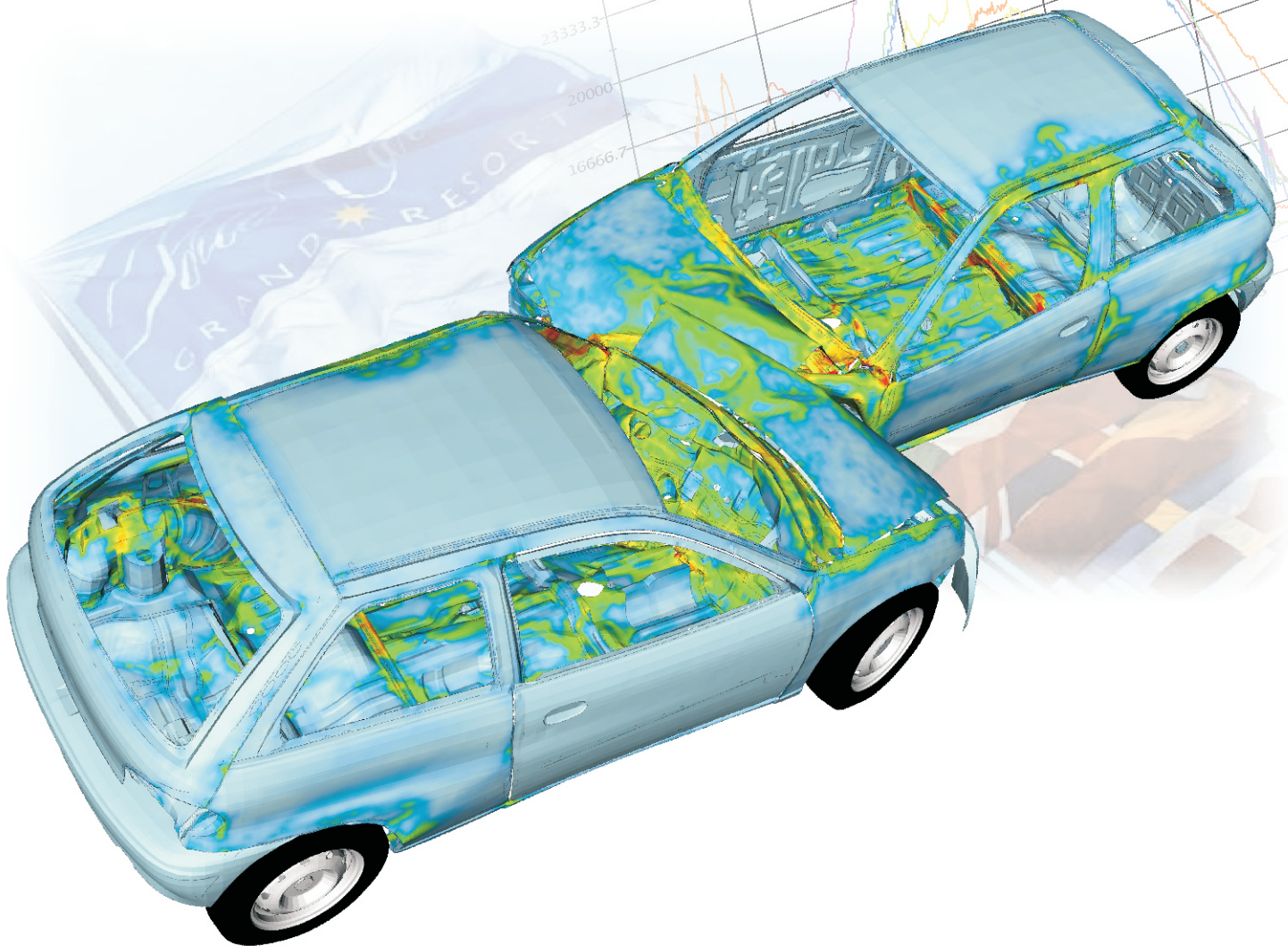


2nd ANSA & μETA INTERNATIONAL CONGRESS

June 14-15, 2007

Olympic Convention Center
Porto Carras Grand Resort Hotel
Sithonia, Halkidiki, Greece

PROGRAMME & ABSTRACTS





2nd ANSA & μETA International Congress

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Sithonia, Halkidiki, Greece

Programme & Abstracts

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Welcome message

Dear Attendees.

Being consistent to our promise to meet again in two years after our first congress, we have the pleasure and the honour to welcome you to the “2nd ANSA & μETA International Congress”.

BETA CAE Systems S.A. assures you that will try to do the best to make your stay pleasant and productive.

During the congress you will have the opportunity to be informed about the latest developments in the products of BETA CAE Systems S.A. and their applications through the technical presentations prepared by our guests from the academic and industrial sectors and by our engineers.

Furthermore, you will have the opportunity to interact with the executive, development and services engineers of BETA CAE Systems S.A. to present your requirements for future developments. You can be sure that we will pay close attention to your requests and will give them a high priority in our development planning. Along with the local distributing teams from the U.S.A., Germany, France, U.K., Sweden, Japan and Korea we will be at your disposal to discuss further technical and business related issues.

I, personally, and the entire BETA CAE Systems S.A. would like to thank you for coming. We would also like to express our gratitude to all those who contributed their papers and presentations for the success of the congress.

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

Enjoy your participation to our event and your stay in Halkidiki.

George Athanasiadis
President
BETA CAE Systems S.A.



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Programme

Wednesday June 13

16:30 - 18:30 **Pre-Registration**
Meliton Hotel lobby

19:30 - **Dinner**
"Athos" Restaurant, Meliton Hotel - Reserved section / 19:30
**collect your ticket with your badge during Pre-Registration*

Thursday June 14

8:30 - **Registration**
Olympic Convention Hall lobby / 8:30

Opening Session H2.1
Olympic Hall 2 / 9:15
Chair.: S. Saltiel, R. Diez

9:15 - 9:30 **Opening Speech**
Prof. Dr. G. Athanasiadis
President, BETA CAE Systems S.A., Greece

9:30 - 10:00 **Building discipline specific FE-models based on the "Common Model" concept**
D. Zafeiropoulos[▲], G. Nikolaidis[▲]
BETA CAE Systems S.A., Greece

10:00 - 10:30 **Structural FE-model of thin adhesive layers well suited for implicit and explicit analyses**
T. Brandt¹, H. Friese¹, B. Heydt^{2▲}, Dr. U. Hindenlang¹
¹LASSO Ingenieurgesellschaft mbH, Germany, ²METABOWERKE GmbH, Germany

10:30 - 11:00 **Coffee Break**

Session H2.2
Olympic Hall 2 / 11:00
Chair.: P. Krishnaswamy, S. Seitanis

Session H3.2
Olympic Hall 3 / 11:00
Chair.: I. Nitsopoulos, G. Nikolaidis

11:00 - 11:30 **Capturing the best practices for the organization and analysis of crash-test simulation load-cases**
I. Makropoulou[▲], K. Skolarikis, K. Kiouptsidis
BETA CAE Systems S.A., Greece

Automated build-up and analysis of NVH models with ANSA/μETA package
M. Tryfonidis[▲], V. Pavlidis[▲]
BETA CAE Systems S.A., Greece

11:30 - 12:00 **Crashworthiness design of ANSALDOBREDA light metro vehicle**
L. Lenzi[▲], S. Raiti
AnsaldoBreda S.p.A., Italy

δYNAMIS: A new solver for linear and nonlinear finite element models
D. Giagopoulos¹, Prof. S. Natsiavas^{2▲}
¹DYNAMical Systems TechnologY, Greece, ²Aristotle University, Greece

12:00 - 12:30 **A CAE tool for processes optimization according to FMVSS201U**
P. Williamson^{1▲}, L. Rorris²
¹P+Z Engineering GmbH, Germany, ²BETA CAE Systems S.A., Greece

Automated process deployment for NASTRAN SOL200 optimization analysis, using ANSA/ μETA package
G. Korbetis[▲], K. Marmaras
BETA CAE Systems S.A., Greece

12:30 - 13:00

An efficient re-analysis methodology for optimization of large-scale vibration systems

Z. Mourelatos¹▲, E. Nikolaidis²

¹Oakland University, Rochester MI, USA, ²The University of Toledo OH, USA

13:00 - 13:10

Family Photo
Olympic Convention Hall entrance / 13:00

13:10 - 14:30

Lunch
"Athos" Restaurant, Meliton Hotel - Reserved section / 13:10
**your meal ticket is in your badge*

Session H2.3
Olympic Hall 2 / 14:30
Chair.: E. Skaperdas, G. Korbetis

14:30 - 15:00

Case study on the FE-model and geometry morphing in Structural Analysis
G. Panagos, Dr.-Ing. N. Drivakos[▲]
BETA CAE Systems S.A., Greece

15:00 - 15:30

Applications of shape optimization with LS-OPT and ANSA
M. Thiele¹, H. Müllerschön¹▲, W. Mühlhuber²
¹DYNAmore GmbH, Germany, ²AUDI AG, Germany

15:30 - 16:00

Analysis of component joints in Finite-Element models of car bodies
Dr.-Ing. H. Wüstenberg[▲]
Volkswagen AG, Germany

16:00 - 16:30

Coffee Break

Session L.4
Olympic Convention Hall lobby / 16:30

16:30 - 18:00

Technical discussions, demonstrations and meetings

20:00 -

Dinner - Social Event: "Greek Night"
"Ambelos" Taverna / 20:00
**your meal ticket is in your badge*

Friday June 15

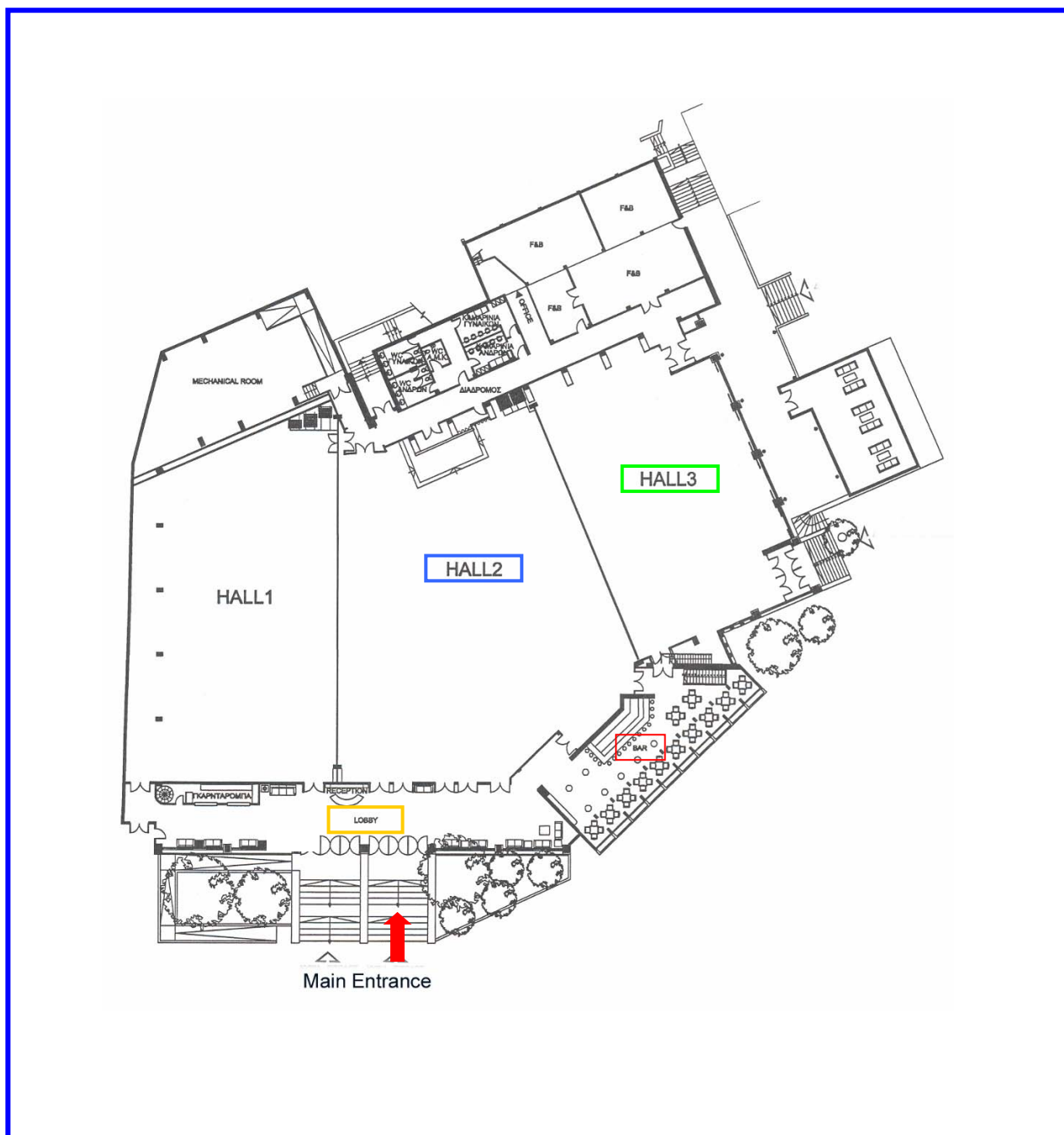
	Session H2.5 Olympic Hall 2 / 9:00 <i>Chair.: S. Natsiavas, G. Galaitis</i>	Session H3.5 Olympic Hall 3 / 9:00 <i>Chair.: Art. Papadopoulos, Z. Tsalparoglou</i>
9:00 - 9:30	Overview on optimization methods I. Nitsopoulos [▲] , B. Lauber FE-DESIGN GmbH, Germany	ANSA for CFD - overview and outlook M. Lanfrit [▲] , T. Lehnhäuser ANSYS Central & Eastern Europe - FLUENT Deutschland GmbH, Germany
9:30 - 10:00	Optimization of a vehicle front part structure at AUDI using ANSA morphing and Optimus M. Kaufmann ¹ , B. Lauber ^{2▲} , Dr. C. Katzenschwanz ² ¹ AUDI AG, Germany, ² FE-DESIGN GmbH, Germany	Combining quality, performance & efficiency in CFD pre-processing E. Skaperdas [▲] , C. Kolovos BETA CAE Systems S.A., Greece
10:00 - 10:30	A new approach for the preprocessing of TOSCA optimization tasks in ANSA G. Korbetis ¹ , D. Marmaras ¹ , B. Lauber ^{2▲} ¹ BETA CAE Systems S.A., Greece, ² FE-DESIGN GmbH, Germany	Automatic optimization of automotive designs using Mesh Morphing and CFD F. Campos ^{1▲} , G. Paolo ² , E. Skaperdas ³ ¹ ICON, United Kingdom, ² ESTECO, United Kingdom, ³ BETA CAE Systems S.A., Greece
10:30 - 11:00	Coffee Break	
	Session H2.6 Olympic Hall 2 / 11:00 <i>Chair.: A. Kaloudis, L. Rorris</i>	Session H3.6 Olympic Hall 3 / 11:00 <i>Chair.: J. Skarakis, K. Kiouptsidis</i>
11:00 - 11:30	Definition and parameterization of a process workflow, applied on modeling for ABAQUS Dr.-Ing. S. Seitanis [▲] , M. Giannakidis BETA CAE Systems S.A., Greece	Prediction of e-coat voids and puddles during automotive painting using ANSA P. D. Hanumalagutti ¹ , Y.-N. Liu ¹ , R. Mothukuri ^{2▲} ¹ Research and Advanced Engineering, Ford Motor Company, USA, ² BETA CAE Systems USA Inc., USA
11:30 - 12:00	Using submodeling technique to understand passivation cracks in microelectronic devices - Preprocessing with ANSA Dr. E. Barti ^{1▲} , Dr. M. Stecher ² ¹ SIEMENS AG, Germany, ² Infineon Technologies AG, Germany	Usage of ANSA's automated volume meshing-methods in the rapid product development process of diesel engines G. Pessl [▲] , Dr. R. Ehart, G. Bumberger BMW Motoren GmbH, Austria
12:00 - 12:30	Crack propagation in various 3-D shell structures, application of special software-tool using ANSA/μETA with standard ABAQUS solver D. Dreissig, B. Weisser [▲] , Dr. U. Hindenlang LASSO Ingenieurgesellschaft mbH, Germany	Pre-processing of lighting heat analysis at Visteon-Autopal T. Havlik ^{1▲} , R. Malucha ¹ ¹ VISTEON-AUTOPAL s.r.o, Czech Republic
12:30 - 13:00	Orthotropic material of bones generated by means of clinical CT-data, applied to FE models for the nonlinear simulation of one-leg stand with pelvis, femur and lower leg R. Schneider ^{1▲} , P. Helwig ² , G. Faust ³ , Dr. U. Hindenlang ¹ ¹ LASSO Ingenieurgesellschaft mbH, Germany, ² University of Freiburg, Germany, ³ University of Stuttgart, Germany	Thermal judder on drum brakes due to mounted radial run out D. Suryatama [▲] , R. P. Uhlig, S. Vallurupalli, R. M. Lundgren, F. J. Zweng DaimlerChrysler NA, USA

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13:00 - 14:30	Lunch "Athos" Restaurant, Meliton Hotel - Reserved section / 13:00 <i>*your meal ticket is in your badge</i>
	Closing Session H2.7 Olympic Hall 2 / 14:30 <i>Chair.: S. Saltiel, S. Seitani</i>
14:30 - 15:00	The development of the 2007 formula SAE by the ART-7 team D. Perperidis [▲] Prepared by the ART-7 team members
15:00 - 16:00	Latest & future developments on ANSA & μETA D. Angelis [▲] , D. Siskos [▲] BETA CAE Systems S.A., Greece
16:00 - 16:15	Closing Speech Prof. Dr. G. Athanasiadis President, BETA CAE Systems S.A., Greece
16:15 - 16:45	Coffee Break
	Session L.8 Olympic Convention Hall lobby / 16:45
16:45 - 18:00	Technical discussions, demonstrations and meetings
19:30 -	Dinner "Athos" Restaurant, Meliton Hotel - Reserved section / 19:30 <i>*your meal ticket is in your badge</i>

Olympic Convention Hall, floor plan



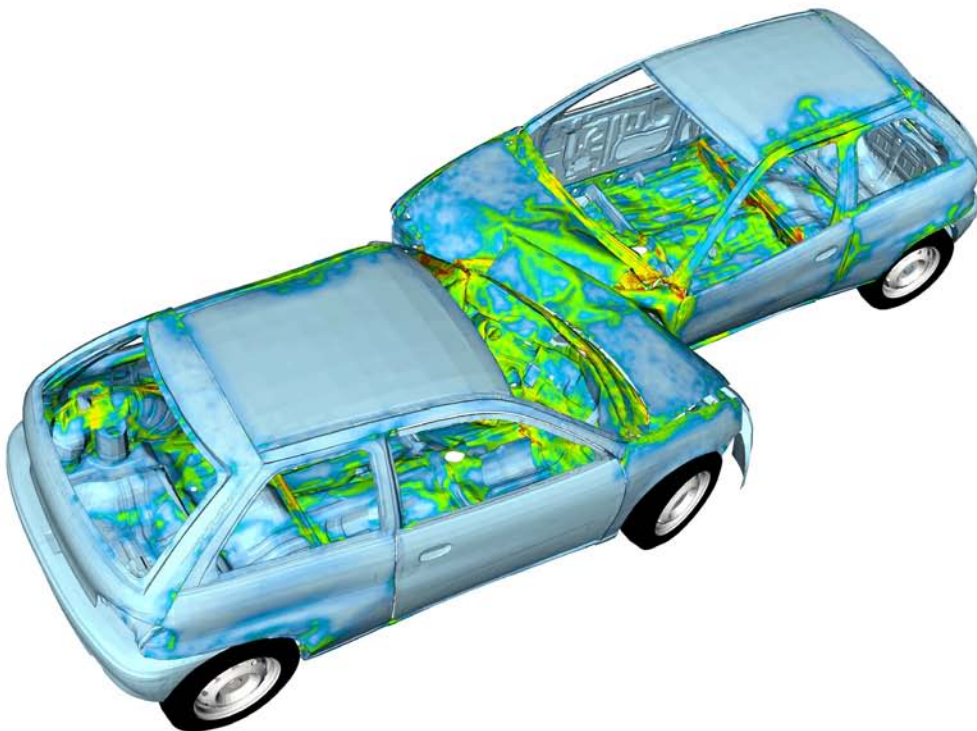
Porto Carras Grand Resort Hotel, site map



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Abstracts

2nd ANSA & μETA International Congress

June 14-15, 2007 Olympic Convention Center, Porto Carras Grand Resort Hotel, Halkidiki Greece

Session H2.1

BUILDING DISCIPLINE SPECIFIC FE-MODELS WITH THE COMMON MODEL CONCEPT

Georgios Nikolaidis^{*}, Dimitrios Zafeiropoulos^{*}

BETA CAE Systems S.A., Greece

KEYWORDS - data management, batch meshing, common model

ABSTRACT - The research & development phase in the automotive industry is faced with a continuously increasing number of FE simulations. Almost 75% of the total time required for the model building of a vehicle for 5 different disciplines (frontal, side & rear impact, NVH, durability) is spent until the engineer is able to apply all kinds of load cases to the analysis model.

Therefore, the big challenge is to establish a pre-processing workflow, which ensures that the different kind of requirements are met by these models, with a high reliability and reduced cost / time effort.

This paper will present the Common Model concept, introduced by BETA CAE Systems, towards the creation of Discipline Models starting from CAD Data.

STRUCTURAL FE-MODEL OF THIN ADHESIVE LAYERS WELL SUITED FOR IMPLICIT AND EXPLICIT ANALYSES

¹Thomas Brandt, ¹Holger Friese, ²Boris Heydt, ¹Dr. Ulrich Hindenlang

¹LASSO Ingenieurgesellschaft mbH, Germany, ²Metabowerke GmbH, Germany

KEYWORDS -

ABSTRACT - Structural stiffness properties of assemblies are affected to a considerable degree by coupling conditions of construction units. More and more adhesives replace welding and other techniques for joining parts. These kind of connections are a high challenge for a realistic representation in FE-analyses. By the method presented here it is shown how such an adhesive layer can be represented in a simply handled way. Additionally it is still possible to use already existing FE-models of assemblies without modifications of the way of discretisation generally applied.

Starting from a volume representation of the connected parts as well as the adhesive layer, the transition to a shell representation of the parts is performed. Here the adhesive layer is inserted in between the parts as an automatically generated network of rod elements. For this purpose there are nearly no extraordinary demands to the connected shell mesh. There is no need of an identical mesh topology of the connected regions. Also, it is possible to couple structures with shell meshes of different element sizes.

For a correct representation of stiffness properties the cross-sections of the rod elements have to be calibrated with respect to the element sizes and the thickness of the connected parts. Also this process of calibration is automated. The calibration itself has been analysed and tested in a study of convergence.

This FE-representation of adhesive layers has a large variety of applications. There are simple stiffness analyses and crash simulations. For crash simulations an additional failure criterion, which still has to be determined, can be defined. Furthermore it can be used in thermo mechanical analyses and in simulations of the adhesive's hardening process in course of fabrication. For this specific application a particular material description has to be defined. Here it is necessary to consider that the adhesive does not show a non-negligible stiffness from the beginning but only when re-cooling the assembly. Influences of different thermal expansion coefficients as well as an inhomogeneous development of the temperature field have to be taken into account and can be visualized by this simulation.

The suitability of the developed FE-representation was tested at samples of simple geometry. Subsequently this technique was validated at a car door in hybrid design.

Up to now this simulation of the manufacturing process is the main application of this method, where it has been used frequently and very successfully.

Session H2.2

CAPTURING THE BEST PRACTICES FOR THE ORGANIZATION AND ANALYSIS OF CRASH-TEST SIMULATION LOAD-CASES

Irene Makropoulou^{*}, Konstantinos Kiouptsidis, Konstantinos Skolarikis

BETA CAE Systems S.A., Greece

KEYWORDS - Simulation model robustness, process repeatability, crash-test simulation, Data Management, Task Manager

ABSTRACT - The current tendencies of modern automotive industry impose the reduction of the CAE turnaround cycle, promoting at the same time the requirement for the generation of robust simulation models. Currently, slight changes in model parameters may result in a great scatter in simulation results. The robustness of the simulation models also suffers from the incorporation of changes that originate from the product evolution process. To develop accurate models, the CAE engineers have a great necessity for pre- and post-processing tools able to safeguard and capture the best practices used for the simulation model build-up and evaluation, reducing the error-prone procedures involved in the CAE-cycle while ensuring the repeatability and versatility of the complete process.

This paper will present the means provided by BETA CAE Systems towards the development of robust, repeatable and realistic crash and safety simulation models and the evaluation of the analysis results. ANSA Data Management facilitates the "replace-include-exclude" procedures that constantly arise during the model build-up, while ANSA Task Manager guides the generation of the simulation models, identifying the dependencies among modelling actions. The simulation model set-up becomes a repeatable and user-independent procedure, safeguarding the model quality and fidelity.

CRASHWORTHINESS DESIGN OF ANSALDOBREDA LIGHT METRO VEHICLE

Luca Lenzi^{*}, Stefano Raiti
AnsaldoBreda, Italy

KEYWORDS - crashworthiness, 15227, crumple, absorption, metro

ABSTRACT - The latest revisions of prEN15227 introduced new strong requirements related to the lifting of the axles mounted on the bogies of the impacting vehicles. This work describes the methodology applied by AnsaldoBreda to demonstrate the compliance of its new Light Metro Vehicle to all the prescription stated in prEN15227.

Starting from the main idea of the train configuration, the passages needed to define the final layout of the adopted energy absorption devices have been illustrated. The whole model has been realized with ANSA and consists of a FEM description of the vehicle VS vehicle crash scenario, with initial vertical offset. The models of the leading cars belonging to the two impacting metro units embody the sacrificial crumple elements, the automatic coupler and the bogies.

Due to the fundamental role covered by the bogies both in the dynamic behaviour of the vehicle and in the analysis of the vertical movements of the axles, a special attention has been dedicated to the development of their models.

The whole final model consists of about 1400000 elements, the simulations have been performed with LSTC LS-Dyna X64 solver and the post processing of results has been carried out with LSTC LS Post and μ ETAPost.

A CAE TOOL FOR PROCESSES OPTIMIZATION ACCORDING TO FMVSS201U

¹Peter Williamson^{*}, ²Lambros Rorris

¹P+Z Engineering GmbH, Germany, ²Beta CAE Systems S.A., Greece

KEYWORDS - FMVSS201U, Occupant Protection, Interior Impact, Head Impact

ABSTRACT - At the start of the last decade leading up to the turn of the century it became apparent that unrestrained occupants in automobile accidents were suffering major head injuries as a result of the impact against the vehicles interior. In order to ascertain the cause of these injuries The National Highway Safety Administration (NHSTA) began its work.

Results of studies carried out showed that impact occurred on points of the upper roof, upper side rails and pillar areas. In order to reduce the risk of severe head injury a legal requirement was developed with the objective being to commit automobile manufactures to setup the car interior as "energy absorbing" as possible. The standard FMVSS201U (Federal Motor Vehicle Safety Standard, Upper Interior) began on 1. September 1998 and became law, with exceptions, in the USA on 1. September 2002.

The FMVSS201U test procedure CFR_571.201 involves the use of a modified Hybrid III 50thile head form commonly known as the FMH (Free Motion Head Form) for use in high impact testing against the interior components of the test vehicle in question. The procedures describe how to position the FMH, how to find the required impact points inside the test vehicle and the impact speed required for the desired impact point. An accelerometer in the FMH measures the acceleration during impact and rebound The HIC(d), Head Impact Criteria, is then calculated in order to measure the severity of the impact on the interior components in question.

In order to increase efficiency and aid in the all phases of a vehicle development program simulation teams are called upon, using the Finite Element Method, to help optimise many aspects of vehicle structural behaviour. FMVSS201U tests are currently being successfully carried out on virtual near to full vehicle finite elements models. In corporation with Beta CAE Systems S.A., P+Z Engineering GmbH has developed and is continuing to improve a tool which aids in generating the necessary data required for the "worst case" placement, highest HIC(d) value during impact. This paper aims to shed some light on the complexity of this problem and show how new developments continually being incorporated in ANSA aid in finding the "worst case" impact for the FMH.

Session H3.2

AUTOMATED BUILT-UP AND ANALYSIS OF NVH MODELS WITH ANSA/μETA PACKAGE

Michail Tryfonidis^{*}, Vassilios Pavlidis^{*}

BETA CAE Systems S.A., Greece

KEYWORDS - Pre and Post Process Automation, NVH Analysis, Data Management, Task Manager, Reliable Models

ABSTRACT - Among the requirements of nowadays vehicles development, NVH defines one of the main attributes ensuring driving comfort with respect to the passenger's welfare. The use of the Finite Element Method (FEM) is becoming more and more important on this field, providing a means for simulating and improving the perceptions of a model, and thus, complementing efficiently the laboratory results.

The creation of reliable models that will deliver accurate results is a strenuous, time-consuming and error-prone process due to the particular requirements of NVH analysis and the communication bottlenecks, naturally existing between the different engineering teams that need to share information and be updated. Moreover, building such models efficiently implies that tedious tasks should be conducted fast, without errors and with the minimum user-interaction, assuring repeatability.

This paper presents an integrated process workflow using the ANSA/μETA Software Package, distributed by BETA CAE Systems S.A., for the development of NVH simulation models and the evaluation of the analysis results. The Data Manager tool imports and handles all different components with their suitable template-based representation and automatically looks after the versioning of parts, thus ensuring that the model will be always updated. The whole process of building up the model is controlled and monitored through the Task Manager, which includes all individual tasks of the workflow in a step-wise manner. Using the Data and the Task Managers, results in the NVH-simulation becoming a repeatable and cost-efficient procedure, assuring at the same time the high quality of the model.

δYNAMIS: A NEW SOLVER FOR LINEAR AND NONLINEAR FINITE ELEMENT MODELS

¹Dimitrios Giagopoulos, ²Sotirios Natsiavas*

¹DYNAMical Systems TechnologY, Thessaloniki, Greece

²Department of Mechanical Engineering, Aristotle University, Thessaloniki, Greece

KEYWORDS - automated finite element modeling, substructuring, static and transient analysis, linear and non-linear frequency response, deterministic and random analysis.

ABSTRACT - δYNAMIS (**DYNA**mics of **Mechanical Systems**) is a numerical code leading to an automated determination of the response of mechanical systems, in an efficient way. These systems are geometrically discretized by finite elements. Frequently, this leads to models with a quite large number of degrees of freedom and strongly nonlinear characteristics. Therefore, one of the basic ideas employed in designing the code was to provide the option of reducing the order of the systems examined by applying appropriate methodologies, when necessary. Apart from increasing the computational efficiency and speed, this reduction makes amenable the application of numerical techniques, which are efficient for low order systems.

In particular, δYNAMIS starts by reading all the necessary data in standard NASTRAN format from pre-processor ANSA, in order to set up the corresponding equations of motion. Then, a number of static and dynamic analyses can be performed. Currently, the code can be used to carry successfully out the following types of analysis:

- Static Analysis (for linear and nonlinear systems),
- Eigenvalue Analysis (real and complex natural frequencies and mode shapes),
- Substructuring (static condensation, component mode synthesis, multi-level dynamic substructuring),
- Linear Transient Response Analysis (direct integration and modal analysis),
- Linear Frequency Response Analysis (direct determination of frequency response functions and modal analysis),
- Nonlinear Transient Response Analysis (direct integration),
- Nonlinear Frequency Response Analysis (direct determination of periodic steady-state response diagrams and stability properties under periodic excitation) and
- Random Analyses.

Once the analysis chosen is completed, the results are directed to post-processor μETA. In fact, in order to achieve compatibility with most state of the art CAE post-processors, these results are written in NASTRAN (op2 or punch file) format.

The validity and effectiveness of δYNAMIS was first illustrated by passing standard tests on the finite element level. Moreover, direct comparison was performed (in terms of accuracy, memory required, data transferred and numerical speed) with MSC.Nastran for several quite complex structures. Besides the computational advantages, the code developed brings a lot of new features and improvements, which can be enhanced further by a proper coupling with the pre- and post-processor. For instance, the structure of the code facilitates greatly the application of parallel processing procedures. In addition, a distinct capability of the code is related to the special contact elements developed for both static and dynamic analyses. Another remarkable and unique strength is the ability to perform frequency response of periodically excited nonlinear dynamical systems in a direct way. Finally, δYNAMIS provides valuable tools towards employing a single original model for all the possible analyses (e.g., vibration, acoustics, fatigue) that need to be run for systems of any geometric complexity.

AUTOMATED PROCESS DEPLOYMENT FOR NASTRAN SOL200 OPTIMIZATION ANALYSIS, USING ANSA/ μETA PACKAGE

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KEYWORDS - (optimization, NASTRAN, morphing, task management)

ABSTRACT - The use of optimization techniques becomes increasingly popular both in the early design stages of the product and during the final testing using the Finite Element Analysis. Furthermore, the computational power now available, is sufficient for using optimization on realistic product simulation models. As a result, the increasing complexity of the optimization problem and the subsequent complexity of the optimization software, render essential the use of a tool that organizes the definition of such processes and evaluates the results.

Pre-processing for the NASTRAN optimizer is possible through the Task Management functionality of ANSA which provides flexibility, reusability and knowledge transfer.

At the same time ANSA Morphing Tool provides all the necessary functionality for shape optimization definition and easy coupling with the NASTRAN optimizer, while μETA PostProcessor offers an efficient way to evaluate the results.

AN EFFICIENT RE-ANALYSIS METHODOLOGY FOR OPTIMIZATION OF LARGE-SCALE VIBRATION SYSTEMS

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KEYWORDS - Optimization, vibration, re-analysis, reduced-order modelling

ABSTRACT - Finite-element (FE) analysis is a well-established methodology in structural dynamics. However, optimization and/or probabilistic studies can be prohibitively expensive because they require repeated FE analyses of large models. Various re-analysis methods have been proposed with the premise to effectively calculate the dynamic response of a structure after a baseline design has been modified, without recalculating the new response.

The parametric reduced-order modelling (PROM) and the combined approximations (CA) are two re-analysis methods, which can handle large model parameter changes in a relatively efficient manner. Although both methods are promising by themselves, they can not handle large FE models with a large number of degrees of freedom (DOF) (e.g. greater than 100,000) and a large number of design parameters (e.g. greater than 50), which are common in practice. In this paper, the advantages and disadvantages of the PROM and CA methods are first discussed in detail.

Subsequently, a new re-analysis method is proposed where the original CA method is modified to further improve its efficiency, especially for problems where a large number of modes must be retained. The modified CA (MCA) method and Kriging interpolation are then integrated with the PROM approach, to formulate an efficient re-analysis method which can be used for optimization studies of complex structures. The method can efficiently handle large FE models with many design parameters that vary in a wide range.

A vibro-acoustic analysis of a realistic vehicle finite-element model is presented to demonstrate the efficiency and accuracy of the new re-analysis method and a design optimization study highlights its capabilities.

Session H2.3

CASE STUDY ON THE FE- MODEL AND GEOMETRY MORPHING IN STRUCTURAL ANALYSIS

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KEYWORDS - geometry morphing, FE- model morphing, morphing, design process, optimization

ABSTRACT - In order to minimize time and resources needed to develop new prototypes, designers use already built models and based on these they continue with the creation of the new one. Again, in order to minimise development cost, old parts, doors, bonnets etc., are modified in order to be used in new prototypes. There are also cases that for finished models some modification are needed in order to meet new requirements, (creation of embosses to control deformation) but minimal or no manual intervention is wanted either for the mesh or the boundary conditions.

This procedure, modifying an existing design in order to develop a new one or to meet specific requirements for some parts, can be achieved using ANSA Morphing Tool. With the morphing tool the engineer is capable of shaping his design according to his every need. Till now, ANSA Morphing Tool worked only on FE-models and in conjunction with the mesh reconstruction/regeneration capabilities of ANSA, it was possible to modify complete models with minimal or no user intervention. The only drawback of this procedure, is that since geometry is not included in the morphing, the final shape can not be outputted and used by any CAD software.

In the present paper, ANSA Morphing Tool for geometry is introduced for the first time. The procedure of Geometry Morphing is presented for a number of cases, alongside with FE-model morphing for the same cases, starting from the initial geometry and concludes after morphing to the final model that also includes the new geometric definition which can be used by a CAD software.

APPLICATIONS OF SHAPE OPTIMIZATION WITH LS-OPT AND ANSA

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KEYWORDS - Optimization, Morphing, Meta-Models, Crashworthiness, Process Flow

ABSTRACT - The purpose of this paper is to explore aspects of shape and geometry optimization for nonlinear applications and to propose optimization strategies for such problems.

Different optimization strategies are discussed and pros and cons are compared. The application of the Successive Response Surface Method (SRSM) for optimization of nonlinear applications is demonstrated. This is performed using LS-OPT as optimization software and ANSA as pre-processor for geometry variation. For this ANSA is run in batch mode and is driven by parameterized control files, which interface with the optimization software LS-OPT. By the variation of morphing control parameters or just geometrical translational or rotational operations the design is optimized with respect to shape properties and geometrical configuration. After morphing operations usually automated batch meshing of the considered parts is applied.

The set-up of the process flow and how the several programs interface with each other is also described in the paper.

In addition, a methodology to get a reliable surrogate model using neural networks is introduced. The surrogate model (Meta-Model or Response Surface Model) approximates the relationship between design parameters and a simulation response and can be used to visualize and explore the design space.

One of the regarded examples treats the optimization of a crash box at AUDI. The procedure of generating an advanced meta-model to get an approximation of the global design space using neural networks is demonstrated for this example. Furthermore, the visualization of multi-dimensional meta-models in two- and three-dimensional design space is illustrated by using the software D-SPEX. The program D-SPEX interfaces with LS-OPT as an advanced optimization and stochastic post-processor.

ANALYSIS OF COMPONENT JOINTS IN FINITE-ELEMENT MODELS OF CAR BODIES

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KEYWORDS - Finite-Element, Model, Check, Connectivity, Optimisation

ABSTRACT - A body-in-white of a car in sheet-metal integral design is composed of components connected by suitable joints. Challenge for the body development is to generate a stiff and lightweight body-in-white structure according to the performance specifications. The finite element analysis is the appropriate method to investigate the performance of a given design.

The stiffness of a body-in-white can be rated using results of a modal analysis or a static loading obtained from a finite element model. Crucial for the usability of the produced results and for subsequent computations is the appropriate definition of the joints in number and location. The checking of models for missing or misplaced joints and the redistribution of joints is a time consuming manual process. To simplify this task a method is suggested which reduces the manual effort.

The key of the suggested method is a reduction of the body-in-white to surface elements which are located in contact distance to each other. During the process of reduction, a projection algorithm is used to identify possible contact surfaces in irregular finite element meshes. Results of a finite element analysis with the full structure are needed to find suitable criteria for the quality of the joining technique. Scalar quantities or vector data on nodes or elements produce usable criteria. Typically, from the results of a modal analysis, the relative displacement between the component surfaces or the strain energy in the metal sheets is used.

A rating of the chosen criteria at the connection faces identifies regions with a potential for improvements of the joining technique. The magnitude of the improvement can be estimated by an automated redesign of the joining technique in sensitive regions. The application of the method is presented on recent car configurations of Volkswagen Nutzfahrzeuge.

Session H2.5

OVERVIEW ON OPTIMIZATION METHODS

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KEYWORDS - Non-parametric optimization, Parametric Optimization, Design of Experiments, Response Surface Modelling, Multidisciplinary Optimization

ABSTRACT - Structural optimization plays an important role in industrial application. A variety of optimization methods for the improvement of structural components exists. Each of these methods has its advantages and drawbacks. The choice of the right method for optimization is dependent on different conditions: The problem size, type of objectives and constraints, number of design variables and much more. Not only the suitable optimization strategy has to be selected but in many cases, the parameterization of the inputs is also an important issue.

The presentation will give an overview of a variety of types of parametric and non-parametric optimization methods and their use on different applications. It will be pointed out how ANSA is supporting the optimization workflow for preprocessing and parameterization of models used for optimization. Not only the preprocessing itself but also the automation of these steps is very important for an optimization procedure, where manual interaction is to be avoided.

OPTIMIZATION OF A VEHICLE FRONT PART STRUCTURE AT AUDI USING ANSA MORPHING AND OPTIMUS

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KEYWORDS - Mesh Morphing, Reconstruction, Structural Optimization, ANSA, OPTIMUS

ABSTRACT - Simulation techniques are used in an early design phase to generate design variants for the evaluation of the components behaviour. The generation of these design variants may be very time consuming. Many aspects have to be considered during the setup of the different simulation inputs. The geometry must be correct, the mesh quality must be adequate and all boundary and loading conditions for the simulation must be applied correctly. The use of mesh morphing techniques brings an enormous benefit as existing simulation models, which are already validated, may directly be used for the parametrization. The availability of mesh reconstruction algorithms ensure the quality of the finite element mesh during the modification procedure.

In this paper, mesh morphing techniques in ANSA are used on the optimization of a vehicle front part structure. Different targets like the weight, packaging, and other functional requirements had to be considered during the optimization. The introduction of shell thickness modifications as design variables did not lead to satisfactory results. So larger geometry changes were introduced by mesh morphing. An existing simulation input is parameterized and the new defined control points may be used as design parameters. The underlying mesh is modified corresponding to the control point movement. This parametrization is now to be used in the optimization system OPTIMUS to build up an automated workflow which may be used for optimization.

A NEW APPROACH FOR THE PREPROCESSING OF TOSCA OPTIMIZATION TASKS IN ANSA

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KEYWORDS - Non parametric structural optimization, TOSCA, shape optimization, bead optimization, topology optimization

ABSTRACT - Non-parametric optimization methods are an efficient way to find an optimal design on a very early phase of the design process. Topology optimization may be used to find new design proposals based upon a maximum design space. Shape optimization is reducing local stress peaks or increasing components lifetimes by modifying the components surfaces only. Bead optimization increases the stiffness of sheet metal structures by introducing stiffeners.

These different types of structural optimization are available in the non-parametric optimization software TOSCA. A completely new approach of executing preprocessing for non-parametric optimization tasks will be presented in the ANSA environment. The intuitive optimization environment provides an easy-to use optimization preprocessor that supports the complete design process. The use of the application will be demonstrated on existing examples of structural optimization.

Session H3.5

ANSA FOR CFD - OVERVIEW AND OUTLOOK

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KEYWORDS - CFD, Preprocessing, FLUENT, Morphing, Meshing

ABSTRACT - Preprocessing is the primary and underlying Step in every CFD process. It is mandatory for a good and reliable result of the subsequent simulation. As computer resources grow and get cheaper, Engineers of all industries want to simulate in more detail and thus deal with complex geometries and a variety of CAD and mesh formats.

Based on an existing mesh, mesh deformation in combination with design optimisation methods yield significant gains in term of CFD productivity and turnaround time.

ANSA offers advanced tools to deal with complex geometries and mesh deformation. It is known as one of the most reliable Preprocessing tools in the world.

The application of ANSA in the CFD process is shown for a specific industrial case.

At the end of the presentation, the future demands of CFD users with respect to a Preprocessing tool will be highlighted.

COMBINING QUALITY, PERFORMANCE & EFFICIENCY IN CFD PRE-PROCESSING

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KEYWORDS - CFD pre-processing, CFD best-practices, meshing, model organization, morphing

ABSTRACT - The creation of mesh models for complicated automotive applications is an increasing challenge as demands for high simulation accuracy and short time cycles are mandated by current market needs. Several steps are included in the preparation of a CFD model and some of them are quite laborious. Many advances have taken place in fully automatic pre-processing for structural applications, but the additional complexity of CFD pre-processing does not allow this yet. The best possible solution for CFD pre-processing must balance well between mesh quality, which will allow and ensure reliable simulation results, and process efficiency with respect to time of manual and automatic operations and the handling of very large amounts of data.

Accepting the fact that user intervention and actions are currently required to ensure a high quality mesh, a case study of a CFD model creation for a racing motorbike is here presented. Following all common CFD recommended practices, a complete mesh model is prepared in ANSA. An investigation of the feasibility of the generation of various mesh configurations and densities with respect to user effort is made. In particular, the geometrical complexity of the model with its multiple interconnected zero-thickness walls provides a challenge for the generation of boundary layer volume elements. In addition, the treatment of the exposed sides of the boundary layer elements with and without conformal interfaces is considered. Representative simulation results are presented and compared to available literature findings. Finally, mesh morphing is performed to examine the possibilities of reshaping and reusing the same mesh model to modify the motorbike's flow characteristics.

AUTOMATIC OPTIMISATION OF AUTOMOTIVE DESIGNS USING MESH MORPHING AND CFD

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KEYWORDS - aerodynamics, optimization, modeFRONTIER, ANSA, FLUENT

ABSTRACT - The growing access to extensive computational resources and the introduction of parallelisation methods has facilitated the integration of CFD analysis and optimisation techniques as a way to reduce lead-times from concept to market.

This paper describes an example of an automotive application where response surface optimisation methods have been successfully applied to fluid related design problems using a combination of ANSA, FLUENT and the multi-objective optimisation product modeFRONTIER, as part of a proof-of-concept exercise.

Session H2.6

DEFINITION AND PARAMETERIZATION OF A TASK MANAGER PROCESS WORKFLOW, APPLIED ON THE GENERATION OF AN ABAQUS LOADCASE

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KEYWORDS - Template driven process, parameterization, automation, repeatability, ABAQUS

ABSTRACT - The current trend of template driven CAE analyses imposes the need to define and parameterize flexible and reusable model build-up processes. Within this concept, this presentation will focus on the actions that a CAE analyst should take to achieve this goal.

For any given task of relatively high complexity, the engineer should plan the skeleton of the automated process and continue on to its implementation. Typical aspects in this respect are the recognition of the loadcase being investigated, the respective model and analysis specific data and the organization of all these in a 'data pool'. Regarding the actual implementation, individual task components need to be defined and correlated to each other, to handle model inter-dependencies and allow easy modifications.

This work exploits existing ANSA Task Manager functionality, to demonstrate the generation of a template driven process for an ABAQUS/Standard durability analysis. ANSA, along side ANSA Data Management and Task Manager, promote parameterization and safeguard model quality while keeping the complete process simple and versatile.

USING SUBMODELING TECHNIQUE TO UNDERSTAND PASSIVATION CRACKS IN MICROELECTRONIC DEVICES - PRE-PROCESSING WITH ANSA

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KEYWORDS - passivation cracks, microelectronics, temperature cycling, robust design, submodeling

ABSTRACT - Electronic devices like integrated circuits (IC) are used for automotive applications. The plastic (in the most cases mold compound) encapsulated devices exposed to temperature cycling (TC) undergo an excessive mechanical stress due to different coefficients of thermal expansion (CTE) of the various materials used in the system.

The large difference in the CTE between mold compound (MC) on the one hand and silicon and lead frame on the other hand causes in the metallization layers thermally induced strains and consequently stresses.

An analysis of the strains (or stresses), as they occur after molding, under subsequent tests, e.g. temperature cycling, and under realistic service conditions revealed that plastic encapsulated ICs show two main failure mechanisms, which are thermo-mechanically induced: metal shifts and passivation cracks.

This paper presents the computation of the thermally induced strains and stresses by using the Finite Element Method (FEM). The very small feature size of the passivation layer comparing with the global package size is one of the greatest problems in the application of the mentioned method and was solved by using submodeling.

Submodeling is a finite element technique that can be used to obtain more accurate results in a particular region of a model. A finite element mesh may be too coarse to produce satisfactory results in a given region of interest. The results away from this region, however, may be satisfactory. By using submodeling to generate an independent, more finely meshed model of only the region of interest made in this case the computation of the strains and stresses possible.

The large possibilities provided by the software ANSA (Automatic Net-generation for Structural Analysis) allowed a time saving generation of the 3D geometry and mesh of the submodel.

Results obtained with the FEM show a very good coincidence with the Scanning Electron Microscope (SEM) images of the passivation surface. It was possible to understand the mechanism of crack appearance and to deduce actions to be taken to develop a robust design.

CRACK PROPAGATION IN VARIOUS 3-D SHELL STRUCTURES, APPLICATION OF SPECIAL SOFTWARE-TOOL USING ANSA/μETA WITH STANDARD ABAQUS SOLVER

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KEYWORDS -

ABSTRACT - A modular crack-propagation software-tool is presented using standard Pre- and Post-processing features of ANSA and μETA together with ABAQUS-Standard to simulate the load/displacement history of an arbitrary 3D shell structure. In order to efficiently simulate fatigue crack propagation in large finite element models a submodel is extracted from the global model. The submodel is subjected to the probably time-dependent kinematics given in the interface to the global model.

Concerning fracture mechanics theory the stress intensity factor (SIF) concept is applied. Various examples will show the general applicability and accuracy of the developed software-modules.

ORTHOTROPIC MATERIAL OF BONES GENERATED BY MEANS OF CLINICAL CT-DATA, APPLIED TO FE-MODELS FOR THE NONLINEAR SIMULATION OF ONE-LEG STAND WITH PELVIS, FEMUR AND LOWER LEG

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KEYWORDS -

ABSTRACT - A realistically modelling of the material of bones on the basis of clinical CT-Data is presented well suited for nonlinear analyses. The determination of the needed independent variables for the orthotropic stiffness was performed using established procedures. The identification of the different directions of orthotropy was carried out with the so called Star-length-distribution.

Using these directions the Youngs-moduli are evaluated by following the method invented by Roh-Hobatho-Ashman interpreting the density distribution of the CT-Data. The determination of the Poissons ratios was ascertained by empirical knowledge and then used for the definition of shear-moduli. The mapping of these sets of data to the realistic FE-model of one-leg-stand is presented, which is built of pelvis, femur and lower leg together with their appropriate muscles and tendons.

The sane skeleton as well as a stabilised trochantric fracture is shown in a one-leg-stand situation, analysed with a nonlinear standard solver to visualize the functionality of the implant with respect to the different distribution of forces.

Session H3.6

PREDICTION OF E-COAT VOIDS AND PUDDLES DURING AUTOMOTIVE PAINTING USING ANSA

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KEYWORDS - V.Traps, e-Coat void, e-Coat puddle, automotive paint, corrosion resistance

ABSTRACT - In automotive painting, Electro-Coat (e-coat) is applied to the car body sheet metal to increase its corrosion resistance. After e-coat application another three coatings of paint materials, namely prime, basecoat and clearcoat, are applied to provide the final paint finish. E-coat voids and puddles are common issues occurred during e-coat application and this study uses ANSA to identify the potential problem areas.

After the car body is coated with e-coat it is sent through a baking oven for curing. Two of the most common issues that occur during this process are voids and puddles. A void occurs when air is trapped in vehicle cavities. This prevents contact of the e-coat bath with the metal and thereby prevents paint deposition. A puddle occurs when excess e-coat liquid is trapped in the vehicle cavities due to incomplete drainage. This excess e-coat liquid reaches its boiling point while in the oven and can cause poor appearance on the vehicle exterior surface.

ANSA's built-in feature, V.Traps, was utilized in this study to detect the formation of voids and puddles. Combined with ANSA's localized meshing and hole creation features, it is easy to study the effectiveness of drainage hole locations on voids and puddles. Results of the case study are presented along with recommendations to enhance V.Traps features. A comparison between the traditional method for void and puddle prediction and ANSA's V.Traps feature is also included.

USAGE OF ANSA'S AUTOMATED VOLUME MESHING-METHODS IN THE RAPID PRODUCT DEVELOPMENT PROCESS OF DIESEL ENGINES

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KEYWORDS - ANSA, CAE-Simulation, automated Volume Meshing, complete engine models, diesel engine

ABSTRACT - In order to stay successful in today's competitive markets, it is necessary to set high end standards in the product development process of diesel engines and it is also essential to reduce the time needed for the development of new products.

Despite a further increase of power and torque, the weight of the new 4 and 6-cylinder diesel engines of BMW has been significantly reduced and high quality and low emissions standards have been achieved.

In this respect, state of the art CAE – simulation methods play an important role for today's development processes at BMW and therefore "New Automated Volume Meshing Methods of ANSA" are a milestone for a rapid and successful application of virtual product development. Some years ago, it was not possible to create complete engine FE – volume models within a rational time range. Hand made meshes take up to 10 weeks of pure meshing time and thus model changes, design variants or optimization loops were nearly impossible to handle, because of the enormous time consumption. ANSA's new automated meshing methods allow an effective creation of complex volume meshes, e.g. for complete cylinder heads or crankcases, within one or two days and so give a benefit of weeks to build up complete engine models.

As a result of this fast possibility to build up not only segment – models but also complete simulation models, effects like global bending, non-uniform temperature distributions, a.s.o. could be taken into account for the numerical optimization of engine parts.

Finally these "New Automated Volume Meshing Methods" allow an effective and rapid virtual product development and guarantee excellent results in component durability and quality despite increasing engine power and weight reduction.

PRE-PROCESSING OF LIGHTING HEAT ANALYSIS AT VISTEON-AUTOPAL

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KEYWORDS - heat analysis, lighting, ANSA, script, I-Deas TMG/ESC

ABSTRACT - Software I-Deas TMG/ESC (hereinafter TMG) is used by Visteon-Autopal for the heat analysis of lighting. ANSA is used for pre-processing and TMG is used for following solving and post-processing. Script for acceleration work created in the TMG (hereinafter TMGscript) allows the fast setting of the complete process but it requires modifications of the script for each analysis, therefore ANSA scripting language (hereinafter ANSAscript) was chosen in preference.

The main function of ANSAscript is to transfer the FE model from ANSA to TMG and to pre-process the analysis. Ansascript recognizes element property names which contain keywords for part names, materials, boundary conditions, etc., and accordingly, creates sets in Nastran deck and TMGscripts which use these sets. The transferring process is to run the TMGscripts created by ANSAscript which work with the FE model saved by ANSAscript as a TMG universal file.

The reason we use ANSA scripting language and not TMG scripting language is that ANSAscript is easier and based on language "C" which is found in most manuals. The process of transferring using ANSAscript, reduces the pre-processing time, simplifies model modification and eliminates mistakes made when setting boundary conditions and materials, manually. This procedure can be applied to any other software.

THERMAL JUDDER ON DRUM BRAKES DUE TO MOUNTED RADIAL RUN OUT

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KEYWORDS - Judder, Drum, Brake, Thermal, Vibration

ABSTRACT - Brake vibration is a phenomenon which induces seat, steering and body vibration on passenger vehicles these days. The phenomenon is popularly known as brake judder. One root cause of the brake judder is the non-uniformed radial thermal expansion of rear brake drums due to localized temperature increase, or known as hot spots. Non-uniformed temperature distribution causes ovality which is a deformed oval shape of the circular drum rubbing surface. The ovality is measured as the Mounted Radial Run Out (MRRO) which is the difference between the longest and shortest drum expanding radii.

The objective of this paper is to study analytically the generation and reduction of drum MRRO. ABAQUS code is used to analyze the MRRO finite element simulations while ANSA and μETAPost are used to pre- and post-process simulation results. Explicit heat transient analyses will be selected to correctly predict the phenomenon. Simulation results will be plotted as graphs to illustrate the MRRO and probable deformation scenarios of brake drums. Various design parameters which are significant to reduce MRRO will be outlined. On board vehicle tests were conducted to verify the recommendations and benchmark the CAE results.

Session H2.7

THE DEVELOPMENT OF THE 2007 FORMULA SAE BY THE ART-7 TEAM

Dimitrios Perperidis*

Prepared by the ART-7 team members¹

KEYWORDS -

ABSTRACT - In September 2007 a formula student team, named ART-7, has been established by students of the Department of Mechanical Engineering of the Aristotle University of Thessaloniki. The main goal of this team is to design and build a formula SAE type race car and to participate in the Italian event that is going to take place in 21-23 September 2007 in the Fiorano Ferrari race track.

In this presentation the Formula SAE event, the scope and procedure of the race and finally the criteria that have to be met are outlined at first.

Next, the choice of the basic design parameters is shown. Suspension, steering and braking systems are described. The analysis of the chassis space frame and the heavily loaded components, such as the wheel uprights, the wheel hubs and the differential arms has been carried out under several driving conditions. Pre- and post-processing have been carried out using the ANSA and μETA software of BETA CAE Systems S.A..

The presentation concludes with an update of the current preparation status.

¹. The ART-7 team consists of : Assoc. Prof. A. Mihailidis (faculty advisor) and the following members: G. Fontaras, G. Karaoglanidis, I. Nerantzis, (PhD students) and I. Aslanidou, V. Bitsanis, I. Bosdas, L. Kozas, I. Nasiopoulos, G. Pappas, D. Perperidis, G. Simos and N. Tsoukala (undergraduate students).

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