateral elements that originate from component edges.
The integration of these two complementary programs will create a more efficient user experience by combining the functionality of several different programs into one environment.

# INVESTIGATION OF MESH INFLUENCE FOR HEAT TRANSFER IN PIPE FLOW

**Björn Jedvik**
Semcon Caran AB, Sweden

KEYWORDS –
CFD, heat transfer, meshing, inflation layers, y+

ABSTRACT –
In order to improve performance of electric vehicles, a research project called Eldrivet was launched in 2011 where participants such as Volvo, Scania, Kongsberg Automotive, Lund University and Semcon gather and contribute with their respective competence.

Within the frame of Eldrivet project, Semcon have studied the performance of a fluid cooled inverter.

Meshes have been made using ANSA and different meshing parameters have been investigated such as y+-value, number of inflation layers, element type together with different CFD parameters in various CFD softwares.

Validation has been performed in Semcon's laboratory and an examination has been made in order to get an understanding of when simulations seem to correspond well to the experiments and when not.

# APPLICATIONS OF ANSA IN THE AERODYNAMIC AND AEROTHERMAL DEVELOPMENT OF NEW MODELS: EXPERIENCES AT CRF AND FGA

**Enrico Ribaldone**
Centro Ricerche Fiat S.C.p.A., Italy

Session 8A

# SAFETY MODEL-BUILD PROCESS USING TC/ANSA INTEGRATION

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KEYWORDS –
Teamcenter-ANSA interaction, Modular connections, MCF, Include files.

ABSTRACT –
Recent requirements for Safety model-built have led to the extension of the existing TC/ANSA interaction to cover (i) the efficient management of system modules as Include files, and (ii) the management of modular connectivity information on the respective Include level.
In this scenario, Teamcenter (TC) is used to organize and manage the vehicle modules (sub-systems) into respective Include files suitable for Safety analysis. Each internal and external connections to the include files are managed in Teamcenter as a separated instance. The format used to document the connections is the Master Connection File (mcf) format.
A PLMXML package containing one or more Include files plus their respective connections is exported to ANSA, using the standard PLMXML transfer mode that covers all TC/ANSA use cases. The PLMXML package encloses a configured set of data representing the context the user wants to work on in ANSA. In turn, ANSA identifies the individual Include files, positions them in the right location and groups the incoming connections based on their originating mcf file. This allows users to create new connections or modify existing (change position, delete etc.) without losing control over which mcf file each connection belongs to. Furthermore, dedicated ANSA tools help users modify, inspect and verify the correctness of Include files. The exported user's work goes back to TC via a PLMXML package, maintaining the individuality of Include files and respective connections.
In addition, the new functionalities of the TC/ANSA integration allow the exchange of component meshes in an existing Include file, without having to redo any of the mesh assembly tasks.

# CAE DATA & PROCESS MANAGEMENT WITH ANSA

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KEYWORDS –
Ansa Data Management (Ansa-DM)

ABSTRACT –
Data Management is unquestionably one of the most critical factors contributing to the efficiency and productivity of CAE. At Volvo GTT, the CAE process have been structured and streamlined to support the design evolution of new products using Ansa DM. Therefore, to increase the CAE efficiency, productivity & Lead Time Reduction during product development, an automatic interaction with PDM and CAE software (Enovia – Ansa) has been established by Ansa DM techniques.
A link has been developed which has a robust capability to read the CAD data & attributes automatically into CAE software, perform translation, mid-surface and batch meshing for different disciplines ( Crash / Durability / NVH) simultaneously . It is **"Fully Automatic"**. The development is called **"ENOVIA-2-ANSA"**
Furthermore, a new method for CAE model set-up has been developed using "Ansa-DM". This procedure answers many current challenges like data organization, collaboration, decision making, existing practices and model scalability. Thereby creating a global reference library for all CAE verifications. Similar to Enovia, "Ansa-DM" is a PDM **"like"** system for CAE development process. A central data repository has been established for data exchange across the sites.

The Unique Features are,

- New GUI **Enovia-2-Ansa** developed for automatic pre-processing
- CAD to meshing could be run in just **3 Click Buttons**
- Batch meshing development has reduced **~ 50 % lead time**
- New efficient and **inexpensive** process

VOLVO GTT Ansa DM Highlights:

- **~ 30 % lead time reduction** have been achieved in a product development cycle
- CAE verification are much quicker in pre-processing phase benefiting the design development for quick concept selection & design development

Any data from any design loop of a project could be retrieved any moment. Complete CAE data of the project life cycle could be accessed across the sites anytime.

Session 8B

# THE CFD SIMULATION OF THE FLOW AROUND THE AIRCRAFT USING OPENFOAM AND ANSA

**Adam Kosík**
Evektor s.r.o., Czech Republic

KEYWORDS –
CFD simulation, mesh generation, OpenFOAM, ANSA

ABSTRACT –
In this paper we describe the complete process of modeling and simulation of computational fluid dynamics (CFD) problems that occur in engineering practice. We focus mainly on the simulation of the airflow around the aircraft. The fluid flow simulations are obtained with the open source CFD software package OpenFOAM. We use the solver based on the Semi-Implicit Method for Pressure-Linked Equations (SIMPLE). The important part is the preparation of the model with the software ANSA. We will describe the preprocessing including the creation and modification of the surface mesh in ANSA and the three-dimensional volume grid generation. We discuss the generation of the three-dimensional grid by the snappyHexMesh tool, which is included in the OpenFOAM package. Furthermore, we present a way of analyzing the results and some of the interesting outputs of the simulations and following analysis. The CFD simulations were performed on the computational model of the twin turboprop aircraft EV-55 Outback. We made comparison between computations made by OpenFOAM, ANSYS Fluent and measurements in a wind tunnel. The computations were performed for different model settings and computational grids. It means, that we considered laminar and turbulent flow and several combinations of the angle of attack and inlet velocity.

# FLUID-SOLID-HEAT COULPING SIMULATN OF A FURNACE

**Zimin Zhan*, Rongbo Bai**
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KEYWORDS -
ANSA, CFD, Furnace

ABSTRACT -
In this work, a temperature distribution was analysed with a fluid-solid-heat coupling simulation for furnace. The Meshed model that was used in this analysis was generated with the CFD meshing function of ANSA. The P-1 radiation model and the k-ε turbulence model were adopted. The results show the temperature of steel liquid layer at about 1400°C and temperature at output of water cooling system at 27°C. The analysis provides a great insight into the thermal transmission pattern in the structure and acts as a starting point for further optimization.

Session 9A

# CREATION AND EVALUATION OF PART ENVELOPES THROUGH AN AUTOMATED PROCESS

**Apostolis Paraschoudis**
BETA CAE Systems S.A., Greece

KEYWORDS –
Kinetics, Morphing, Wrapping tool, Scripting

ABSTRACT –
The creation of part envelopes is a common and useful study case for engineers. It lets them know the maximum volume that parts occupy during their movement. This paper focuses on the case of wheel envelopes during the kinematic movement of a suspension. The process is a combination of the Kinetics, Wrapping, Morphing and Scripting tools.

Through this process the user will create (load) a kinematic model of a suspension, define the Morphing boxes and parameters for the wheel and run the automation script. The script will move the suspension in various positions and save the wheel in every position. Then it will run the Wrapping tool that will provide the overall volume that the wheel occupies during its movement among all its positions and will apply a penetration check between the overall volume and the wheel arch. The script will continue with another loop, by parametrically increasing the width and/or the radius of the wheel. Finally, a report is given showing if any of the wheel sizes that have been checked interferes with the wheel arch.

# A PRE-PROCESSING INTERFACE EMBEDDED IN ANSA FOR ACOUSTIC RADIATION ANALYSES WITH RADACT

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KEYWORDS –
Acoustic, Radiation, Fluid, ACTRAN, RADACT, FRF, Green, Field Points, Modal Response, Pellicular, Modal Extraction, Mumps, Sparse, Krylov

ABSTRACT –
RADACT is a module of ACTRAN, an acoustic radiation modeler, which is able to perform acoustic radiation analysis in batch mode, based on NASTRAN formatted structure results, structure and acoustic mesh.

Motivation:

- RADACT does not have any GUI for the creation of the ACTRAN input file prior to submitting it to the solver and, therefore, needs to be written manually.
- Users, who are used to build up a model with a common pre-processor like ANSA, have to learn with ACTRAN another GUI, in order to set up an acoustic radiation analysis.
- The structural model and the fluid volume mesh have to be created within the pre-processor anyway, so why not set up also the RADACT analysis, which needs the fluid and structure mesh as input file.

Solution:
The RADACT interface embedded in ANSA provides the user with capabilities to easily create and export a RADACT input file, which is ready to be solved with the ACTRAN solver. Moreover, it automatically creates or imports all necessary meshes for the acoustic finite and infinite domain, by using the convenient selection capabilities embedded in ANSA for the respective properties from the model. It also assigns the respective structural results file and sets up all necessary solver and analysis parameters, in order to export the complete RADACT input file.

# ANSA AND µETA AS A CAE SOFTWARE DEVELOPMENT PLATFORM

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KEYWORDS –
Python, scripting, SDK, API, development

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. In such cases, the current tools, need to provide the hooks for user extension and customization. The CAE engineer should not need to reinvent the wheel, instead APIs (Application Programming Interface) based on the latest IT industry standards should be available.

A key CAE engineer, in his typical work, needs more than a script that will assign material properties, apply a load or automate a three step process. He will often need to develop a new tool that others will use. He will also need to couple the pre-processor with the CAD and DM systems and the postprocessor with the solver and the report tools. Also, he will need to find ways to communicate the engineering work done in Pre to his colleagues in new, inspirational forms.

Scripting is extremely useful, both as a data modification tool and as an internal development tool. It makes complete sense to use a powerful, documented, cross-platform standard such as the Python programming language. The added benefits of Python is its popularity among engineers and scientists and the rich availability of third party scientific and mathematical libraries.
The new approach of scripting in our applications aims towards openness. We develop high end pre-processing and post-processing tools that handle the simulation modelling process from the CAD data import to the report composition of the analysis results. These tools will prove even more valuable when users have complete access to the ANSA and µETA core.
As we move forward, the scripting capabilities will become a programming interface. The design will be 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.
Notes:
taken from python.org/about/quotes/

"Python, like many good technologies, soon spreads virally throughout your development team and finds its way into all sorts of applications and tools. In other words, Python begins to feel like a big hammer and coding tasks look like nails." -- Mustafa Thamer of Firaxis Games.

Session 9B

# ADAPTIVE FINITE ELEMENT METHOD FOR AEROSPACE AND AEROACOUSTIC APPLICATIONS

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Royal Institute of Technology, Sweden

KEYWORDS -
LES, turbulence, adaptivity, finite element methods, aeroacoustics.

ABSTRACT –
In this talk I would like to present the simulations performed for the 2nd Workshop on Benchmark Problems for Airframe Noise Computations (BANC-II), and also for the workshops BANC-III and the 2nd AIAA CFD High Lift Prediction Workshop (HiLiftPW-2), which are upcoming events this year. This series of workshops is organized, among others, by NASA, ONERA, DLR and Boeing Commercial Airplanes and its main goal is to assess the predictability of existing CFD codes for aeronautics and aeroacoustics applications. In the BANC-II workshop, held in Colorado Springs in 2012, we studied the flow past a high-lift wing profile and the flow past a complex nose landing gear geometry. The simulation results for the landing gear were blindly compared with experiments and the results of other participants. Our simulations showed good quantitative agreement with the experimental data. The results for the high-lift wing profile were preliminary in 2012 and we are currently performing further simulations with this geometry for the BANC-III workshop to be held in Berlin. Finally, for the HiLiftPW-2 we simulate the flow past a complex airplane geometry. The computational meshes used in all of the aforementioned simulations were generated with ANSA, which was a key ingredient in the quality of the results obtained.

# NUMERICAL SIMULATION OF THE BETA CAR CABIN THERMAL COMFORT ACHIEVED BY HVAC AND/OR OPEN WINDOWS AT CRUISING SPEEDS

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KEYWORDS –
ANSA, µETA, Beta Car, Grid Generation, thermal comfort

ABSTRACT –
Passenger comfort is of great importance in the cabin design of modern passenger cars. Thermal comfort is assured by factors that depend on heat exchange between the human body and the ambient environment. The market demand for highly effective and efficient HVAC systems for automotive applications has determined a great impulse in the research and development of innovative methods and instruments to predict passengers' thermal comfort with the lowest possible fuel consumption. The present study utilises computational fluid dynamics simulations in order to demonstrate the differences in fuel consumption and cabin comfort achieved by operation of HVAC systems, open cabin windows, or combination of both. All studies are based on the BETA Car and investigated cases include cruise, as well as, city driving conditions.

# CFD SIMULATION OF A BUBBLING FLUIDIZED BED BIOMASS GASIFIER USING ANSA MESHING AND ANSYS FLUENT

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KEYWORDS –
Multiphase flow, biomass gasification, fluidized bed, ANSA, FLUENT

ABSTRACT –
Biomass is considered to be one of the renewable energy sources with high potential to contribute to the world's energy need. Exploitation of biomass for energy production through gasification procedures is an environmentally benign solution. With gasification in general, residues or waste products such as biomass, tires, municipal waste, refinery residues, and generally any carbonaceous materials, can be utilized to produce heat and power efficiently. The gasification process is challenging regarding modeling since it concerns multiphase fluid dynamics, gas–solid flow, volumetric and particle chemical reactions, turbulence and heat transfer simultaneously. Modeling the process via simulation tools such as ANSA, ANSYS FLUENT and µETA eventually helps the design and optimization of industrial-scale biomass gasifiers. This paper describes the simulation of two bubbling fluidized bed reactors, one lab-scale (5 $kW_{th}$) and one pilot-scale (20 $kW_{th}$), where two approaches were applied for meshing each of the two models and so two different meshes were generated for each reactor. Both approaches utilize ANSA tools; the first captures the flow boundary layer with the Zone Cut / LAYERS function and the second with O-GRID generation from the HEXABLOCK menu. A 180° symmetric cylindrical reactor was used in all models and special consideration has been given to the effect of the fluidization medium (air) velocity profile to the sand-bed fluidization behavior validated on experimental pressure measurements. Experimentally derived kinetics has been applied to simulate the gasification reactions of olive kernel particles in the experimental set-up. The results are validated on producer gas composition, temperature profiles and mass balances.

Session 11

# CAE CONTRIBUTION TO THE MID-TERM PLAN NAMED "NISSAN POWER 88"

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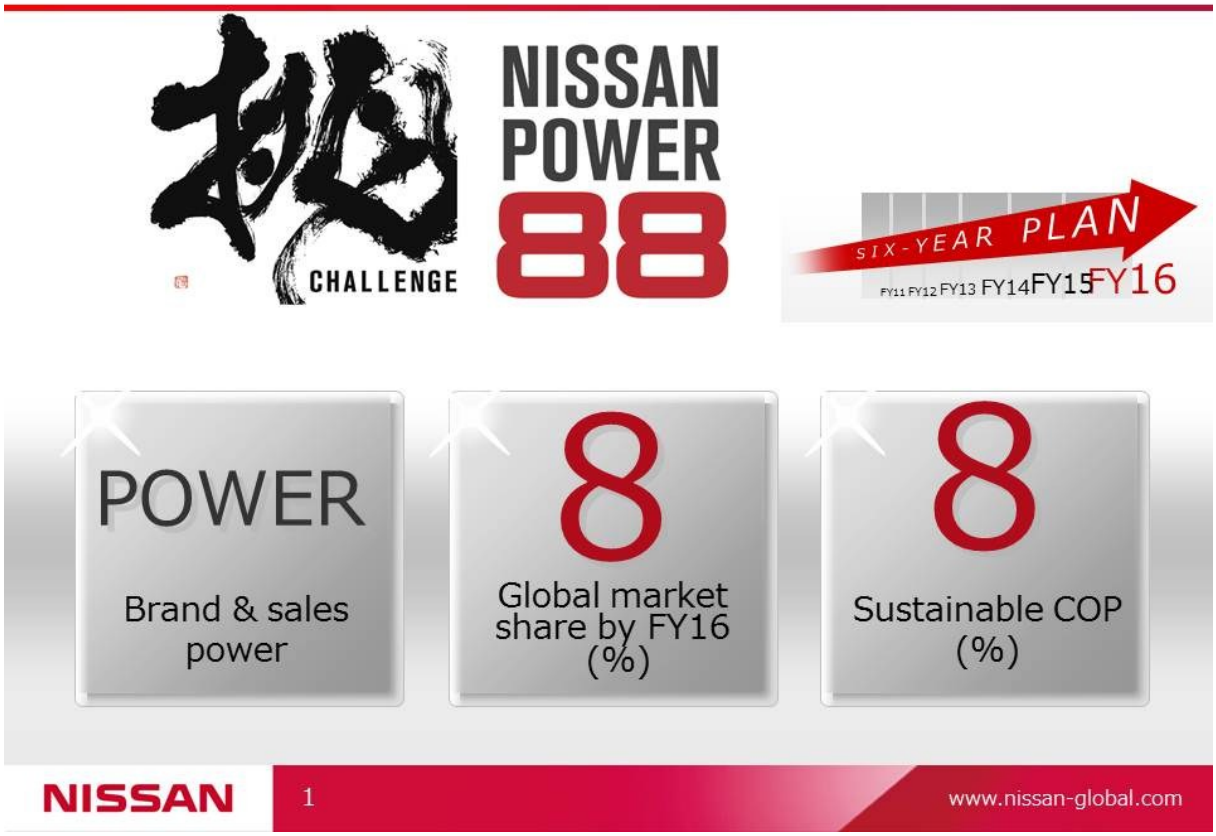
KEYWORDS – Nissan Power 88,vehicle development process

ABSTRACT –
Nissan Motor Co., Ltd. announced new mid-term plan named "Nissan Power 88" in Jun 2011."Nissan Power 88" is a wide-ranging, six-year business plan that will accelerate the company's growth across new markets and segments, for fiscal years 2011 to 2016.The name of the plan emphasizes key corporate goals: Nissan will renew its focus on the overall customer experience through actions that elevate its brands' power and sales power. By the end of fiscal 2016, the company will aim to achieve a global market share of 8% and increase its corporate operating profit to a sustainable 8%. This presentation shows CAE contribution in the vehicle development process in "Nissan Power 88".



Session 12A

# VEHICLE DYNAMICS AND DURABILITY SIMULATIONS USING ANSA AND ABAQUS

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KEYWORDS –
Co-simulation, Substructures, Dynamics, Suspension, Tires

ABSTRACT –
ANSA is widely used in the automotive industry as a pre-processor to generate detailed finite element models for crashworthiness, NVH and durability simulations. High performance computing (HPC) is enabling engineers to increase the fidelity of these simulations while reducing the turnaround time. Traditionally engineers resorted to either Implicit or Explicit finite element technique to solve dynamics of systems. Recently a co-simulation approach has been implemented in Abaqus that combines the strengths of Implicit and Explicit solution techniques by solving different regions of the same model using different solution techniques. This co-simulation approach combined with HPC provides a powerful and efficient tool to analyze systems with varying degrees of dynamics in space and time.

This paper describes a methodology in ANSA to generate models for subsequent implicit-explicit co-simulation using Abaqus. The vehicle body and chassis are solved using implicit solution technique. Substructures (superelements) are used to represent the body as well as some of the chassis components. The tire-road interaction is solved using an explicit solution technique.

# FOLLOWING NATURE'S LEAD FOR ULTIMATE DESIGN EFFICIENCY - THE ACP PROCESS AS APPLIED TO FSV

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KEYWORDS –
Optimisation, FutureSteelVehicle, ACP, WorldAutoSteel, ETA, Design Process, Synchronization, Advanced High Strength Steels

ABSTRACT –
The shapes and configurations of nature are wildly complicated, non-intuitive and completely amazing. The shapes and forms found in nature in the structure of a tree, a human skeleton, insects and animals are truly the most efficient designs imaginable. By mimicking the flawless balance between structure and strength of nature's most efficient shapes, engineers can learn how to incorporate similar balance to product structural design for automobiles, aircraft and other systems.

The Accelerated Concept to Product (ACP) Process™ is a methodology which enables the structure of a product, such as the vehicle's body-in-white, to mimic "Nature's Way" [13]. Doing so creates the ultimate design efficiency, where structure and strength are perfectly balanced for the intended function.

ACP is a proprietary, performance-driven, holistic product design development method based on design optimization and incorporates the use of multiple CAE tools in a systematic process to generate the optimal design solution. This methodology provides solutions, which address the challenges facing the modern product development environment. It achieves this by synchronizing the individual facets of the product development process, resulting in an overall reduction in development costs and time to market.

Material selection and utilization, product performance requirements and manufacturing and assembly processes are all considered as early as possible in the design cycle. The resulting design offers a robust and highly efficient solution; which when combined with the strength and design flexibility of materials; facilitates significant mass reduction for the final design. This enables mass reduction, while realizing and even exceeding performance requirements. It begins with the progression from packaging space, to the initial design skeleton, to initial concept of the vehicle structure, through to final design concept [9].

The final design of the Future Steel vehicle (FSV) Program has been completed. During the final phase of program, FSV achieved 39% mass reduction and the new mass target was achieved in the design upon completion of the final optimization tasks, concluding the program [11,15,18].

The paper will cover the ACP Process, which enabled significant mass reduction results and will explain 3G (the balance of geometry, gauge and grade), 2G (grade and gauge) and 1G (gauge) optimization effects. Further, the results of the FSV mass reduction evolution will be disclosed [17].

The project involved optimization, from vehicle baseline to detailing the steel body structure concepts for the vehicles to meet aggressive mass targets of 177.6 kg, while meeting 2015-2020 crash, stiffness, NVH, and durability performance objectives and total life cycle Greenhouse Gas emissions targets. FSV's steel portfolio, including over 20 different AHSS grades representing materials expected to be commercially available in the 2015 – 2020 technology horizon, is utilized during the material selection process, while full vehicle analysis was used to determine material

grade and thickness optimization [15,17]. Achievement of such aggressive weight reduction with steel will set a new standard for vehicle design approaches for the future.

Session 12B

# MODELING AND DESIGN OPTIMIZATION OF A FORMULA STUDENT RACE CAR

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KEYWORDS –
Formula Student, FEM Modeling, Components design, Optimization

ABSTRACT –
Formula Student Series is a competition where teams from universities around the world design and construct a single-seater race car to participate in related international events. Teams have to conform to a set of rules imposing restrictions at the general specifications of the car, such as the dimensions, the engine capacity and the safety. The paper presents a series of case studies from the use of Finite Element Method (FEM) modeling and design optimization of various components from the current race car of the Aristotle Racing Team (ART), investigated with the aid of ANSA and µETA software packages. More specifically, various structural parts were modeled and analyzed to reduce weight and deformation, given the restrictions imposed by materials' mechanical and physical properties. Moreover, extensive Computational Fluid Dynamics (CFD) analysis of the intake manifold was performed for optimizing the air flow to obtain a better engine performance. Additionally, multiple crash analyses of the front part of the car were carried out for reducing the number of the experiments, thus minimizing cost and development time of the car impact attenuator. The use of optimization tools in several components, led to a significant reduction of weight without compromising in structural stiffness.

# NEW TECHNIQUES TO IMPROVE MODELLING, DESIGN AND OPTIMIZATION OF COMPLEX THERMOPLASTIC COMPONENTS

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KEYWORDS –
Productivity, optimization, modelling, SPACECLAIM, ULTRASIM

ABSTRACT –
One of the main advantages in designing with thermoplastic materials is the ability to form very complex shapes. Add to that complexity the hybrid nature of many of today's technologies and the complexity increases. This presentation will introduce the techniques and tools used within ANSA or in conjunction with ANSA, such as recently introduced SPACECLAIM, to increase the efficiency a finite element model is created and then automatically exported via build-in direct interfaces to either a structural analysis and/or injection molding simulation software such as Moldex3D. Also will demonstrate a process where a part is optimized using other tools outside ANSA which synergistically work along ANSA to create a seamless integrative simulation process where, processing conditions (ULTRASIM), geometry morphing, hybrid laminate construction are integrated together to yield a design that otherwise is almost impossible to achieve.

Session 13A

# RECENT ADVANCES IN RE-ANALYSIS METHODS FOR NVH INCLUDING SHAPE AND TOPOLOGY OPTIMIZATION

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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 optimization requires repeated FE analyses of large models. We have developed various re-analysis methods such as the parametric reduced-order modelling (PROM), the combined approximations (CA), and the modified combined approximations (MCA), for gauge (e.g. thickness) 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 previous conferences, the advantages and disadvantages of the PROM, CA and MCA methods have been demonstrated for only gauge changes. In this presentation, we will discuss many improvements to reduce the computational effort of the above re-analysis methods including numerical approaches for mode and design variable elimination, efficient estimation of triple matrix products in forming a modal model, and a sequential re-analysis approach for large perturbations of the design variables. We will also present a re-analysis methodology for shape changes (morphed models or modified models by adding or deleting parts), and a topology optimization approach using re-analysis. Many examples, including a vehicle finite-element model, will demonstrate all developments.

# NVH MODEL INTEGRATION AND CONFIGURATION COMPLEXITY HANDLING TOOL USING ANSA

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KEYWORDS –
NVH model Integration, Assembly, Configuration, ANSA Include Manager

ABSTRACT –
To compete in the modern automotive industry there is a heavy reliance on engineering analysis through CAE. The CAE community has been continuously challenged to build and analyze more vehicle configurations to improve quality and reduce overall R&D expenditure. To accomplish this, efficient tools are needed to build and integrate various vehicle configurations using standard model integration methods to improve quality and data sharing.

An efficient tool to integrate NVH CAE models based on vehicle configurations utilizing ANSA Include Manager was developed. This tool automates model integration, handles configuration complexity, eliminates duplication of effort, increases quality, and standardizes the process. This tool enables building and analyzing more vehicle configuration models while improving quality of NVH CAE assessments.

At the heart of this tool is ANSA Include Configuration Manager. Vehicle configurations are defined in an ANSA file and called as needed. Once requested, the include manager picks the appropriate subsystems and assembles the model. Other auxiliary data for assembly is read through an ASCII file. The final model is exported as an analysis deck with subsystems as include files or embedded models based on the options selected. Several check points and flags are incorporated into the tool to make the process robust. Model updates is easily accomplished by swapping the subassemblies in the include manager and updating the corresponding data in ASCII file.

# CONCEPTUAL CAR DESIGN AT BMW WITH FOCUS ON NVH PERFORMANCE

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KEYWORDS –
ANSA, Nastran, Optimus, Concept modeling, NVH

ABSTRACT –
Full vehicle concept modeling and optimization in early-phase development for acoustic and vibration comfort is of vital importance in automotive industry. Beside other aspects, a crucial factor in search for premium NVH performance throughout the design phases is global and local, static and dynamic car body stiffness.

A multi-objective optimization process, using beams and shells FE concept models, is used to fulfil the more and more challenging functional requirements in order to obtain optimal performance of the car body. In this sequence, numerous conflicting functional targets and design constraints have to be respected, while minimizing construction space and weight.

Currently the optimization process is based on MSC Nastran beams and shells FE models with arbitrary beam cross section profiles and simulation runs with the built-in gradient-based optimization functionality in Nastran. This process is described with ANSA as pre-processor enhanced by ANSA user scripts and stand-alone tools.

Beside the efficient and well established Nastran optimization, an alternative approach with Optimus as an open optimization tool is shown. The benefits are more freedom concerning the definition of the design variables, multi-disciplinary workflows and the choice between various optimization algorithms.

Examples for this approach are presented highlighting the coupling of ANSA to Optimus via automated setup of ANSA optimization tasks with different design variables like property values and morphing parameters.

# SQUEAK & RATTLE SIMULATION AT VOLVO CAR CORPORATION USING THE E-LINE™ METHOD

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KEYWORDS –
Squeak&Rattle simulation, modal transient, E-LINE method, interior assembly, instrument panel

ABSTRACT –
A new method for Squeak&Rattle simulation and a new approach for correlating the simulation results to real Squeak&Rattle issues have been presented in the SAE paper 2012-01-1553.
This presentation focuses on the integration of this new simulation approach into an existing virtual design process. Both the technical aspect of the integration and also the organizational integration will be shown.
The technical aspect can be split into a pre- and post-processing part. On the pre-processing side the improvement of the FE model and the load defintion using test data will be described. On the post-processing side the stick-slip test data base and the tolerance analysis will be linked to the E-LINE™ program in order to use these data as a criteria for the Squeak&Rattle assessment.
By taking the capability of this new simulation approach into account the organizational integration is presented where the E-LINE™ method becomes an efficient tool to support the daily design work within both interior and exterior applications.

Session 13B

# NUMERICAL SIMULATION OF BLOOD FLOW IN LAD MODELS WITH DIFFERENT DEGREES AND LOCATION OF STENOSIS

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KEYWORDS –
ANSA, Hexa-Block, Grid Generation, Blood flow, Coronary, stenosis

ABSTRACT –
Coronary Artery Disease is the formation of atheromatous plaques on the walls of Coronary Artery, and it is considered as the number one cause of death in developed countries. Coronary atheromatous plaques, besides reducing the blood supply of the heart muscle, often lead to angina and myocardial infarction; it has been suggested that the exact location of the stenotic lesion plays a critical role on the outcome of the disease. In this work we will attempt to investigate whether similar degree of stenosis in different locations can lead to significantly different flow patterns. A model of a physiological Left Anterior Descending (LAD) artery will be constructed based on averaged data from about 200 patients. A pure hexahedral mess featuring boundary layers for the whole computational domain will be created using the Hexa-Block feature of ANSA. Using the Morphing Tool of ANSA stenotic lessions will be added to the initial geometry at different locations and with different degrees of stenosis. Transient numerical simulations of blood flow will be performed for the stenosed geometries, and the flow patterns for different locations of stenosis will be presented.

# FINITE ELEMENT MODELLING OF A TOTAL WRIST IMPLANT

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KEYWORDS
Finite element, biomechanics, orthopaedics, joint replacement

ABSTRACT –
The aim of the project was to create finite element model of a commercially available wrist implant to examine its behaviour under loading. The finite element model was validated by carrying out mechanical tests. Little is known about the mechanics of wrist implants under loading and how they interact with the surrounding bone. Surgical outcomes have been poor and further research is needed to investigate the mechanical behaviour of the wrist implants under loading. A finite element model of the Universal 2 implant (Integra) was created using 3 dimensional scanning of the implant and a CAD model reverse engineered and inserted into a three dimensional model of the radius bone by using Mimics (Materialise). The implant consisted of 3 components: a proximal component made from CoCr alloy, a polyethylene spacer and a titanium distal component. The finite element modelling was carried out in Abaqus (Simulia) and solved using the implicit solver. Loading was applied to the distal component as surface pressure and the proximal end of the radius bone was fixed. Mechanical tests were carried out where the implant was fitted with strain gauges and loaded in uniaxial compression. The results showed good agreement between the FE model and the mechanical tests. Majority of the stresses were transmitted through the proximal stem and areas of reduced loading were seen in the bone. From the results it can be concluded that the design of the implant stem will have great effect on the stress distribution within the bone

# FINITE ELEMENT BASED IMPLANT OPTIMIZATION AND PREOPERATIVE PREPARATION

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KEYWORDS –
Lumbar Spine, Finite Element Analysis, Kyphoplasty, Spinal Fixation

ABSTRACT –
Over the past decade the medical sector has been revolutionized through its interaction with modern mechanics and engineering. Human modelling has become ubiquitous to this effort, facilitating bio-realistic preoperative preparation and simulation based optimization of aloplast implants. Lumbar spine pathologies are no exception to this. With a life-time prevalence of 70% they have grown to epidemiologic proportions raising the attention of physicians all over the world. Recent advances in spine modelling have established this methodology as an effective alternative to in vitro examination, as Finite Element simulations allow in situ evaluation of the highly interdisciplinary phenomena governing spine biomechanics.

A dynamic endo-anatomical model of a lumbar spine was developed considering anatomical based mesh generation, non-linear properties, muscle action and solid ligamentous tissue, thus accurately reflecting the constantly altering and highly complex response of the human spine dictated by both, external stimuli and gait.

Based on this model a patient specific surgical treatment for osteoporotic/osteolytic vertebral compression fractures was preoperatively evaluated. The effect of uni- and bipedicular filling during balloon kyphoplasty was assessed in terms of the retrospective local rigidity and elevation of load transfer to adjacent vertebral levels. This allowed the prediction of post-surgical pathogenesis, as patients diagnosed with a prevalent vertebral fracture have been reported to be susceptible to further trauma by a fivefold increased risk.

The model was furthermore employed to optimize the integration spinal fixation implants, in treatment of deformities or immobilization of degenerative intervertebral discs, to determine the resulting stiffness and the loss in overall mobility.

5th

# ANSA & µETA

## INTERNATIONAL CONFERENCE

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