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BETA
SIMULATION SOLUTIONS

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Abstracts

Session 2

RENAULT MODEL FACTORY: MANAGEMENT OF MODEL BUILDING

Laurent Noyelle
RENAULT SA

KEYWORDS –
Model Building of CAE Models: quality management, lead-time reduction, cost reduction; Process management, data management, simulation configuration, CAE data life cycle

ABSTRACT
Renault has created a specific central organization to build and manage 3D simulation models that are used for the analysis of the performance of vehicles. Main purpose of this organization is to optimize the cost and the lead-time of CAE model building and ensure a well-established level of quality in reference to the methods that have been verified and validated by specialists in each domain of analysis.

Lead-time is constrained by the engineering process that requires simulation analysis based on a frozen vehicle definition at each digital development loop. Models should be provided quickly to let sufficient time for simulation analysts to evaluate the behavior of vehicle and propose some design modifications to solve performance issues or optimize the design cost / weight.

Analysts should be confident in the quality of models. If not, they will spend time for reviewing the quality of models instead of searching design proposals to increase the performance of vehicle. More critically in case of errors spread in models, they could propose some modifications of design based on simulation analysis that could be wrong and let take bad decision in projects. These errors could in worst cases be discovered during physical tests, leading to huge additional cost of validation. For these reasons, quality should be built without compromise: it should be carefully processed; evidence should be brought to demonstrate the quality that is achieved on the different parts of a model. Also, uncertainties that are embedded in models due to quality issues that could not be reduced (usually the case when inputs from design are not mature enough or when the methods are not robust enough) should be summarized and shared with simulation analysts for them to estimate the confidence in results that are produced.

In this presentation, Renault will focus on the specific contribution of SPDM tools to deal both with lead-time reduction and quality of models in the context of a central organization of CAE model building (model factory).

ANSA/META DEPLOYMENT IN GROUPE PSA

Jean-Christophe Carniel
Groupe PSA

KEYWORDS –
Software replacement, leadtime

ABSTRACT
In 2014 Groupe PSA decided to define alternative options to replace CATIAV5 dependent simulation solutions including VLAB. The main objective of this project was to make this shift while transferring the benefits and the know-how of the existing solutions for the following disciplines: Structures, Durability, NVH, Crash and Optimization. This was also an opportunity to reach 3 main goal: leadtime, adaptability, deployability.

A multiyear close partnership between Groupe PSA and BETA CAE Systems took place to make this project possible. Development were engaged by BETA and provided through a shared deliverable plan in addition with training material, migration tool,…

Deployment have been committed since 2017 on new project vehicle and as soon as any opportunity appeared. Different KPIs were measured to confirm the achievement of the targets.

Session 3B

CAE DATA MANAGEMENT AND STANDARD PROCESS TOOLING: STORYBOARD FROM RENAULT GROUP MODEL FACTOR

Jeremie Gomez
RENAULT SA

KEYWORDS –
Models Build-up Process, Data Management, Configuration

ABSTRACT
From 2014, RSA decided to concentrate all activities concerning vehicle performance validation within same division. Taking opportunity to group all levels of CAE domain (methods, modelling, analysis, tests), Model Factory was in capacity to standardize, communalize and organize its activity with optimized approach … in the past, several SDM projects were attempted to deploy a global way to manage CAE data, without success …

After a tool benchmark in 2016, we decided to choose BETA tool SPDRM to support our project, in relation with ANSA/META suite already exclusively used for vehicle modelling. Two years after start of this project, a big stage of deployment has been completed.

This session will resume briefly the global process which drives RSA Model Factory process, and focus on some chosen use cases developed and deployed in this context of data management backbone project, methods standardization, modular configuration, automated processes:

•SPDRM data management (global data model for all domains)
•Crash diversity and loadcases configuration: monitoring of runs/models
•Modular organization and lifecycle tracking: Dependencies between models (parent-child)
•Full NVH trimmed body assembly (connectors and A-Points modular assembly)
•Automation examples with task management

FUTURE MODEL-BUILD-UP PROCESS IN ANSA USING MODULES

Dr. Jürgen Bruns
Volkswagen AG

KEYWORDS –
Model Build-up, ANSA, MODULEs

ABSTRACT
For the state-of-the-art prediction of car body behavior more and more physical and geometrical details must be implemented, so the number of entities in a car model is constantly increasing. Cost pressure and the need to develop car bodies based on the same platform for different brands, markets and customers leads to a highly parallel development process for the diverse subassemblies, like body-in-white, doors, powertrain et cetera. During the model-build-up and for the generation of car body variants these subassemblies are represented and handled as solver INCLUDE files.

To merge all these INCLUDES without having conflicts in the entity IDs a numbering convention is necessary, which prescribes the valid numbering space for each subassembly. But the increasing level-of-detail will disrupt the numbering space of certain subassemblies in the foreseeable future. As a solution for this problem the so called MODULEs were implemented in NASTRAN and Pamcrash, over the last years based on the requests and ideas of Volkswagen. The intention is to encapsulate the subassemblies in a way that the full range of entity IDs can be used during model-build-up for each subassembly. This leads to the possibility of having the same entity ID several times in a model. Since ANSA is an essential part in the VW model-build-up process, this functionality was implemented in ANSA and tested by Volkswagen. This presentation will give an overview about MODULEs characteristics and their usage during model-build-up with ANSA, the current level of implementation and future needs.

AUTOMATED CHECKLIST FOR INTERMEDIATE DELIVERIES

Julien Barbier
Groupe PSA

KEYWORDS –
ANSA, Model Check, Model Quality, leadtime, python scripting

ABSTRACT
During model assembly process for vehicle (in NVH, Durability and Crash perimeters), intermediate deliverables are required. ANSA checks must guarantee their quality. These checks were manually performed and without any tool to insure the correct process and robustness.

Thanks to ANSA python scripting capabilities, we were able to automatize all these checks into only one toolbox. The tools allow users to either perform checks interactively into ANSA, and then to easily correct errors, or to automatically generate an excel file that contains validation report.

This automation allows us to save time on model checks and insure that model quality is best in class. The automatic report allows an easy check and a quick overview of an ANSA model even without having to open it.

LEAD TIME REDUCTION - FAST AND EASY SETUP OF STRUCTURE LOAD CASES USING ANSA

Dr. Christoph Thiem
Opel Automobile GmbH

KEYWORDS –
Automation, Python, Script, Structure simulation

ABSTRACT
During the virtual development of a new car body structure, various load cases have to be simulated to evaluate the performance of the vehicle. For each change in the simulation model these load cases have to be set up and evaluated again, which causes a high lead time.

The aim of the presented project is to create script-based semi-automation tools within the ANSA environment that help the user to reduce this lead time. Additionally, the created programs should be fast to learn and reduce the number of potential errors compared to the conventional process.

The implementation was done for five typical load cases of the body-in-white (BIW) and the trailer hitch system. For each load case the script starts with a GUI where the user can specify the required inputs. These are, for example, the path of the ANSA model, the weight of the vehicle and load case specific data like the allowable maximum weight of a bicycle carrier. The user can save and load the input for a fast reuse. After the input is complete, the script supports the user during the creation of the corresponding load case. For this, the routines can support in cutting the FE-model, creation of forces and boundary conditions as well as the creation of NASTRAN headers for SOL101, SOL103 and SOL400. In addition, checks are performed on the final model and unnecessary entities are deleted automatically.

By implementing the described programs in ANSA, the lead time of approximately 2 hours per load case could be reduced to a maximum of 30 minutes. Due to the hardcoded formulas and calculations, the robustness against mistakes and oversights could be improved. A study showed that learning the use of the tools could be done through a help file because it is self-explanatory even for a less-experienced user.

Nevertheless, it should be avoided to provide the scripts to users without experience and understanding of the load cases as this could lead to fundamental errors in the results impossible to be caught by the scripts.

Session 3A

CASE STUDY: COLLABORATION FOR ADVANCED PROCESS AUTOMATION, GENERAL MOTORS & BETA CAE

Joshua Sims[1], Scott Larsen[2]
[1]BETA CAE Systems USA,
[2]General Motors

KEYWORDS –
Case Study, Collaboration, Process Automation

ABSTRACT
CAE process automation development faces many hurdles, including differing skill levels, sensitive information, and resource scarcity. BETA CAE Systems and General Motors developed an automated meshing tool through an informal partnership which fostered a wonderful collaborative experience. The development process was streamlined and the tool produced is robust, modular and well understood by all parties. This partnership provides a template for an extremely positive and efficient model of the client – vendor relationship.

ADVANCEMENTS IN BATCH MODEL PREPARATION WITH THE SDM-CONSOLE

Michael Tryfonidis
BETA CAE Systems

KEYWORDS –
dcm, batch meshing, mid-surfacing

ABSTRACT
To achieve weight reduction and increase fuel efficiency, automakers, are altering production techniques in the structure of their cars.

Rather than using regular sheet metals structures made out of steel, Tailor blank and aluminium meet the requirements as they lead to lighter structures and smaller number of parts, saving manufacturing and assembly cost.

However, even for regular sheet metals parts, alternative ways in using of welding and stud plates are considered. Such a way is the use of pressed elements. These parts though, constitute a challenge for batch processing towards FE-preparation, so that the proper mid surfacing and mesh strategy is being applied.

This paper will present the advancements made towards the batch processing of parts as put forward by BETA CAE Systems with its SDM-Console software tool, utilizing the latest achievements in pre- processing.

CAD SHAPE RECOGNITION AND MESH GENERATION TECHNIQUE USING ANSA SCRIPT

Koji Otani
Integral Technology Co., Ltd

KEYWORDS –
FEM, FEA, Automatic, Mesh Generation, Shape Recognition, CAD cleanup

ABSTRACT
It is important to use high-quality mesh for simulations since the result may vary depending on the input FEM mesh model. To assure the quality of simulation results, it is common to create FEM mesh models according to specific meshing rules.

In this paper, we described how we automatically generate FEM mesh for CAD models according to meshing rules using ANSA script. The CAD shape recognition algorithm that we used is for both surface-only CAD models and solid models. From the input CAD models, we analyze characteristics of each face and face continuity. The characteristics of face includes size, radius, and shape. For solid CAD models, we also analyze thickness to assure solid mesh quality. FEM mesh generation algorithm works based on this shape recognition database. To satisfy advanced meshing rules, we use shape data such as cross-sectional shape and face combination. We also use the CAD shape recognition data for quality error mesh modification process to maintain the CAD shape representation as much as possible.

Using the technique we described in this paper, we achieved to clean up CAD models and generate high-quality mesh according to meshing rules while maintaining CAD shape representation as much as possible. We applied this technique to an engine CAD model and confirmed that the entire process takes only about 1.5 hours to get the meshing result without quality error.

EXPLORATION OF MESHING STRATEGIES FOR HIGHLY COMPLEX PARTS

Dimitris Zafeiropoulos[1], Stylianos Karditsas[2], Christos Sachanas[2], Lazaros Adamoudis[2], Michael Tryfonidis[2]
[1]BETA CAE Systems International
[2]BETA CAE Systems

ABSTRACT
BETA has already dealt with the challenge of meshing sheet metal parts with constant thickness, through sophisticated, highly automated processes that deliver premium quality mesh. Traditional BiW scope of work for BMW is handled through DCM (KOMVOS), which benefits from robust and efficient tools including Catia conversion, Mid.Surfacing, and Batch Mesh. Parts at such scopes are meshed fully automatically by an estimated percentage more than 98%.
Rapid technological progress leads to new challenges, like tackling with different scopes of work which include plastic or aluminum casting parts, tailor rolled and tailor welded blanks, elongated parts, composites, parts with pre-stressed elements, complex composed parts and 3D printed parts.
BMW Closures department introduces such a different scope of work, consisting mostly by casting parts, whereas sheet metal parts of uniform thickness are met only by 20%. As a result, automated processes lead to a productivity increase that is not as high as found in BiW-domain, due to the parts' nature.
This presentation deals with the results of a thorough exploration of the mesh strategies identified in the closures domain and the automation level that can be achieved as of today for meshing complex geometry parts of different types. Nevertheless though, the outcome of this work goes beyond a simple reporting of what can be achieved, but serves as a signpost to where mesh automation can or should be levelled in the ANSA versions to come

Session 3C

THE TOTALLY NEW EVALUATION SCHEME OF JNCAP FROM 2020

Prof. Sadayuki Ujihashi
BETA CAE Systems Japan

KEYWORDS –
Automobile, JNCAP, Active & Passive Safety, ACN, Overall Evaluation

ABSTRACT
Due to the recent development of active safety technology and its rapid spread to the automobile market,

JNCAP has been discussed about that the current evaluation scheme needs to be altered fundamentally because the consumers are much more interested in about the active safety equipment of automobiles than the performance of passive safety.

So far the five star rating of JNCAP is available only for the passive safety performance such as frontal and side impact safety though in 2014 JNCAP already started to evaluate the active safety performance by autonomous emergency braking system.

As a result of the long discussion JNCAP decided to start new evaluation scheme combining the active safety and automatic collision notification system performance with the traditional passive safety.

Thus the highest five star rating is not given unless not only passive safety performance but also high level of active safety performance and automatic collision notification system are equipped about the new cars available in the market from 2020.

In this presentation the detail of the totally new evaluation scheme of JNCAP will be introduced by comparing the current evaluation scheme.

MULTI MATERIAL MODELING WITH ANSA: AN APPLICATION IN THE AUTOMATED ASSEMBLY PROCESS AT FORD

Tunc Uzun[1], Heiko Wuestner[1], Thanassis Fokylidis[2], Niels Pasligh[1,3], Vangelis Karatsis[2], Chien Ping Mark Ng[4]
[1]Ford Werke GmbH
[2]BETA CAE Systems
[3]RIC Aachen
[4]Ford Motor Company of Australia Ltd

KEYWORDS –
Connections, Solid Nugget, Multi-Material, script,

ABSTRACT
The simulations of virtual models hold a key role during the design process of a vehicle. The numerus different components in a CAE model make its assembly one of the most demanding tasks during the model buildup.

Over the last years, the effort to achieve higher accuracy in crash test simulations has resulted in more detailed models. As a result, the FE representations used to connect the different parts vary a lot and get complex sometimes. To support effectively such time-consuming and error-prone modeling processes, the available tools should offer increased automation and standardization levels.

A commonly used method is to simulate the area of these connections by using different material properties representing effectively not only the material of the connecting flanges but also the heat affected zones in each flange. Ford-Werke GmbH in cooperation with BETA CAE Systems has come up with a fully automated process within ANSA pre-processor that reads the CAE and its connection file, assigning the proper connectivity to each connection. Additionally, with the use of external files assigns the needed materials in the area of each spotweld using the respective LS-DYNA keywords. Finally reports to the user the results of the assembly procedure and the final status of each connection.

The current paper explains the basic terms of the automated process mentioned above. Moreover, it presents the techniques used within ANSA to assembly a full analysis model in a fast and robust way combining different FE-representations and multi material assignment in the area of a connection

CONNECTION MODEL AUTOMATIC CREATION TOOL DEVELOPMENT AT VEHICLE CAE MODEL BUILDING

Takashi Nasu
Nissan Automotive Technology / Vehicle CAE center

KEYWORDS –
Automation tool, Connection

ABSTRACT
Regarding automotive development, the CAE workload is increasing due to number of evaluation & number of models increasing with the combination of variant of models becomes complex, and crash requirements become severe.
And necessity of productivity improvement is increasing.

Regarding the vehicle CAE model building process,
Connection model is created depending on connection type (Bolt, Clip etc.).
To create the connection model, the type recognition of connection CAD data is needed, and classification is repeated 3,000 times because the 1 vehicle has 3,000 connection parts.

The new tool has been developed that can be recognized connection CAD data with the numerical data (Area etc.) in CAD data, and connection work became automated by ANSA.

SUBSTRUCTURING TOOLS FOR EFFECTIVE PRE- AND POST-PROCESSING

Nikolaos Nikoglou
BETA CAE Systems

KEYWORDS –
Substructuring, Interface file, Displacements vs. time histories, Optimization

ABSTRACT
Studying and optimizing specific areas (or parts) of a model is a common requirement. However, solving the full model multiple times is ineffective in terms of time, costs, and computational requirements, thus making it beneficial to work on substructure models.

The ANSA/META pre- & post-processing suite provides the appropriate tools for effectively handling a wide variety of such cases.

The Substructurer tool of ANSA offers the capability to easily create substructure models from a full one, set up in various solvers, such as the LS-DYNA, PAM-CRASH or ABAQUS. The substructuring is performed in only a few steps in a semi-automatic way, while interfaces are created automatically on the substructure area borders. During the full model analyses the Displacements vs. time histories of the interfaces are written in the interface file and then used to drive them during the substructure analyses.

The LS-DYNA Substructuring tool of META collects and stores the displacement data of selected interface areas from the full model crash analyses in various solvers, such as the LS-DYNA, PAM-CRASH, or RADIOSS, into an LS-DYNA interface file. This file is used subsequently for the substructure analyses with the specific use of LS-DYNA solver. The tool can be used also to modify the displacement data of an interface file derived during a full model LS-DYNA run. Modifications such as i) rigid body motion removal, ii) crash pulse application, and iii) scaling, can be applied.

Session 3D

LATTICE STRUCTURES MODELING: INTRODUCTION TO HOMOGENIZATION

Nikoleta Pasvanti[1], Andreas Psarros[1], George Korbetis[2], Andreas Vlahinos[3], Athanassios Mihailidis[1]
[1]Aristotle University of Thessaloniki,
[2]BETA CAE Systems
[3]Advanced Engineering Solutions

KEYWORDS –
Lattice structures, homogenization, Schwarz's P structure

ABSTRACT
The significance of lightweight structures is indisputable. Architectured materials like complex lattice structures can now be easily fabricated, due to the evolution of Additive Manufacturing (AM) technology. They contribute to weight reduction up to 80% of the initial bulk material, to cost reduction as less material is being used to manufacture them and less time is required with the aid of AM. Being almost as durable as a solid part, lattice structures are being used widely in medicine for implants, in the automotive and aerospace industry.

A review of the conventional CAE methods acknowledged crucial difficulties that led to the conclusion that these approaches can be grinding and inappropriate. The purpose of this research is to propose an effective and less time-consuming modeling method via material homogenization.

Two lattice unit cells were investigated: the simple beam lattice cell with diagonal beams (cell size: 10x10x10 mm, cross section diameters: 1, 2, 3, 4, 5 and 6 mm) and the unit custom cell Schwarz's P (cell size: 10x10x10 mm). The appropriate load cases were run in order to populate the stiffness matrix of the former lattice cell and the results were nondimensionalized. The material behavior according to the mass fraction of the structure was investigated. There were three parameters explored which have an impact on the results: the element length, the presence/absence of fillet radius and the element type. The pre and post-processing were automated with a script and imposed on the latter geometry. A hybrid solid – lattice part was designed afterwards for each geometry configuration and analyzed using two different approaches: solid mesh on the real part's geometry and solid mesh filled with elements of the equivalent material in the place of the lattice. The results obtained from the analyses for each unit cell were compared.

The solid mesh approach gives more accurate results but carries significant disadvantages regarding model complexity and solution time. The numerical homogenization method is effective, less time and memory consuming and allows for design freedom as no particular design limitations are taken into account.

RAPID REMODELING IN ANSA/META FOR ADDITIVE MANUFACTURING DESIGN OPTIMIZATION

Xiao Chen[1], George Korbetis[2], Panagiotis Pantazidis[2], Dimitrios Drougkas[2]
[1]Ford Werke GmbH
[2]BETA CAE Systems

KEYWORDS –
Topology optimization, Additive Manufacturing, Pre/Post processing

ABSTRACT
Additive manufacturing (AM) technologies are one of the key technologies in the future in automotive industry, since it allows complex product design and enables rapid prototyping. AM positioned to provide a disruptive transformation not only in product manufacturing process, but also in product design process. It is challenging to find the optimal design solution for AM product, as well as pre/post process the topological optimized design. This paper aims to present the advanced pre/post processing functionalities in ANSA and META, which enable smoothing, remodelling and validating topology optimized designs efficiently.

STANDARDIZATION OF X-ATTRIBUTE BODY ASSESSMENT BY COUPLING FEM AND MKS

Emilie Debauche[1], Markus Wick[2], Markus Herbst[3]
[1]Arrk P+Z Engineering
[2]Ford Werke GmbH
[3]BETA CAE Systems

KEYWORDS –
Trimmed Body, MKS, Adams, MNF-File, Vehicle Dynamics, Vehicle NVH, Road Load Data, NVH Console, Display Model

ABSTRACT
The procedure described is completely new for attributes such as Vehicle Dynamics, Vehicle NVH and RLD working with MKS. Its development was completed in co-operation with Beta CAE.
The process of creating standardized trimmed body control models within the Design Integration (DI) department and delivering these models to the vehicle attributes teams for evaluation (e.g. Body NVH and Safety) within a rigid time frame is well established.

The attributes report their assessments and recommendations on the control models simultaneously to program management.

For attributes using the MKS solver, issues occurred in the process which caused delays. To overcome these issues, DI developed a new process which incorporates smoothly FLEX body analysis models using MKS solver.

Development of this new process needed to resolve certain shortfalls, such as the adaption to weight targets, the dis-assembly into individual structural components, and the animation of analysis results in Adams.

The first steps of the process use ANSA, in order to prepare the model for the mnf file generation. This presented the first challenge to get a display model into the mnf file created with the NVH console. EPILYSIS was updated in order to achieve this. Other challenges resolved were the creation and viewing of animations and how to speed up and simplify the connection of different modules in light of changes,

This presentation gives an overview of the developed process, explains its details and gives an outlook on future steps.

EPILYSIS NEW TOOLS AND ENHANCEMENTS FACILITATE ANALYSIS SET-UP AND IMPROVE SOLVER PERFORMANCE

V. Pavlidis
BETA CAE Systems

KEYWORDS –
EPILYSIS, Optimization, Topology, Finite Element Analysis, NVH

ABSTRACT
EPILYSIS as the new FEA Solver of BETA CAE Systems has assisted the company to provide a complete package of solutions. With the drive to become better at all aspects of the solver, a series of new tools and enhancements have been implemented. Tools for checking the models integrity, updates in the optimization and also expansion in standard analysis types are some of the new features in the latest versions.

The new tools like the “First Elastic” and the “Normal Modes” are a helpful contribution in order to check the models integrity and conserve an important amount of time necessary for the solutions. The “First Elastic” tool is useful so that the first elastic eigenvalue of a single body structure can be calculated and monitored. While with the “Normal Modes” tool the number of the elastic eigenmodes below a certain frequency value can be computed and possible mechanisms can be detected.

In the optimization field a series of updates and new tools have been added. The stress constraint has been created for the topology optimization. And a new unique visualization has been added for improving the interpretation of the topology results when manufacturing and symmetry constrains have been used.

As a result of the ongoing development of our software, a series of standard analysis like the Modal Complex EigenValue Analysis and the Superelement Analysis has been added in EPILYSIS. Finally, a series of new performance benchmarks has been performed that show the comparison between EPILYSIS and the industry standard solvers in multiple solution types.

Session 4

ISOGEOMETRIC ANALYSIS OF LOCAL DEFORMATION AND FRACTURE FOR AUTOMOTIVE FRAMES

Kenji Takada
Honda R&D Co., Ltd. Automobile R&D Center

KEYWORDS –
Isogeometric Analysis, NURBS, high-strength steels, fracture

ABSTRACT
In order to reduce automobile body weight and improve the crashworthiness of passenger cars, the use of high-strength steels is greatly increasing in years past. However, the high-strength steels generally become less ductile. As the results, the fracture of steel material and spot weld failure may occur due to local deformation at corner of automobile frames. Therefore, the accuracy improvement of local deformation to predict the fracture is highly demanded by automotive industries. However, current shell and solid elements of conventional FEM generally use bilinear shape functions. It was found that bilinear shape function was difficult to predict a complicated local deformation with high accuracy. To resolve this problem, Isogeometric analysis was considered as a better alternative. Isogeometric directly deals with 3D CAD constructed by NURBS and calculates the NURBS model using high order shape function elements. First, NURBS generator tool was developed which can convert CAD data to analysis-suitable geometries. Using this tool, local deformations of typical crash verification models were investigated, which were S-frame model, 3-point bending model, L-T model of spot weld and hat-section model. These simulation results based on the Isogeometric analysis correlated well with the experimental tests regarding the local deformation. Next, V-notch plate models and 3-point bending models with V and U-notch were calculated to investigate the fracture and crack propagation. it was also found that 16 nodes shell and 64 nodes solid elements with C2 continuity were highly effective for fracture and stress concentration problems.

BRINGING REALITY INTO THE VIRTUAL WORLD

Eric DeHoff [1], Kishore Pydimarry [1], Santosh Patil[2]
[1]Honda R&D Americas, Inc.
[2]BETA CAE Systems USA

KEYWORDS –
CAE, automotive

ABSTRACT
Over the past twenty years and more, the automotive industry has been moving from a physical test-based development process to more of a virtual one. All aspects of the vehicle's design and performance targets are being driven by the use of CAE simulations. This includes all types of methods from traditional FEA for structures and CFD for aerodynamics to 1-D models of vehicle control systems. One of the key steps in this process is taking the data from one format like CAD and putting into various formats that physics-based solvers can use. Products like ANSA with its multidisciplinary capabilities address that need. Creating an efficient process to build and analyse models with as much detail as a physical vehicle is critical because of aggressive development cycles and ever-increasing number of load cases being analysed. The simulation software tools used in this process need to be optimized for performance, ease of use and robustness while handling large CAE models which are often more than 100 GB in size. Results visualization like realistic rendering and virtual reality is also very important when communicating with non-CAE experts and bringing their typical understanding of reality into the virtual world. In this paper we discuss current trends and state of the art in CAE simulation and discuss challenges and opportunities presented by ever increasing demands for better mobility solutions.

AUTOMATION OF PRE- AND POST-PROCESSING IN FERRARI GT CARS PROJECT

Dr. Luciano Mariella, Rubens Curatola
Ferrari S.p.A

KEYWORDS –
ANSA, META, CFD, pre-processing, post-processing, automation, Batch Meshing, Python

ABSTRACT
The current automotive market every day is becoming more demanding in many different aspects (models and variants, lead time, costs, technical requirements, etc.). To win such a challenge, the automotive industry is reacting in many ways, and one of them is moving to a more “digitalized” factory, widening the use of virtual simulations before moving to physical reality. Following this trend, the aero/thermal/acoustic aspects of a new car are increasingly investigated and managed through CAE before to build initial prototype.

Ferrari is not an exception on this regard: all the modern GT cars derive from a processes and strategies that are heavily depending on CFD simulations, especially during the conceptual phase of the project. Indeed, at the early stage important aspects like external aerodynamics performance, crew cabin air conditioning, underhood and batteries thermal management are evaluated using CFD, and due to the overall tight constraints already mentioned, is crucial to handle the full CAD-to-results process in an accurate, fast and robust manner.

To improve such a workflow, assisted by BETA CAE specialists, we recently finalized “CFD tools automatization” campaign that led to a remarkable improvement of the overall efficiency in pre- and post-processing stages. Surface and volume mesh generation using ANSA is now widely relying on the Batch Meshing technique, while post-processing with META is fully automated through direct Python scripting integration.

COMPLETE VEHICLE CAD EXTRACTION, TRANSLATION AND QUALITY REPORT GENERATION AT CEVT

Jesper Bäcklund
China Euro Vehicle Technology AB

KEYWORDS –
ANSA, METAPOST, AUTOMATION, PYTHON, CAD TRANSLATION

ABSTRACT
During the development a new vehicle, at specific points in times, the current design is frozen and released, and important attributes are analysed virtually to ensure that requirements are fulfilled. After such a release, vast amount of data is available and CAE models needs to be created or updated as fast as possible with high quality. Traditionally, CAD files used to be sent to external resources for modelling. The process of collecting, checking and preparing all data was cumbersome and a significant amount of time was also needed to check and correct the received models which could have been based on incorrect input.

To bring order after a release, CEVT have developed a python-based umbrella script for managing all data after a release, which relies heavily on ANSA and METAPOST. After an automated CAD extraction from the PLM-system, models are not only automatically translated. As much model preparation as possible along with a variety of checks are also performed on each model. For example, CAE representation of standard parts are read from ANSA DM, the middle surface is extracted from thin parts and later batch-meshed, intersections are checked internally within each subsystem and externally between different subsystems. Compare reports in ANSA are generated between current and previous release. The process is highly parallelized, and all data is collected and automatically presented in various report-layers.

The day after a release, we now have a clear picture of the quality of the release along with prepared input for external resources. Problematic subsystems with missing input or other issues can easily be identified and additional instructions can be attached before sending to external resources. With the compare reports, we can identify subsystems with small changes. These are more efficiently handled internally and reduces the workload for the external resources. All of this has led to significant time-savings and would not have been possible without the Python API of ANSA and METAPOST.

Session 5B

SUPERELEMENT WELDS FOR PRODUCTIVE CAR DEVELOPMENT

Nils Himmelsbach[1], Christian Graber[1], Michael Tryfonidis[2]
[1]BMW Group
[2]BETA CAE Systems

KEYWORDS –
Spot welds, Super elements, fatigue

ABSTRACT
The most commonly used fasteners in modern body construction are resistance point welding joints. There are several concepts for the assessment of fatigue strength with the aid of numerical methods, whereby the assessment method based on the Nominal Stress concept has become the standard in many cases.

The aim of this study is the analysis and evaluation of spot welds based on a suitable notch stress model. The implementation of the concept was made by the use of so-called supplements substructure technology. As a result, the number of degrees of freedom could be reduced sufficiently, in order to use the method in the context of structural analysis (e.g. BiW). The approach allows for adequate analysis of spot welds while, at the same time, a significant reduction in the modelling effort is achieved.

IMPROVEMENT OF EVALUATION EFFICIENCY BY 3D REPORT

Seiichi Takakuwa
Honda R&D Co., Ltd Automobile Center

KEYWORDS –
Durability, META Post Processor, automation, evaluation processes

ABSTRACT
Due to the evolution of digital development, the application rate of CAE in vehicle development has been increasing, and it is urgent to improve efficiency of evaluation processes.

Honda has been working on systems that can effectively verify CAE and test results with high efficiency.

As an important milestone, Honda has deployed the META 3D report, that can automatically summarize CAE results and maximize benefit of post processor, in durability department.

This presentation reports the activity.

MIGRATION OF A POST-PROCESSING PROCESS: FROM MEDINA TO META

Urs Stefan Jedrkowiak, Thomas Brandt, Alexander Schwarzkopf Rheinmetall
Automotive AG

KEYWORDS –
METAPOST, Automatisation, MEDINA

ABSTRACT
Rheinmetall Automotive AG is a global player in developing and delivering a multitude of products for the automotive Industry.

One of our core competencies over more than 100 years is the development and production of pistons for any kind of combustion engine from a few grams to several hundred kilograms of weight. Worldwide local presence of the simulation department in all significant markets requires a standardized process for simulation in order to cope with the high level of detailing and to ensure an equal high level of simulation quality worldwide.

The challenge, to come from a longtime and global well established process with the appropriate status of data, to build up and to improve existing work flows within a very short time, has been accepted at Kolbenschmidt by using Beta products.

We will present the current status of the development of a mostly automatized process to produce Visualizations of the results and allow the simulation specialist to see, verify, evaluate and assess them before they are automatically transferred to Reports. What were the challenges and how do we convince and teach our colleagues worldwide to utilize the new process?

ANSA: ONE OF THE CAE ANALYSTS' BEST FRIENDS

Edoardo Ferrante, Dr. Emiliano Costa, Sergio Macchiavello, Alberto Rossi, Maurizio Iannolo, Alessandro Bozzolo, Andrea Trevisi
RINA Consulting

KEYWORDS –
ANSA, CFD, FEM, pre-processing, multi-disciplinarity, ROI

ABSTRACT
The modern industry is characterised by an elevated level of competitiveness and, consequently, it needs to address high level technological demands in terms of performance and reliability of produced systems and their components. In this framework, CAE designers and analysts are constantly urged to invest in innovative technologies and procedures to enable manufacturers to reduce product development costs and delivery times. Given such a challenging working context an engineering consulting company needs to face daily, the adoption of common practices and tools to efficiently manage the pre-processing stage is of paramount importance and constitutes a strategical and economical advantage. To this end the "Industrial Design & CAE" team of RINA Consulting has been making an extensive use of ANSA pre-processing for many years to build numerical models (both FEM and CFD) designed to handle engineering applications in a wide range of industrial sectors including aerospace, defence, manufacturing, energy, transportation and civil infrastructures. The presented work shows that such a tool is a powerful means to support our team in solving multi-physics and cross-sectorial engineering problems in an effective and time-saving manner.

Session 5A

NVH POST-PROCESSING AUTOMATION

Dr. Martin Schönecker
Opel Automobile GmbH, Groupe PSA

KEYWORDS –
NVH, Metapost, Meta Python Scripting, Automation

ABSTRACT
When dealing with a considerable number of curves, and multiple iterations of some analysis, the 2d plotting workspace in META might become unhandy to manage the amount of data. In order to facilitate a rather easy way to extract and present the data of interest, a toolbar was developed which utilizes the curve's attribute list as a means to sort, collect, and modify curves and their appearance in 2d plots. The toolbar also acts as a frontend to some commonly used calculations, and serves to very quickly generate complete reports from large data sets. The 2d post toolbar is an example of the many possibilities the Python scripting interface offers to the user to automatize repeated tasks.

EVALUATION OF VEHICLE INTERIOR NOISE BASED ON LOADS FROM A MULTI BODY ANALYSIS - AN INTEGRATED BETA SUITE SOLUTION FOR ADDRESSING NON-LINEAR MOUNTS

Apostolos Paraschoudis, Markus Herbst
BETA CAE Systems

KEYWORDS –
Kinetics, Acoustics, Multibody Dynamics, EPILYSIS, NVH, Display model, Tire-Road interaction

ABSTRACT
Ride comfort has always been one of the key factors for car owners during the decision of a car purchase. Excessive noise in the passenger cabin develops an uncomfortable environment for the occupants and therefore a lot of research and testing is invested on this area. In this presentation an integrated approach is showcased exclusively through the BETA CAE software suite. The approach starts with a vehicle ride Multibody Dynamic analysis through Kinetics in order to obtain important loads information on critical locations of the chassis for several road surface profiles. With the import of those loads in META post processor, those loads can be translated to sound pressures in the cabin using Frequence Response (FRF) and Transfer Function (TF) related tools. In the meanwhile, the representation of the Trimmed Body in the whole process as a Display Model – which is a simplification technique of a modal reduced file through EPILYSIS – allows a huge reduction in the amount of data and easier data manipulation without sacrificing the accuracy of the dynamic behaviour.

HOW DID WE REALIZE SPDRM AND WHERE WILL WE GO?

Haruki Kubokawa[1], Irene Makropoulou[2], Antonis Perifanis[2]
[1]HONDA R&D Co., Ltd. Automobile R&D Center
[2]BETA CAE Systems

KEYWORDS –
SPDM, NVH, Automation

ABSTRACT
As reported in 7th BEFORE REALITY CONFERENCE 2 years ago, HONDA NVH FEM team established a strong squad with BETA CAE Systems and has been pushing to realize “State of the art automated CAE platform”.

It is considered that, together with the high affinity of Deep learning technology, the importance of Management system for Simulation, commonly called “SPDM” is being core for improving competitiveness in the CAE committee.

The several key enablers which realized the platform deployment at HONDA will be reported in this session together with BETA CAE Systems.

Also, the future plan of HONDA would be touched on as much as possible.

Session 5C

CRASH MANAGEMENT SYSTEM OPTIMIZATION TOOL IN ANSA AND META

Mr. Pedro Ruiz, Ricardo Liñan, Alvaro Arconada
SOLUTE

KEYWORDS –
CRASH, CMS, ANSA, META, CAR END, CRASHBOX, ENERGY DISSIPATION, LOW SPEED IMPACT, SCRIPTING

ABSTRACT
The crash management system, namely CMS, is located at both ends of the body car serving as an energy dissipation element that aims to control the local collapse of structure when the car suffers a low speed impact. The target is that both CMS structures (front-end and rear-end) not only meet legislative requirements, but also improve the damageability and reparability of the vehicle. This ensures the cost remains as low as possible, and the insurance companies reflect this decrease in the insurance policy.

There are also additional scenarios that must be considered in their design, such as the compatibility with high speed crashes or pedestrian protection and the integration into the overall concept of the vehicle. Needless to mention that the cost effectiveness is a key factor in the determination of definitive solution.

Within the CMS, the crashbox plays a vital role in the energy absorption. The parameters that determine its behaviour at low speed impacts are several, but geometric features (thickness, beads, height, width, cone-shaped angles) do offer a very open scenario when a new crashbox is designed. As there are so many possibilities, a quick definition of each one is key to sweep all the desired combinations.

With all this, the development of a FEM automation tool was decided in SOLUTE to speed-up the time of development, as well as the internal productivity.
The target of the tool is to set up the different crashbox geometries to be simulated as well as respond to the simulation results to reach a closer solution to the optimum geometry for each car design.

To achieve this, the new tool is defined by scripting in ANSA and META. As a result, engineers can study the sensitivity of each design parameter to match their production requirements.

ANSA FOR FMVSS201U: A FLEXIBLE PROCESS

Thanassis Fokylidis[1], Israel Corrilo[2], Carlos Cano[2], Hector Hernandez[2], Joanna Rakowska[3]
[1]BETA CAE Systems
[2]FORD of Mexico
[3]FORD Motor Company

KEYWORDS –
FMVSS201U, Interractive, Autotmation, Marking, Positioning, Stochastic

ABSTRACT
It is a common knowledge that over the last years, the Occupant Protection legislation requirements on interior safety properties of automobiles have become considerably more demanding. Specifically, for the upper interior of a vehicle, FMVSS201U regulates the procedure to identify the most critical areas and the exact way that the headform must impact them. CAE analysts following the guidelines of FMVSS201U need flexible tools that enable them not only to automate their processes but also to interfere in any stage and make any modification and check the influence.

Ford Motor Company and Ford Mexico in cooperation with BETA CAE Systems have employed a process in ANSA pre-processor that enables the user to interfere at any stage of the marking process and tune the position of every Target Point. Moreover the process is extended with special tools that fully automate the positioning on all the identified targets. Finally the Stochastic studies are applicable avoiding any user interaction.

The current paper explains how one can use the ANSA interactive tool for FMVSS201U marking and what one can achieve by having the chance to make any user modification on it. In addition, it presents how the additional Targets for stochastic studies are predicted. Finally it goes through the fully automated positioning process that not only positions the Impactor to all the Targets but it creates the relative LS-DYNA loadcases in one step.

CAE MODELING OF BOLTS FOR CRASH

Mr. Jens Raine, Per-Anders Eggertsen, Simon Rydberg
Volvo Cars Corporation

KEYWORDS –
CAE, bolt, screw, modelling, material, automation

ABSTRACT
Reliable CAE crash results are crucial for Volvo Cars, in order to secure that the final products meets safety requirements and also the customer expectations to be leading in safety.

At Volvo Cars the introduction of new technologies and new materials, such as electrified vehicles, aluminium and new joining techniques creates a huge challenge in the ability to predict crash performance. One key area is pre-strained bolt elements that are used to attach critical components that either should break away or withstand a certain load during a crash. Examples of such critical interfaces are the front and rear sub frames and the battery box attachment to the car body in EV:s.

The outcome of the work is a reliable and efficient modelling technique of pre-strained bolt generation through ANSA. Scripting in order to secure efficiency in the modelling phase and also a methodology to define the bolt material through physical testing and validation in simulation. The new modelling technique is used in upcoming Volvo cars and will be used onwards in all coming projects.

CRASH LOAD PATHS ANALYSIS BASED ON FIELD LINE VISUALIZATION IN META POST-PROCESSOR

Lailong Song[1], Rainer Moll[2], Michael Tryfonidis[3], Sideridis Athanasios[3], Fabian Duddeck[4]
[1]BMW Group
[2]IDIADA Fahrzeugtechnik GmbH
[3]BETA CAE Systems
[4]Technical University of Munich

KEYWORDS –
crashworthiness, force flow, load path analysis

ABSTRACT
In order to fulfil the increasing legal and customer demands on safety requirements of the automobiles, the virtual development process based computational methods is utilized to optimize structural and restraint system performance in the crash. The improving reliability of these crash simulation provides the engineers with valuable information which is even not accessible in the hardware test.

In the virtual vehicular crashworthiness design process, the main energy absorption and the safety of the passenger compartment are assured by the force levels and deformation potentials along the so-called load paths. If the crashworthiness relevant components are aligned with the direction of impact, the load paths can be identified based on engineering judgement. However, during a crash event, plastic deformations of these components give rise to buckling, time-dependent contacts, rotations and failure of the structures, making the load path analysis challenging.

In this research project, we utilize a modified dual-prime streamline seeding algorithm to generate field lines representing the load transfer along the structure, which is subjected to dynamic loading and non-linear deformation. The visualization of the load transfer in MEAT Post-processor, i.e. the color coding, distribution, flow direction and lengths of the field lines, can help the engineer to identify the load paths, thus to extract the load bearing structure for further engineering design work.

Session 5D

BUILDING A FULL UAV AERODYNAMIC DATABASE USING ANSA PRE-PROCESSOR AUTOMATED MESHING TOOL

Danny Gilad
Elbit Systems

KEYWORDS –
CFD, UAV, Database, Aerodynamics, Mesh, ANSA, automation

ABSTRACT
Computational fluid dynamics (CFD) has become a vast tool in the preliminary design of airplanes at the modern age, and specifically UAV's (Unmanned Air Vehicles).

At Elbit systems UAV division, CFD analysis is used in order to build an aerodynamic database that best describes the aerodynamic behavior of the UAV and is the basis for the control system design. A reliable DB is vital for the flying qualities and air worthiness of the UAV.
Thus, ANSA pre-processor is used as part of the CFD analysis process in order to create high fidelity mesh for a large variety of UAV configurations, in a short time period.

This article discusses one such UAV which underwent an ongoing CFD analysis at several different configurations, using many of the features that ANSA introduces.
Specifically, the ANSA automatic batch mode, enabled to mesh the same UAV at different elevator, rudder and aileron deflections, using the same definitions and parameters, and repeat the process with a second flaps configuration.

This meshing stage is usually the longest and most influencing stage of the CFD analysis.
The automatic meshing ability enabled to optimize the meshing time in the CFD process, without devaluating the mesh quality.
CFD Results were later compared with wind tunnel results, having excellent agreement between them.

The rapid design process helped position the CFD tool as an inherent step in the design process, having high confidence prior to test flights. In some cases wind tunnel tests were even passed upon, saving time and money for the project.

AERODYNAMIC DESIGN OF UNMANNED AERIAL VEHICLES WITH INNOVATIVE LAYOUTS, USING LOW AND HIGH-FIDELITY NUMERICAL TOOLS

Prof. Kyros Yakinthos[1], Pericles Panagiotou[2], Pavlos Kaparos[2]
[1]Aristotle University of Thessaloniki
[2]UAV-Irc

KEYWORDS –
Fixed-wing UAV, Aerodynamic design, Blended-Wing-Body, VTOL, CFD

ABSTRACT
In the current study, a methodology for the aerodynamic design of fixed-wing Unmanned-Aerial-Vehicles (UAVs) is presented. The methodology is based on the three phases of the aerodynamic design for manned aircrafts i.e. the conceptual, preliminary and detail design phases, and it is adapted for UAVs. The conceptual design essentially refers to the initial design phase, where the first configuration layout is drawn based on the mission requirements, design specifications and regulations. Key UAV layout aspects are defined and early trade studies are conducted. Having defined the overall platform shape, the preliminary design is in turn initiated, where each part (e.g. wing, fuselage, empennage) is analyzed in detailed. The investigations are conducted synergistically with the other aviation disciplines, such as structures, propulsion, control and electronics, whereas optimization studies are also performed to fine-tune the UAV performance. Finally, during the detail design the construction drawings are generated taking into account manufacturability and production considerations. To facilitate the required calculations a combination of both low- and high-fidelity tools and methods is employed. The low-fidelity tools refer to the Laboratory of Fluid Mechanics and Turbomachinery (LFMT) in-house sizing tools, which are based on well-established textbook methods and can provide a rapid and complete weight, aerodynamic, stability and performance analysis of a UAV platform. The high-fidelity methods refer to the Computational Fluid Dynamics (CFD) modeling that is performed to support the sizing calculations and to accurately extract the much-needed aerodynamic and stability coefficients of the aerial vehicle. The CFD modeling is conducted using the BETA CAE software (ANSA, META), coupled with the CFX flow solver. A step-by-step presentation of the UAV aerodynamic design methodology philosophy is made, emphasizing on the interaction between the various tools at each design phase. The sizing procedure of two of the LFMT UAV prototypes (RX-3, RX-4) is also presented, as representative fixed-wing UAV design case studies.

INVESTIGATION OF AERODYNAMIC LOADING ON A TRAIN PANTOGRAPH

Dr. Konstantinos Ritos, Craig Roddick, Dr. Ioannis Kokkinakis
University of Strathclyde

KEYWORDS –
CFD, ANSA, META, RANS, pantograph

ABSTRACT
This preliminary study investigates the flow around a train pantograph performed by a 4th-year Mechanical Engineering student at the University of Strathclyde. We study the effects of wind speed and direction on the forces applied on the pantograph and further discuss the effect of the attached airfoils on the aerodynamic forces. ANSA has been utilised to create a 3D mesh around the complex geometry of the pantograph. In addition, new capabilities of automated mesh generation through ANSA are discussed and results between different meshes are presented. Post-processing of the results is carried out in the CFD package as well as through the post-processing capabilities of META. Through this study, we want to highlight how pre- and post-processing tools can be used to effectively contribute to the aerodynamic study of complex geometries by inexperienced users under little guidance.

COMPUTATIONAL HAEMODYNAMICS IN ARTERIAL GEOMETRIES IN RELATION TO OBESITY-INDUCED CARDIOVASCULAR DISEASES

Dr. Asimina Kazakidi
University of Strathclyde

KEYWORDS –
Biofluids, Haemodynamics, Computational fluid dynamics, ANSA, OpenFOAM

ABSTRACT
Childhood and adolescent obesity, primarily a dietary disease, has become a major challenge of the modern society. Obesity is known to accelerate endothelial dysfunction, one of the key biological indicators of lesions of atherosclerosis that underlie most cardiovascular diseases. Early vascular changes can be clinically assessed with measurements of the aortic and carotid intima-media thickness (IMT), and flow-mediated dilatation (FMD) of the brachial, radial, femoral, or popliteal artery, induced by transient hyperaemia. The haemodynamic environment in high-risk patients is likely to be altered in a way that has not yet been clearly understood. This work will discuss the design and mesh generation challenges of idealised and anatomically-realistic vascular geometries, with the use of the ANSA® pre-processor (BETA CAE Systems SA), for the assessment of early signs of cardiovascular diseases in relation to obese children and adolescents. It will also present arterial models that attempt to clarify some of the flow-related mechanisms that are believed to contribute to early vascular changes. Numerical simulations of the time-dependent, incompressible Navier-Stokes equations will be presented utilising a high-fidelity finite volume solver in OpenFOAM®. The models help evaluate the haemodynamic shear stresses along the arterial walls and the possible location of early atherosclerotic lesions. Further work is ongoing on multi-scale computational modelling in patient-specific three-dimensional anatomies combining blood flow computations with macroscopic and microscopic features.

Session 6B

DISCOVERING THE ANATOMY OF A SHOCK ABSORBER WITH THE AID OF COMPUTED TOMOGRAPHY AND BEYOND

Dr. E. Karatsis, P. Michailidis, I Mezitis,
BETA CAE Systems

KEYWORDS –
RETOMO, Machine Learning, CT (Computed Tomography), Segmentation, Reverse Engineering

ABSTRACT
Real objects need to be introduced into the CAE world for quality control, design evaluation, FE simulations and other. Computed Tomography (CT) provides a powerful method for achieving this in a nondestructive way even for complex assemblies. In this work, a CT scan of a shock absorber is virtually disassembled with the aid of RETOMO in order to see its anatomy. Innovative machine learning algorithms introduced in RETOMO greatly reduce required user time while improving segmentation quality. The complete process from CT data to CAE model is demonstrated through a realistic reverse engineering scenario. Eventually the seamless interaction of the BETA suite is exemplified through the creation of a CAE model for a durability load case.

COMPOSITE LIFE PREDICTION MODEL FOR LEAF SPRINGS USING FINITE ELEMENT MODEL AND TESTING

Kishore Mysore Nagaraja, Hrushikesh Patil, Sharanbassappa Patil, Suresh Nagesh
PES University

KEYWORDS –
Fatigue Failure, Finite Element Method, LMS testing, Composite leaf spring

ABSTRACT
Composite leaf springs are emerging as a replacement for standard steel leaf spring as when as Mono-leaf spring. One of the main reasons is that the composite leaf springs are lighter in weight and can be produced to have the same parameters as the standard steel leaf spring. Since the suspension is subjected to varying loads at random time interval, it is necessary to understand its behavior such as fatigue failure. In this work, the main focus is on developing a life prediction model for a composite leaf spring. This includes developing a regression model comprising finite element simulation data using ANSA software and LMS experimental testing data. The ANSA simulation data is coupled with the LMS data to develop regression based models coupling test with analysis. These regression models are expected to predict the life cycle of the composite leaf spring for a range of the stress ratios and the loading patterns.

BEAM MODELING: NEW DEVELOPMENTS

Kostas Skolarikis[1], Vasileios Evangelou[2]
[1]BETA CAE Systems International
[2]BETA CAE Systems

KEYWORDS –
beam, cross section, warping, PBEAML, PBMSECT

ABSTRACT
Beam is probably the most influential element in the history of structural mechanics and it continues to be invaluable even today despite the fact that computers can easily handle models with millions of Degrees of Freedom. The model order reduction and the engineering parameters it provides, make beam a powerful tool in the early concept phase of vehicle development.
BETA CAE Systems has been a pioneer in beam modeling from its first steps constantly enhancing the tools in this area.

Major developments related to beam modeling are scheduled for the upcoming versions of ANSA, EPILYSIS, and META. These developments include:
- new capabilities in the cross section calculator,
- a new R-type element for beam to shell/solid connection,
- utilization of beam's warping(seventh) dof for better accuracy mainly in open sections,
- support of sizing optimization of PBEAML and PBMSECT in EPILYSIS,
- accurate 3D animation of beams taking into account the rotational dofs in META.

This presentation will demonstrate these new major developments and highlight the benefits from employing them.

Session 6A

EFFICIENT TIME DEPENDENT RELIABILITY ANALYSIS OF LARGE SYSTEMS UNDER NON-GAUSSIAN LOADING

S. Patil[1], Z. P. Mourelatos[2], V. Tsianika[1], D. Papadimitriou[1]
[1]BETA CAE Systems USA
[2]Oakland University

KEYWORDS –
Time Dependent Reliability, Non-Gaussian Random Process, Reliable Design, Computational Efficiency, Superelements

ABSTRACT
Designing reliable products is a complicated task because of inherent uncertainty in loading, presence of system random variables and degradation of components over time. If the loading is a random process, time dependent reliability must be considered. Such a reliable design can reduce cost, improve reliability and identify the maintenance needs of the system. In practice the random loads are often non-Gaussian. To calculate the time dependent reliability of the system under non-Gaussian loading, the response of the system must be calculated in terms of system dynamics and input uncertainty in the time domain for many, often hundreds of realizations (trajectories of input) of the random process using simulation-based methods. Also, real world systems have many nonlinear components making the entire problem nonlinear. This significantly increases the complexity and cost of simulations.

In this paper we present an accurate method to generate the trajectories of non-Gaussian processes and a component mode synthesis (CMS) methodology to significantly reduce the cost of non-linear transient simulations for large systems. ANSA's superelement and connector functionality is used to substructure the finite element model into linear and nonlinear subsystems. In CMS, truncation of normal modes of each substructure provides significant computational cost savings. The dynamic substructures and the residual non-linear substructure along with the applied loads and appropriate boundary conditions are assembled together to form a small finite element model which can be efficiently time-integrated even for hundreds or thousands of simulations. Using such time-dependent response of the system (trajectories of output) we can proceed with reliability analysis such as fatigue life prediction and calculation of time-dependent probability of failure.

TYRE FEA MODELLING USING ANSA & META

Kesava Reddy Koduru[1], Shivakumar Biradar[1], Athanasios Papadopoulos[2], Markus Herbst[2]
[1]BETA CAE Systems India
[2]BETA CAE Systems

KEYWORDS –
Tyre, ANSA, META, Abaqus

ABSTRACT
Over the last decades, tyre companies are using FEA methods to reduce the product development time and reach the market requirements. By using advanced multi-purpose FEA software, the engineers are able to succeed the above goals. In this paper, the most common tyre simulations are presented. The ANSA pre-processor is used for the complete preparation of the tyre for the Abaqus solver (2D meshing, 3D meshing, solver setup etc). Another big advantage of ANSA is the automation capability that can be applied in this process. The simulation types that will be presented are:

•Tyre axi-symmetric modelling
•Tread pattern Hex mesh
•Postprocessing of Static loading of tyre
•Coupled air-tyre modal results post-processing
•Tyre Modal Model preparation
•Modal response and Modal/FRF correlation
•Cleat impact analysis setup and post-processing
•Tyre hydroplaning analysis setup and post-processing
•Automation of pre-processing of tyre curing process
•Tyre exterior noise radiation analysis using Actran
•CFD analysis for air-flow around the tyre

For all the above simulations, the results will be evaluated in the META post-processor. The continuous developing that has been done the last years, in order to support all the needed keywords for the tyre modelling in ABAQUS, provides the ability to set-up several kind of tyre simulations through the BETA suite.

ANSA AS PRE-PROCESSOR FOR CODE_ASTER

Roman Fratczak, Maciej Czaplinski
Nobo Solutions

KEYWORDS –
ANSA preprocessor, code_aster

ABSTRACT
Currently, in version 19 ANSA supports nearly all world-recognizable FE solver decks. A one more deck may be interesting for current users especially if it is an open source solver like Code_aster (CA). In principle, the very weak point of CA solver is the pre-processor -where ANSA could cover a big amount of preprocessing functionalities. Especially in the structural analyses or even rotordynamics. Some features in CA – common for all FE decks – are relatively “well-hidden” or introduced in a specific way. This makes a CA user non-efficient – especially when compared to a commercial FE package. We would like to share briefly our experience in CA to indicate a “bottle-neck” and present the solution already applied in ANSA based on a case studies.

The exemplary functionality to be nearly directly applicable is a mesh preparation. Especially mesh quality criteria, an element coordinate system orientation & correction, 0D discreet element representation. Also preparation of boundary conditions – using an element or nodal groups that is strictly connected with the mesh if often a time consuming stage in CA. Material assignment (i.e. anisotropic), contacts definitions and especially mesh connection that also have an impact on nodal groups and connected constrains- those can be easily done in ANSA, but with bigger effort in CA. One more interesting thing would be a mesh partitioning for parallel solvers. The amount of aspects that may be covered by ANSA increases, with number of analyses types to be considered (dynamic, acoustic, etc.) in example where applied forces need to be arranged on circumferential elements as s complex vector.

Such overview with direct examples provided with -in house developed tools may be interesting either for ANSA users either for ANSA developers.

Session 6C

STAMP-CRASH PROCESS: COUPLING OF FORMING AND CRASH SIMULATIONS AT BMW

Dr. Janine Mergel[1], Andreas Ickes[1], Marcel Meder[1], Michael Tryfonidis[2], Helga Reith[1]
[1]BMW Group
[2]BETA CAE Systems

KEYWORDS –
Mapping in ANSA, crash simulations, sheet metal forming, data management, SDM systems

ABSTRACT
In automotive industry, the accuracy of crash simulations can be considerably improved by accounting for also the manufacturing process of the body-in-white components. To this end, the forming history of deep-drawn body parts is used to enhance the virtual models for both the body in white and the full vehicle. We here present an interlinking approach, the "stamp-crash" process, to systematically connect the engineering of deep-drawing tools with the design and development of the body parts. The stamp-crash process involves the following components:

1) An already existing simulation data management (SDM) system used at BMW to build, mesh, and process the CAE model of the vehicle;
2) An interface to a central database containing all model data as well as the forming results for relevant body parts;
3) An ANSA-based mapping tool to initially transfer the forming history of each individual part to the overall CAE model; and
4) An automatic re-mapping procedure developed in cooperation between BMW and BETA CAE Systems.

Using the same database in both the crash and deep-drawing "worlds" offers several advantages: It allows for version control of all models during the entire design process, and is crucial for the automatic re-mapping. This re-mapping accelerates building the CAE model, e.g. by using commonality of body parts or capturing re-meshing. Overall, by improving the quality of both crash simulations and strength or stiffness computations, the stamp-crash process accelerates the entire design and development of new vehicles at BMW.

ADDRESSING THE CHALLENGE OF LATE DESIGN STAGE OPTIMIZATION: A PASSENGER CAR SIDE IMPACT CASE

Michael Tryfonidis, Eva Ioannou
BETA CAE Systems

KEYWORDS –
Crash, CAE analysis, Optimization, Side impact, Design change

ABSTRACT
Optimization methods are widely used in CAE analyses for a big range of problems and for different product design stages.

Apart from the standard processes, optimization is also used as a flexible tool to fix unexpected problems that arise in any of the design stages of the product.

This paper investigates the case where an improvement in CAE model behavior is required at the very end of the design process. In the presented side impact analysis there are special considerations and constraints that must be taken into account. Such constraint is that the stumping and punching tools that are already manufactured. The aim of the optimization is to improve the impact behavior using the minimum of design changes on the model.

CRASH LOADCASE SETUP USING INCLUDE CONFIGURATOR TOOL

Rajiv Pillai
Volvo Group Trucks Technology

KEYWORDS –
ANSA, Data Management, Connector definition, Include, Include configurator

ABSTRACT
The study focuses on the include preparation using ANSA and setting up of different load cases using Include configurator tool. The objective of the study was to make use of the automation capabilities of ANSA like connector definition between two different subsystems.

We did not have a defined method for braking down the subassemblies into Includes for crash simulations which made the debugging process or the model management very cumbersome. The study was done as part of method development activity to use the ANSA capabilities like using Include preparation tool, Connector and Include configurator tool. ANSA version 16.1.3 is used for the method development. Latest version of ANSA has advanced methods to do similar activities and that's the limitation with the study.

The Includes Configurator is a tool for the generation of different model variants and load cases. It has been based on the concept that a simulation model consists of several include files stored in a repository structured similarly to a file structuring. The Includes Configurator can handle combinations of different include files of the model. Each of the combinations corresponds to a different variant or load case.

In the Includes manager window the user can define the load cases and then determine which includes will participate in which of the load cases. The Includes Configurator provides useful functionality when handling includes with the aid of ANSA Data Management. The Includes Configurator provides useful functionality when handling includes with the aid of ANSA Data Management.

Future scope for the study can be using scripting to automate the workflow using ANSA Scripting capabilities. Scripts can be created for updating the configuration with latest changes to the includes or reloading the configuration from ANSA DM.

Session 6D

EXTERNAL FLOW ANALYSIS (CFD) FOR AN AIRBORNE GIMBAL

David Lozano
Elbit Systems – ISTAR

KEYWORDS –
ANSA, META, CFD, External Flow

ABSTRACT
This presentation shows work done by Elbit Systems – ISTAR Analysis Group. This work includes external flow analysis (CFD) on a new product as a part of the development process in order to predict aerodynamic effects which occur during flight: drag and moments.
Because of the unique requirements of the product, few dozens of different cases/geometrics/conditions were needed to be considered.

The multiple analyses together with demanding schedule required the use of new analyses tools in order to create a “semi-automatic” process that will be simple, easy to use and especially fast to implement.

Our solution was to use automated ANSA modeling tool – “Batch Mesh”.
The use of Batch Mesh scenario enabled an almost automatic modeling process and helped to meet to demanding project schedule.

Successful comparison to wind tunnel test was done.

ROOF RACKS AERODYNAMIC OPTIMIZATION FOR A UTILITY VEHICLE

Inaki Caldichoury, Facundo Del Pin, Rodrigo Paz, Chien-Jung
Huang LSTC

KEYWORDS –
lsdyna, cfd, aerodynamics, optimization

ABSTRACT
The factors that impact the aerodynamic design of a vehicle have been and continues to be the subject of extensive research in the design of ground vehicles. Stricter environmental regulations force the automotive industry to invest a large amount of resources to improve fuel efficiency and emissions requirements. It is expected that automakers will improve fuel consumption by 20% to 60% by the year 2025 which represents a very difficult engineering challenge. However, there is a growing number of after-market accessories that can be attached to a vehicle resulting in a change of the original vehicle performance that many times is not rigorously studied carrying consequences that are not clearly explained to consumers. The most common accessory are roof racks which are used to transport oversized items. According to Yuche et al. [1] roof racks are responsible for 0.8‰ of light duty vehicle fuel consumption in the United States in the year 2015 corresponding to 100 million gallons of gasoline per year. It is then important that the design of roof racks is improved to reduce the individual vehicle fuel consumption. In this work the aerodynamic design of roof racks for a utility vehicle will be improved using Computational Fluid Dynamics (CFD). The solver used in this work is the LS-DYNA module ICFD which resolves the incompressible Navier-Stokes equations for turbulent flows. To study the influence of the different geometric design parameters LS-DYNA is coupled to the LS-OPT tool which is used for optimization. Finally LS-OPT is coupled to ANSA to handle mesh morphing in a fully automatic optimization loop. The results show that a simple modification in the slant angle for the roof rack model considered in this work may produce a favorable result in the reduction of the drag force when compared to the original design provided by the manufacturer.

LATEST DEVELOPMENT IN VOLUME MESHING FOR CFD

Vangelis Skaperdas
BETA CAE Systems

KEYWORDS –
Volume meshing, ANSA, CFD, Octree

ABSTRACT
CFD simulations are always at the forefront of memory demanding CAE applications, as size of volume mesh used for them increases continuously. Current CFD simulations for external aerodynamics are performed on meshes of the order of hundreds of millions of elements, while billion size meshes will very soon no longer be considered as exotic. This imposes demanding challenges on the pre-processing software as it has to deliver the maximum mesh size, within the shortest time, and all these on a limited amount of available hardware RAM.

This work summarizes the latest developments in ANSA v19 regarding volume meshing for CFD, which allow it to excel in a very competitive market. Two external aerodynamics cases are presented, one from the automotive and one from the aerospace sectors, each one focusing on the specific demands of the respective industry.

The octree based Hextreme algorithm of ANSA now provides CFD users with very fast mesh generation turnaround times, as it does not rely on watertight geometry or high quality surface mesh, and runs on multiple CPU threads. An appealing match to the automotive industry, which deals with complex geometries and short development cycles.

On the traditional, bottom up, approach of surface meshing, layers generation and volume meshing, an aerospace case is presented with high quality surface meshing exhibiting anisotropy at leading and trailing edges, very fine layers for y+1 modeling and total cell count of hundreds of millions cells. Great improvements in speed and memory footprint for mesh quality improvement and input/output are demonstrated with the introduction of the Light Volume Representation approach, a new optimized data structure in the latest ANSA versions specifically developed for CFD meshing applications.

Session 7B

THE ANSA / LS-DYNA APPROACH FOR ISOGEOMETRIC ANALYSIS SIMULATIONS

Lambros Rorris[1], Attila Nagy[2], Stefan Hartmann[3], Ioannis Chalkidis[4], Anastasios Vafeidis[4]
[1]BETA CAE Systems International
[2]Livermore Software Technology Corporation
[3]DYNAmore GmbH
[4]BETA CAE Systems

KEYWORDS –
IGA, LS-DYNA

ABSTRACT
Isogeometric Analysis (IGA), is maturing and becoming capable to be incorporated in industrial applications. Widely used in the automotive industry for crash analysis, LS-DYNA is the first commercial solver to provide IGA features. Highest accuracy and shorter run times make IGA effective for crash analysis. Nevertheless, the complexity of the current automotive models and the maturity of the already established methods and processes require the development of the respective IGA tools and processes to reach and exceed the current levels of effectiveness. The new technical challenges offer the opportunity for new solutions and improvements in engineering simulation technology.

BETA CAE Systems and LSTC have joined their efforts to develop all the required tools and workflows that will enable analysts to move to the IGA era. These tools, will allow for the creation and analysis of shell structures models consisting of single or multi patched trimmed surfaces, along with all the necessary functions to apply boundary, and initial conditions for crash load cases. In this presentation these developments are presented.

CONNECTING DESIGN AND ANALYSIS: EXPLICIT ISOGEOMETRIC ANALYSIS USING ANSA AND LS-DYNA

Lukas Leidinger[1], Stefan Hartmann[2], Lambros Rorris[3], Roland Wüchner[4], Fabian Duddeck[4], Lailong Song[1]
[1]BMW Group
[2]DYNAmore GmbH
[3]BETA International
[4]TU Munich

KEYWORDS –
CAD/CAE Integration, Isogeometric Analysis (IGA), Isogeometric B-Rep Analysis (IBRA), Explicit Analysis, Non-Uniform Rational B-Splines (NURBS), Shells, Crash

ABSTRACT
Despite significant advances of pre-processing tools such as ANSA in the past years, generating high-quality FEA models from CAD geometries is still a time- and cost-intensive part of the virtual vehicle development process. One reason why these model generation steps (geometry cleanup, de-featuring, meshing, etc.) are still not fully automated is the fact that FEA and CAD models rely on different geometry descriptions, i.e. (linear) polynomials and Non-Uniform Rational B-Splines (NURBS), respectively.

Isogeometric Analysis (IGA) has the potential to drastically cut-down these model generation efforts by performing the analysis on NURBS-based CAD geometries directly. In order to perform IGA on complex industrial models which usually consist of numerous trimmed surface patches, novel analysis capabilities such as numerical integration of trimmed elements or coupling of trimmed surfaces are required. The Isogeometric B-Rep Analysis (IBRA) framework and its recently developed extension to explicit dynamics (Explicit IBRA) cover these capabilities. The corresponding IBRA exchange format furthermore allows transferring topology, geometry and analysis-related data bi-directionally between CAD system and solver, leading to a closed design-analysis loop. For our prototypical workflow we connected the CAD program Rhinoceros with the leading commercial IGA solver LS-DYNA by means of user interfaces.

In a perfect world, CAD engineers would design models according to specific modeling guidelines to enable isogeometric analysis on CAD models without any further modifications. However, in case a CAD model does not conform to such guidelines – be it for historical or practical reasons – some amount of model preparation will remain even for IGA models. ANSA recently enhanced its preprocessing capabilities with several IGA model preparation features.

In this contribution we (i) provide a brief overview on Explicit Isogeometric B-Rep Analysis in LS-DYNA and (ii) demonstrate how we use the ANSA IGA features to prepare a historical, not guideline-conforming CAD model for isogeometric analysis.

SCRIPTING AND THE WORLD BEYOND

Constantin Diez
LASSO GmbH

KEYWORDS –
Python, Scripting, Automatization

ABSTRACT
Python has been the heart of scripting in ANSA and META for many years and ever since it has been introduced it has attracted many people to engage into scripting easier than ever. This most common language offers very versatile possibilities of automation, but also has inherent limitations often forgotten. These limitations occur more frequently nowadays since automatization is pushing forward and bigger tasks are being tackled. As a result the interface obviously hasn't found a consistent place in the upcoming data-based CAE world yet.

The presentation will first focus on the current state of Python Scripting in general, as well as in the context of ANSA and META. Thereupon scenarios will be explained which need an extension of common scripting. First existing possibilities like native Python modules and their varieties will be discussed. Thereafter new interfaces, programming languages, trends and technologies will be explained and also demonstrated, giving hints of what is possible and where the future of CAE automatization might lead.

METADB AS A HIGH-PERFORMANCE RESULTS CONTAINER

Antonis Perifanis
BETA CAE Systems

KEYWORDS –
META, post-processing, compression

ABSTRACT
This presentation will give an insight look into the recent developments that render the META database a powerful tool in the analyst's hands. First of all, metadbs can now be an advantageous alternative to solvers databases for storing results. Translation of files to metadbs is an out-of-the-box solution while compression ratios achieved usually vary between 7% and 15%. Translated metadbs are treated exactly in the same way as solvers databases meaning the type and the physical meaning of results are 'identified' and additional possibilities are offered like the calculation of stress invariants from the stress tensor. History results stored in the metadb are listed to be plotted individually and can be selected based on the generated post-processing attributes. The efficient reading performance of compressed metadbs can be a relief in cases where the transport of high volumes of data over the network or the solver's database format is a hurdle causing long reading times.
Furthermore, the metadb can be utilized as a means to save the realized post-process work. Display of results, identification and annotation of areas with problems, auxiliary entities like isofunctions and cutting planes can be included in the metadb for some time now. Based on this, automated processes have been set up running after job submission to generate metadbs with already post-processed results. Metadbs could then be loaded for interactive reviewing the results. However, in cases of large models, the need to load the full database can prove to be time demanding. After the last developments it is possible to browse through the metadb contents and selectively load part of it. The user has the option to load only a window with its contents, a specific area instead of the whole model, a plane and the parts cut by this plane or an isofunction and the surrounding area. The performance gains from this approach can be a game-changer for how analyses are reviewed.

Session 7A

xMCF V3.0: AN INTERFACE STANDARD FOR EXCHANGING WELD INFORMATION WITHIN CAD/CAE

Dr. Genbao Zhang[1], Carsten Franke[2], FAT AK-25
[1]Volkswagen AG
[2]PROSTEP AG

KEYWORDS –
Connection techniques, CAD-CAE integration, knowledge-based engineering, design meta information, data exchange, joining technology

ABSTRACT
Joining technologies play an important role in modern automotive structures whose designs are mainly determined by functions vs. weight and cost. This leads to the application of a variety of materials with a wide spectrum of mechanical and physical properties and, hence, requires joining technologies specifically tailored to the joining partners. These joining technologies have to be cost-optimized and to deliver desired mechanical properties like high fatigue and crash strengths.

In order to characterize a specific joint completely, numerous attributes like geometry, process parameters, strengths etc. are necessary. Different divisions like CAD, CAE Manufacturing or different OEMs use often only a subset of these attributes. Therefore, each engineering function has been using their own way to describe joints leading to incompatibilities or gaps in data transfers. In order to allow a seamless data flow from CAD data creation through the various virtual and physical optimization & verification steps (CAE, Testing, Feasibility, Manufacturability/Production Planning) and finally to manufacturing control processes a comprehensive standard for the characterization of joints is required.

More than 15 years ago, the AK25 (Working Group 25) “Joint Technologies” of the Research Association of German Automotive Industry (FAT/VDA) began to develop the standard xMCF (Extended Master Connection File) for joints, in co-operation with several leading vendors for pre and
post-processors in CAE and fatigue software. While the focus was around a seamless process especially for fatigue prediction of welds in the beginning, meanwhile, the project has significantly grown into a cross-functional standard that can also support the definition and automated virtual builds of full vehicle assemblies.

MULTIDISCIPLINARY SPOTWELD OPTIMIZATION USING OPTIM WELDS

R. Nimbalkar[1], T. Jankowiak[1], V. Gandhi[1], R. Bhojan[2], A. Kurane[2], A.Coppe[2], J. Sims[1], J. Rakowska[2], R. T. Katragadda[2]
[1]BETA CAE Systems USA
[2]Ford Motor Company

KEYWORDS –
Spotweld Optimization, Nonuniform weld distribution, Multidisciplinary

ABSTRACT
Welding is an essential part of any automotive assembly but determining the proper placement of welds can be a time consuming and difficult process. At the same time, there is a strong need to decrease the overall number of welds in automotive assemblies to reduce manufacturing cost and time without sacrificing structural integrity. The current spotweld optimization procedures used today involve much trial and error and are typically limited in capabilities. Optim Welds, a multidisciplinary FEA spotweld optimization tool developed by BETA CAE Systems, USA allows engineers to efficiently optimize the locations of spotwelds, including non-uniform weld distribution, on an assembly while also saving time and resources compared to current optimization approaches. Starting with a running FEA model, Optim Welds guides the user through the entire optimization procedure. Tools are provided to easily create and parameterize spotweld lines, while an optimization workflow is automatically generated according to user inputs. The resulting optimization is capable of handling multiple loadcases, disciplines, and solvers simultaneously, with the user being able to freely choose their preferred finite element weld representations. Non-uniform weld distribution is achieved through flagging critical welds in the model according to a user-specified threshold criterion, which are then carried over to subsequent designs automatically. Weld lines are parameterized in groups, leading to a reduction in the number of design variables and total optimization time. At the same time, the use of critical welds strategically places welds in important locations. Model symmetry can be defined to ensure weld placement is feasible for production. A case study with a simplified vehicle model using frontal and side crash loadcases was performed. Results after 77 designs showed a reduction of 270 welds (4%) while still meeting performance targets.

FEATURE BASED MORPHING: A RADICAL CHANGE IN CONCEPT AND DETAILED MODELING

Eva Ioannou, George Korbetis
BETA CAE Systems

KEYWORDS –
Morph, Component, Optimization, Concept model, Design change

ABSTRACT
Optimization has become an inseparable part of pre-processing for engineers which is used in all design stages during the product development.
During the concept modeling, global changes such as model dimensions or cross sections modifications are made. In the final stages, local design changes, standard features handling and on-the-spot small components definition could be used to improve model behavior.
All design changes should be defined directly on the Finite Element model which is essential to avoid going back to the CAD department for an updated model and reproducing the model mesh. Additionally, such design changes should also be driven by an optimization process.
In the latest ANSA version, upgraded morphing and feature handling tools are delivered to help the engineers perform global and local design changes in the most efficient way.

AUTOMATION OF MULTI-DISCIPLINARY ANALYSIS PROCESSES WITH ANSA/META AND OPTISLANG

Dr. Lars Gräning
Dynardo GmbH

KEYWORDS –
Multi-disciplinary optimization, process automation, Meta-model, crash box, geometry morphing, crash worthiness, durability

ABSTRACT
Despite the huge success in reducing time to market due to the progress and installation of software solutions for virtual product development, the automotive industry has to face increasing demands from multiple disciplines, e.g. related to the boost in electrification and autonomous driving. The fusion of various different disciplines towards a holistic design approach will be crucial in order to raise or maintain a high level of efficiency in the future.
Multi-disciplinary design optimization (MDO) characterizes different attempts in the field of system engineering to offer optimization processes and methods that incorporate diverse fields of technical expertise. While it is expected that the technical system optimized with an MDO approach is superior to the optimization with individual disciplines, an efficient integration of a multitude of disciplines bears a number of challenges. Most of them are linked to the exchange of information between engineering teams associated to different technical fields. Enterprise software solutions for the automation of MDO related applications are required to not only support individual CAE processes but to encourage and foster cooperation among teams.
Together with engineers from BETA CAE, a show case based on the analysis of crash worthiness and durability of a double rail structure has been developed. Given the plugins for ANSA and META post, optiSLang is used to rapidly construct workflows for the design analysis that comprise steps for geometry variation (including shape morphing), finite-element analysis as well as the post-processing and parsing of the simulation results. The scenario at hand acts as demonstrator for different aspects of MDO process automation, coupling ANSA/META and optiSLang. With this demonstrator we like to emphasize the benefit of using meta-modelling techniques as vehicle for information exchange between disciplines and groups. As an example, exploiting meta-models for sensitivity analysis allows to communicate information about the relevance of design parameters for different performance indicators, which can be a key factor to avoid conflicts in the overall MDO process.

Session 7C

CELLBOND-PHITEC FINITE ELEMENT Q-SERIES CRASH-TEST-DUMMY SEATING PROCEDURE, ANSA PERSPECTIVE

Daniele Speziani[1], Petros Goutas[2], Chamila Bamunuarachchige[2], Elena Riscaldina[1], Michela Vaira[1]
[1]Phitec Ingegneria Srl
[2]Cellbond

KEYWORDS –
Safety, ATD, crash test dummy, Q6, Q10 Upgrade Kit

ABSTRACT
Cellbond-Phitec is developing new Finite Element (FE) Q6 and Q10U crash test dummies that have some extra features compared to the current available FE models, the dummies will be released to the market on Q4 2019 for LS-Dyna solver, other solvers follow.

The dummy development starts from 3D CAD provided by Cellbond, a 3D hexa dominant meshing has been completed taking care that the model solution time step is equal to 1µs (typical value for automotive crash test simulation). Rigid and small sized parts, like: bolts, washers, instrumentation supporting brackets have been modeled using rigid material.

Successively material validation as well as component tests: head impact test, neck pendulum, chest compression test and abdomen compression test have been carried out at Cellbond ATD laboratory, evidence of good match of physical testing and computer simulation is provided.

Differently from the physical model, today's deformable simulation model has to be positioned into the crash environment using a preliminary "seating" simulation. During the seating procedure the dummy suit has to be deformed accordingly with the movements of the limbs, without creating any initial interference that could affect the contact behaviour.

A common procedure is to run a dynamic simulation that applies imposed displacement to limbs extremities so the rest of the dummy (body and suit) is moving accordingly. The disadvantages of this process are:

•Long setup and long simulation time needed to reduce dynamic effects
•The process is not iterative and user friendly

With the new procedure ANSA morphing boxes are used to position the dummy by avoiding the usage of simulation and by simplifying the complete process. The belting task can follow to generate and deploy the belt on the dummy torso.

Morphing boxes are accurately created in order not to have any initial interference after the positioning procedure.

AUTOMATION PROCESS FOR OCCUPANT SAFETY MODELS WITH ANSA AND LS-DYNA

Dimitrios Perperidis, Michael Meyer, Maximilian Beck, Matthias Bauer, Bruno Clement, Peter Protsch
PSW automotive Engineering GmbH

KEYWORDS –
Dummy, Seat, Seat Belt

ABSTRACT
CAE Models are becoming more sophisticated and detailed enabling us to predict tendencies as well as represent physical repercussions more accurately. However, ensuring a standard quality for the provided models is a cumbersome task. Automation tools ensure that some critical aspects are partially fulfilled, while the time needed and effort for the preparation of the model is also reduced.

Nevertheless there are still many issues that may rise in the process.

The present paper deals with such a process with regard to the setup of an Occupant Safety Model, and more specifically handles the critical parts of such a model. The following steps are implemented in such a process, taking into account the discipline, the regulation and some additional parameters:
i)Dummy positioning and Dummy depenetration with the Marionette tool provided from version 19.0.0
ii)Seat positioning according to the user's needs through the Kinematic Tool
iii)Dummy- Seat depenetration
iii)Seat belt generation and positioning with the corresponding components (Retractor, Seat belt buckle etc.)

Thanks to the various tools that ANSA provides, and their resulting flexibility, a number of checks is implemented for each of the above mentioned steps, ensuring that the process is always consistent and the same criteria are met for all models (Set definition, Contact checks etc.). As a result an “error free key file” is created.

Although, applying the automation process reduces the time needed to create stable and qualitative CAE models, further steps are planned, so that the user is provided with the flexibility to:
i)Retract information from a Database
ii)Resume the process from a certain step, depending on the effect of the redefined parameters

EVALUATION OF OCCUPANT INJURY RESULTS USING META FOCUS ON THOR

Fabian Heil, Ricardo Tejero de la Piedra
Opel Automobile GmbH

KEYWORDS –
THOR, META

ABSTRACT
First part of the presentation explains the use of META's Occupant Injury Criteria (OIC) Tool to plot CAE and hardware test results of the relatively complex THOR dummy.
Challenges related to the large number of channels and THOR specific injury metrics will be discussed. Detailed presentation of the user friendly OIC Tool to compare several CAE runs with hardware test results. The OIC tool can be used as well to compare several hardware tests or several CAE simulations, which allows as well an export to a PowerPoint presentation.

(Second part is optional, depending upon availability of successful application).
Second part of the presentation is focusing on the coupling of DOE results with META within LS-OPT. META is used in this particular case as Post-Process Tool for a complex DOE including a great number of CAE runs, which includes changes of restraint parameters and friction parameters. The LS-DYNA THOR Dummy has been used as an example to illustrate possibility to plot a great number of results. META provides LS-OPT a large set of data to visualize the sensitivities of each design parameter with respect to the injury response of the THOR.

MODELLING OF DETAILED SUBJECT-SPECIFIC FE RIB MODELS FOR FRACTURE PREDICTION

Dr. Johan Iraeus[1], Linus Lundin[2], Simon Storm[2], Bengt Pipkorn[3]
[1]Chalmers University of Technology
[2]ÅF Industry
[3]Autoliv Development

KEYWORDS –
Finite element, Hexa block meshing, Rib, Human Body Model, Fracture

ABSTRACT
Purpose: Traditionally, anthropometric test devices have been used to access occupant injury risk in car crashes. In recent years, as a complement, there is also an increased use of detailed finite element (FE) human body model (HBMs). Such models can be used to evaluate injury on tissue level, for example fracture of single ribs. Previous efforts to create subject specific rib models for fracture prediction, have shown mixed results. Therefore, the aim of this study is to evaluate if subject specific FE rib models, using high quality hex-mesh, based on state-of-the-art clinical CT data can predict rib stiffness and fracture location in anterior-posterior rib bending.

Method: High resolution clinical CT data was used to generate detailed subject-specific geometry for twelve rib FE models. The cortical bone surfaces were estimated using a cortical bone mapping algorithm. Subject specific material data was created from the contralateral ribs. After initial smoothing, hexa-boxes were fitted to the rib geometry. A high quality, pure hexahedral mesh was created for each rib, consisting of 0.61 to 1.53 million elements. The FE ribs were then positioned in a FE model of the test fixture and subjected to the same anterior-posterior rib bending as in the physical tests. Rib fracture location was estimated as the position for the element with highest first principle strain at the time corresponding to rib fracture in the physical test. In addition CORA analysis was used to evaluate rib end rotations, reaction force and rib strains.

Results: For six out of the twelve ribs the model predicted the fracture locations. For the same six ribs there was agreement (a CORA score above 0.75) between the predicted and measured force-displacement curve. Also, the material tests indicated higher ductility for these ribs compared to the other six. Therefore, it can be hypothesis that the difference between two groups can be attributed to differences in cortical bone structure, e.g. intracortical porosity, on a level that is not captured in high resolution clinical CT.

Conclusions: This study indicates that rib fracture location in anterior-posterior rib bending, can be predicted using first principle strain, as long as the rib cortex is of sufficient quality. This provide guidelines for further enhancements of HBMs to enable tissue based injury criteria.

Session 7D

MULTIDISCIPLINARY SIMULATION OF AUTOMOTIVE WATER PUMPS

Dr. Remo De Donno
Industrie Saleri Italo

KEYWORDS –
ANSA, META, automation, ANSYS, OpenFOAM, Dakota, Python

ABSTRACT
Saleri has been using the BETA CAE products since several years to simulate automotive water pumps and cooling systems. CAE engineers use daily the ANSA pre-processor, which ensures a fast and reliable setup for CFD (OpenFOAM and ANSYS CFX) and structural (ANSYS Mechanical) simulations, including optimization studies (Dakota). Once the solution is ready, the META post-processor is able to automatically generate the results of interest.The purpose of this presentation is to show some key phases of the simulation workflows at Saleri, underlining the essential role of the BETA CAE products in achieving consistency, repeatability and robustness.

DESIGN AND CFD ANALYSIS OF A NEW ROTARY GAS COMPRESSOR

Dimitris Vogiatzis[2], Evangelos Mallios[1], Michalis Garbounis[1], Savvas Savvakis[1], Zisis Samaras[2]
[1]theSARMproject
[2]Aristotle University of Thessaloniki

KEYWORDS –
theSARMproject, gas-compressor, oil free, air-compressor, compressor, SARM, CFD, ANSA, CONVERGE, META

ABSTRACT
Amid the increasing demand for higher compression levels in gas compressors, the innovative design of a novel rotary thermal engine, called SARM, favors the development of a new configuration of gas compressors. This study aims to use Computational Fluid Dynamics (CFD) simulations to develop the models of three different applications and compare the existing gas-compressors with the one inspired by the SARM engine. For the high-transient simulations, this study uses the pre-processing software ANSA in conjunction with the CONVERGE solver, and the post-processing software META. With an even greater power-to-weight ratio of today's most high-tech compressors, oil free sealing method, significant lower number of components and a calculated peak pressure of 27 bar in the best-case scenario, the presented type of gas compressors can be the game changer in a range of different applications.

AUTOMATED MORPHING AND OPTIMIZATION OF BLADE ASSEMBLIES IN AEROSPACE AND AUTOMOTIVE APPLICATIONS

Raghu Mohan Reddy Suravaram, Ravi Nimbalkar, Joshua Sims
BETA CAE Systems USA

KEYWORDS –
Optimization, Parameterization, Automation, DOE, Morphing, CFD, Crash, NVH, Durability

ABSTRACT
Blades are the integral parts in assemblies such as Jet Engines, Turbines, and Torque converters. Optimizing their shape, size, and numbers is of utmost importance for engineers to improve their performance without sacrificing structural integrity, while helping reduce the manufacturing costs and time. This calls for morphing and parameterization set up on these blades. The current methods used for setting up morphing parameters are time consuming and applicable to the system for which they are setup and cannot be used for other systems. This severely limits the users in using these techniques for different and complex blade assemblies, adding a lot of overhead costs and time. This paper presents a unique process and tools developed to provide fully automated and transferable solution using a specialized plug-in. The plug-in provides tools for fast and easy model-prepping, morphing, and optimization task setup for any given complex blade assembly. Starting with a unique blade design and housing assembly, the tool allows users to setup various morph parameters, pre-processing actions, CFD volume mesh building, and model checks as part of the automated process. The plug-in comes with a library of morph strategies which can be automatically fitted to a new blade design. The process leads user in a stepwise guided manner to setup shape, size, and number of blades as design variables. Special purpose user buttons which drive the model-prepping process provide prompts to the user to make sure the setup is defined to produce robust designs during the DOE run. As the tool has a transferable setup, it can also be used for ribs optimization for a multidisciplinary design optimization in various structural applications.

This plug-in is presently deployed at a few major OEMs in the USA. The tool has been used for optimizing many complex blades, ribs and similar features (baffles, vanes). This tool has showed adaptability and robustness in generating feasible designs for optimization studies. This method has saved up to 80% of lead time involved in design parameterization which has reflected in cost savings.

THE PRE-PROCESSING PRIORITY IN FLUID-DYNAMICS DESIGN

Dr. Marco Maganzi[1],[2], Giovanni Lombardi[1], Antonio Ercoli[1]
[1]University of Pisa
[2]CubitLab

KEYWORDS –
ANSA, CFD, pre-processing, multi-disciplinary, automation

ABSTRACT
In the last years, thanks to the development of computational capabilities, the CAE methodology has become an essential tool in the design especially in the preliminary phase and configuration analysis. This happens also and above all in the fluid dynamic design by using CFD codes, which have reached high levels of reliability.

In recent years the simulation times have significantly reduced and this means that the pre-processing phase has become the real bottleneck within the project.

The engineering consulting companies can face trouble to define standard methodologies for the analysis, because of the wide range of application fields, and need to reduce operational costs and response times to be competitive. This kind of problems induce us to find a strategy to automate the entire design process as much as possible.

This work aims at showing the use of ANSA tools for our cases, and the development of pre-processing automation methods easily adaptable to most of them.

Session 8

BMW - NEXT LEVEL ENGINEERING: DIGITALIZATION OF KNOW-HOW IN VEHICLE DEVELOPMENT

Gagan Saket[1], Hans-Peter Daunert[1], Michael Tryfonidis[2]
[1]BMW Group
[2]BETA CAE Systems

KEYWORDS –
Early car development phase, integrated environment, parametric structure

ABSTRACT
Next Level Engineering (NLE) is a framework for a highly integrated working environment in the early development phases (strategy and concept phase). It allows reaching the functional targets in car development by taking into account design proposals certified by CAE simulations. A flexible parameterization and high quality data management will facilitate the application of optimization technologies such as Machine Learning and others.

The existing development methodology in vehicle engineering is insufficient to enable efficient and innovative concept development. The reasons for this are the ever increasing complexity and requirements of vehicle configuration through multiple variants, emerging drive train concepts and also requirements to enable autonomous driving.

The development phase includes a pre-development or concept phase, which at the moment is approximately 18 months. In parallel to the pre-development phase, there are several other comprehensive vehicle overarching topics undertaken and executed in several specialist departments and these activities, depending on the complexity, consume a lot of effort and time. One of the main bottlenecks in these processes is the identification of root causes during the vehicle development to the functional verification and validation.

In these established process of the series phase an iteration cycle takes approximately 3-6 months. This includes CAD design, CAE model generation, simulation and re-introducing optimization changes into the CAD design. Within this cycle the time for CAE model generation alone – starting with CAD geometry as input – is estimated with 4-5 weeks

In contrast to the series phase, the time for iteration cycles with NLE has been set instead of multiple months to only a few days as a target. This is due to a different approach: instead of using CAD data for a new concept, a predecessor CAE model is used as starting point for the simulation. This way the number of iterations can be significantly increased, so that finally a concept can be validated within the demanded timespan.

In this presentation, the concept of NLE will be presented. The technical challenges that are dealt with and how they will be solved is explained. Also the IT-related challenges to support such an integrated environment will be addressed.

FE-BASIS MODEL, THE BIRTH OF A DIGITAL ASSEMBLY LINE

Paul-Edouard Munch
Dr.Ing.h.c.F. Porsche AG

KEYWORDS –
FE-Basis Model, Digital assembly line

ABSTRACT
What it is the FE-Basis Model?

- It‘s role in the research and development process.
- The motivations behind.
- A digital assembly line based on SPDRM

Process highlights

- Creation of modules dedicated for CAE-engineers.
- Recycling of parts.
- Organization of the meshing process.
- Running of calculation for 5 different disciplines based on the same ANSA-model.

What are the next steps?

- Further automations thanks to AI.
- Creation of other digital assembly lines.

Session 8B

MULTIDISCIPLINARY TOPOLOGY AND PARAMETRIC OPTIMIZATION OF A BIW, FOLLOWING A UNIQUE HOLISTIC PROCESS WITHIN ACP OPDESIGN

Alexis Kaloudis
BETA CAE Systems International

KEYWORDS –
Topology optimization, Parametric optimization, Shape optimization

ABSTRACT
Topology optimization has raised a new challenge in the optimization processes: how to interpret and convert its results into smooth 3D surface geometry (parametric if possible), to use it subsequently in other applications such as shape optimization.
Our approach for developing a solution to this problem is based on the morphing boxes and cross section tool technology of ANSA and was applied on a BiW.
Substructuring, as a solution to the problem of long computational times in full vehicle optimization for crash load cases,
is well known for a long time. But it brings along certain time-consuming procedures.
A process driven environment, as a new BETA's software tool, ACP OpDesign, has been developed to facilitate the creation
and management of multiple ready-to-solve substructures, based on the capabilities of the preprocessor.
Within this environment these substructures are subjected to various load cases, evaluated regarding their results und updated accordingly.
The main loop of the process is concluded with the setup of the of the MDO.

BMW - NEXT LEVEL ENGINEERING: UTILIZING DIGITALIZED KNOW-HOW THROUGH MACHINE LEARNING

Gagan Saket[1], Michael Tryfonidis[2], Dimitrios Siskos[3]
[1]BMW Group
[2]BETA CAE Systems
[3]BETA CAE Systems International

KEYWORDS –
Early car development phase, integrated environment, parametric structure, Machine learning, optimization

ABSTRACT
Next Level Engineering (NLE) is a framework for a highly integrated working environment in the early development phases (strategy and concept phase). It allows reaching the functional targets in car development by taking into account design proposals certified by CAE simulations. A flexible parameterization and high quality data management will facilitate the application of optimization technologies such as Machine Learning and others.

This presentation will showcase how knowhow about a given vehicle and its engineering behaviour has been digitalized.

QUALITY MANAGEMENT OF CAE DATA WITHIN A SPDM ENVIRONMENT

Spyridon Tzamtzis, Irene Makropoulou, Menelaos Pappas
BETA CAE Systems

KEYWORDS –
quality, lifecycle management, error tracking

ABSTRACT
CAE data quality plays a key role in the performance of the complete simulation activity. High quality of data increases the confidence of CAE analysts in the results of the simulation and in the CAE process as a whole. Given that the evaluation of the simulation results and the subsequent decision making are only the last steps of a complicated, multi-stage process that is usually distributed among different engineering teams, quality issues at any step of this process may render the results unreliable. The first question that arises is: What does it take in order to ensure a minimum standard of data quality?

Today, SPDM systems gain more and more ground among engineering teams, especially in big organizations. We move from the era of “SPDM as a data repository” towards the era of “SPDM as the reference point for CAE”. This evolution raises the expectations for data quality management too. Now that the data are stored in an organized manner and data relationships can be traced, how easy is it to identify the impact of an error in the data stored in the repository? And what is the process that should be triggered after the detection of a problem in order to make sure that the root cause of the problem is discovered and that the same problem won’t occur again in a different data set?

This paper will discuss how SPDRM, the Simulation Process, Data and Resources Manager of BETA CAE Systems, responds to these questions with its solutions for both the prevention and the treatment and management of quality issues. First, with its powerful workflow management engine, SPDRM enables the capturing of the right “recipe” for the data preparation at the desired level of detail, including the right check-points for the verification of the quality of the data in hand at various steps of the process. Second, with its inbuilt Issue Management console, essentially it integrates an Issue Tracking tool with the SPDM environment, allowing the reporting, analysis and progress monitoring of issues in the context of the CAE activities.

Session 8A

MODELLING OF CASTING STRUCTURES - A COMPREHENSIVE INVESTIGATION

Dr. Octavian Knoll[1], Michael Tryfonidis[2]
[1]BMW Group
[2]BETA CAE Systems

KEYWORDS –
Casting structure; Discretisation; Shell element; Solid element; Aluminium die-casting

ABSTRACT
This paper investigates the influence of finite element discretisation on the structural behaviour of a casting structure. Here, a generic casting component consisting of ribs and varying thicknesses is analysed. The discretisation or meshing of such a geometry is a challenging task. Different approaches are applied and studied in this work. A numerical reference is found from an analysis where solid element types and mesh sizes are varied. Then, various strategies to compute the mid surface for shell modelling are evaluated and compared with the solid reference. Finally, a hybrid modelling approach is analysed. Here, an attempt is made to combine the advantages of shell and solid modelling. The present numerical investigation is based on two load cases. The component is subjected to bending and compression loading. An aluminium die-casting alloy is used as material and its behaviour is described by an elasto-plastic model including a ductile failure criterion. Simulations are performed using an explicit finite element solver. Based on the results, the various modelling approaches are discussed in terms of accuracy, computational time and modelling effort. Subsequently, recommendations are given for the structural design.

FAST FLOW SIMULATION USING COMBINATION OF MOLDEX3D AND ANSA/META

Jing Jin, Jeffrey Cao
BASF(China) Co., Ltd

KEYWORDS –
Fast Flow, Moldex3D API, Automatic

ABSTRACT
With the trend of shorter and shorter product development cycle, especially in consumer and automotive industry, the requirement of response for simulation is getting stronger as well.

Instead of only pursuing accurate simulation result only, more and more companies are seeking quick and automatic simulation method that allow engineer to get acceptable accurate result but in much less time. i.e. the traditional flow simulation needs hours of calculation time to get plastic part's fiber orientation, weld line position etc. Now that validation method becomes the bottle neck of accelerate product development especially in earlier concept stage which need not super accurate result but fast and multiple paralleled simulation process.

BASF cooperate with Coretech developed an automatic simulation tool that allow user can quick submit simulation request to Moldex3D solver with API function from it. It can also combine the API from ANSA/MEAT and Moldex3D together to have seamless process simulation and post processing even for non-professional CAE engineer. It can reduce the calculation time from hours to minutes with acceptable accuracy level of simulation result. It does help us to shorten the development speed in concept idea filtering.

Additionally, with API function from Moldex3D, we can also use the tools combining with optimization tools to get faster solution with much less time.

UNLEASHING THE FULL POTENTIAL OF ANSA MESHING CAPABILITIES FOR RTM ANALYSIS

Panagiotis Fotopoulos
BETA CAE Systems

KEYWORDS –
Molding, RTM, mesh, laminates, layers, material angle, morphing, DFM, properties, middle surface, symmetry

ABSTRACT
The progress of technology supplies industry with new methods which, need to be inherited by the CAE community. A commendable collaboration of ANSA with Moldex3D has proved that pre-processing challenges can be tackled effectively. In a particular case, Resin Transfer Molding special layered mesh, combined with the complexity of the model geometry, posed a challenge to achieve adequate accuracy, while maintaining the mesh quality and flow at a satisfactory level.

The starting step is the preparation to work on the symmetric model. Next step is the middle surface extraction, which holds information of the relatively thick solid geometry. This causes fillet areas to emerge the first challenge, since elements extrusion is prone to intersections. Then, the advanced Laminate tool takes over to model the three different areas of the model with the specific parameters for layers, materials and angles.

The conversion from layers to solid elements overcomes a diversity of specifications such as, variable number of layers for each of the three model areas, equal distribution of the drop-off pentahedral elements along the thickness, same property ID for identical layers and local linear layers thickness distribution in order to fill the solid geometry. The automation with the ANSA Python API is necessary to transfer the information of the layers to the generated solid elements. Even when the layered mesh is generated, it still needs to be accurately adapted to the solid geometry bounds, providing accurate depiction of the model. Evolving the Morphing tool capabilities, the outer mesh areas fit to the outer skin, while the shape modifications are smoothly transitioned to the inner elements.

The final result proves a credible model that can be imported into Moldex3D for RTM solution. The overall process is an indisputable proof of the harmonic and effective collaboration of ANSA and Moldex3D for escalated potentiality and broadened capabilities.

DEVELOPMENT OF AN EFFICIENT TOOL FOR MODELLING PLASTIC PARTS USING MACHINE LEARNING

Yoshikazu Nakagawa[1], Osamu Ito[1], Prakash Krishnaswamy[2], Umesh Mallikarjunaiah[2]
[1]HONDA R&D Co., Ltd.
[2]Xitadel CAE Technologies India Pvt Ltd.

KEYWORDS –
Plastic Part, Reducing Modeling Manpower, Machine Learning

ABSTRACT
Plastic parts in automobile, such as bumper fascia, grilles, and covers, need to be represented precisely in a finite element model because it indeed affects pedestrian protection and low speed collision performance.

The plastic parts include some special features like clicks, dog-house bosses, and ribs which make the structure's geometry complicated. Therefore, representing plastic parts in the model is difficult and hard to automate. We had no choice but to create a model for plastic parts manually using huge manpower.

We developed a plug-in tool for ANSA to reduce the modeling manpower for plastic parts. This tool has two unique features. The first feature is a library which contains information to precisely represent each of the geometrical features. In the conventional case, the differences among clicks, dog-houses and ribs were not taken into account, and a uniform representation was applied to a whole model. As a result, the representation did not fit with the demand of users and they needed to be revised by hand. This new tool can apply an appropriate representation for each feature.

The second feature is an improved shape recognition performance. There are many different types of clicks, and even within the same type there are different shapes, including slanting angles, length and width. An existing approach could only recognize the geometry when the target shape perfectly agrees with the reference shape. This tool has more flexibility for recognizing shapes by applying machine learning.

Among several different features, this presentation mainly focuses in introducing our approach to automate the modeling of clicks. We succeeded in reducing the modeling manpower for clicks by 93% after the application of the tool.

Session 8C

FACILITATING THE INDUSTRIAL IMPLEMENTATION OF AN ADAPTIVE ISOGEOMETRIC CONTINUUM SHELL ELEMENT FOR LAMINATE ANALYSIS

Camiel Adams[1], Martin Fagerstrom[1], Joris J.C. Remmers[2], A. Vafeidis[3]
[1]Chalmers University of Technology
[2]University of Technology Eindhoven
[3]BETA CAE Systems

KEYWORDS –
Isogeometric analysis, Delamination, Adaptivity, Continuum shell formulation, NURBS

ABSTRACT
To accurately predict damage growth in large composite structures, it is required to have models that are both valid and computational efficient. In this respect, isogeometric continuum shell elements provide an interesting option. First of all, the higher order continuity achieved via isogeometric analysis yields an increased in-plane smoothness that enable the use of larger shell elements. In addition, the high in-plane continuity also leads to stress derivatives that are continuous across element edges, which allows an element-wise recovery procedure to enhance the out-of-plane stress predictions.

Furthermore, in an isogeometric continuum shell modelling framework it is rather straightforward to modify the through-thickness kinematics to incorporate weak and strong discontinuities. By introducing weak discontinuities at ply interfaces, the through-thickness strain discontinuities at these locations are explicitly accounted for. This enables a much better 3D strain and stress prediction, something which is key for a good estimation of the amount of intralaminar damage. By introducing strong discontinuities, the element is also capable to represent initiation and growth of one or several delamination cracks.

In the current contribution, we present a fully adaptive continuum shell element that allows for an update of the through-thickness kinematics at any required time instant during the simulation. A particular challenge for industrial implementation of this approach is the pre-processing stage. By using the so-called Bezier extraction technique, isogeometric elements can be implemented in a structural analysis code following a standard FE-scheme. However, in comparison to FE, additional geometry information is then required as output from the pre-processor (e.g. element-wise Bezier extraction operators). In the current collaboration, ANSA has therefore been augmented with the ability to provide the essential geometry information, thereby facilitating the first step of the adaptive shell element implementation in commercial FE-codes, ultimately making this modelling concept directly accessible for the industry.

EFFICIENT SCREENING OF COMPOSITE STRUCTURES USING THE EXTENDED 2D FEM APPROACH IN META TOGETHER WITH A STATE-OF-THE-ART FAILURE INITIATION CRITERION

Henrik Molker, Renaud Gutkin, Annika Lundberg
Volvo Car Corporation

KEYWORDS –
Composites, Global shell model, Full stress tensor, Extended 2D FEM, META

ABSTRACT
The introduction of structural parts made of composite materials in automotive industry demand new CAE-verification methods. One major issue is to ensure that all possible failure modes can be evaluated and to avoid secondary modes of failure. For complex geometries and/or complex load cases the low out-of-plane strength can cause secondary failure.
In order to assess complex composite structures, the full 3D stress tensor is needed to ensure that all possible failure modes can be captured. Conventional shell elements only give accurate results for the in-plane stress components, while the out-of-plane components are neglected. The implementation of the Extended 2D FEM approach [1] into META [2] makes it possible to get the full 3D stress tensor from second order shell elements. With the full stress tensor, state of the art set of failure initiation criteria can be used to evaluate the component. Two different cases are used to show the applicability of the procedure. The first example is a simply supported plate from the literature [3] is used to demonstrate the results and how META can be used to visualise the results. The second example is a large structure of joined composite parts [3] to illustrate the applicability in a global model where additional calculations are performed to predict failure initiation using a state of the art set of failure initiation criteria, LaRC05 [4].
The tools and results can then be used in a framework for analysis of composite structures where the Extended 2D FEM approach is used in a screening part of global models [3]. Critical locations from the screening can later on be analysed in more detail using submodelling techniques [5].

[1]Rohwer K & Rolfes R. Calculating 3D stresses in layered composite plates and shells. Mechanics of Composite Materials 1998;34(4):355–62.
[2]META version 19.1.0, BETA CAE Systems, December 2018.
[3]Molker H, Gutkin R, Pinho S & Asp L E. Hot-spot Analysis in complex composite material structures. Composite Structures 2019;207:776-86, 2019
[4]Pinho S, Darvizeh R, Robinson P, Schuecker C & Camanho P. Material and structural response of polymer-matrix fibre-reinforced composites. Journal of Composite Materials 2012;46(19-20):2313–41.
[5]Molker H, Gutkin R & Asp L E. Submitted manuscript, 2019

FULLY AUTOMATED PARAMETERIZED MODEL CREATION OF ULTRA-LIGHTWEIGHT CARBON FIBER WRAPPED COMPONENTS IN ANSA

Pascoe Scholle
LASSO GmbH

KEYWORDS –
Scripting, Ultra Lightweight Structures, Automated

ABSTRACT
Using ANSA for the design and modelling of ultra lightweight carbon fibre wrapped structures is an area still in its infancy. ANSA geodesic curves, which are used to represent the carbon fibre rovings, are ‘fitted’ by hand using the TOPO tools, can be both time consuming, and tedious. Furthermore, the position of each roving plays a crucial role in the structures ability to effectively transfer the applied forces smoothly from the load itself down to its fixed base.
We present a methodology which aims to improve the design and manufacturing process through automating and parameterizing the curve fitting process, combining topological functions integrated into ANSA's python package and ANSA scripting.

The method presented here, aims to automate the creation of a 3d tube like structure, representing the mould to be wrapped with carbon fibre rovings, as well as simulate the wrapping process, all done using python and the ANSA python package. Taking a few input parameters, the algorithm advances along an axis defined by some arbitrary geodesic curve in space, systematically placing guidance points for generating multi-patch Face and surface entities. This process creates a 3d printed helical skeleton, consolidated in forms adapted automatically to the desired design. The fully automated wrapping process is simulated using KINEMATIC BODIES, which represent the 3d skeleton and the robotic tool head in ANSA. Steering of the robotic devices is achieved by means of geodic curves representing the fibre roving.

A finite element analysis using beam elements will illustrate the even transmission of compressive and tension forces in the structure showcasing the structure's integrity.

NON-LINEAR MULTI-SCALE MODELLING OF COMPOSITES USING ANSA TOOLS

Vangelis Palaiokastritis, Eleftherios Tsivolas
BETA CAE Systems

KEYWORDS –
Composites, Multi-scale Modeling, Mean-Field Homogenization, Materials

ABSTRACT
The scope of this presentation is to demonstrate a workflow for the Multi-scale modelling of structural components made with Composite materials in ANSA environment. Taking advantage of ANSA Homogenization Tool and Results Mapper the user is able to bridge the gap between process simulation and structural analysis and automatically generate a model for the examination of the microstructural behavior of the composite.

The aim of this case study was to substitute the metallic (aluminum) material of a beam, subjected into 3-points bending, with a Short Fiber Reinforced Polymer (Carbon/Epoxy) to reduce its weight. With known properties of the constituents, a material with equivalent response was estimated for both the elastic and plastic regions, using Mean Field Homogenization formulations. Afterwards, the fiber orientation from the molding simulation was mapped in the structural model. Both models (metallic and composite) ran in the nonlinear regime resulting in almost identical flexural behavior. Furthermore, the high strain area of the model was isolated and a Representative Volume Element (RVE) was automatically generated in ANSA based on given microstructure information and orientation tensor from the molding analysis. The RVE model was subjected into the boundary conditions (strain) of the macro-scale analysis to examine cases of fiber-matrix interfacial damage.

Finally, the beam made by the Composite Material had approximately half of the weight of the aluminum beam. Although in case of the aluminum and composite beam the material response did not exceed the plastic region, in microscale level fiber matrix debonding was observed at the end of the analysis.

Session 8D

EFFICIENT WATERTIGHT PREPARATION TOOLS AND METHODS FOR CFD MESHING AT PSA GROUP

Nikolaos Batsaris[1], Gael Roy[2]
[1]BETA CAE Systems
[2]PSA Group

KEYWORDS –
CFD meshing, ANSA, Watertight, Automotive

ABSTRACT
Traditionally, CFD engineers spend far too much time on the tedious task of creating a watertight surface mesh out of large and complex CAD assemblies for external aerodynamic simulations. A notoriously time-draining process is usually followed where manual and repetitive tasks involving labor-intensive CAD repair is needed to allow for a high quality volume mesh generation.

This study presents a new ANSA methodology combining batch meshing, surface wrapping and new advanced mesh tools for gap closure, as proposed to PSA group for the optimization of the CFD model preparation cycle. A set of CAD data of a complete car assembly is used to present all the steps of the process, starting from identification and separation of the different sub-assemblies of the vehicle into different Parts and Groups in the Model Browser, so that each is processed with the optimum approach according to its importance on overall the vehicle aerodynamics.

The engine area is treated with surface wrapping, while the upper external surfaces are treated at geometry level in order to maintain all details. For the underbody and underhood areas, where most of the complexity exists an approach at FE-mod level is followed where the panels are batch meshed, released to FE and then intersected and fused together automatically and robustly.

This study offers the chance to benchmark these advanced tools against traditional watertight approaches at geometry level not only in terms of generating an equally high quality surface mesh but also in applying an efficient time management for the entire modeling process.

EFFICIENT HANDLING OF CFD RESULTS THROUGH COMPRESSION

Aristotelis Iordanidis
BETA CAE Systems

KEYWORDS –
CFD, compression, results

ABSTRACT
The increase in computing power density during the last decade has enabled generation of industrial CFD models with ever increasing complexity and mesh sizes often ranging to several hundred million elements. The latter, combined with recent trends towards LES (transient) simulations impose high demands in storage media, where not only a model file, but multiple result files need to be saved. Typically, files require several hundred gigabytes.
Enormous file sizes render model manipulation a real challenge. Opening the model is inefficient and model exchange between colleagues is rather prohibitive.
In recent versions, META allows compression of results when saving files in native metadb format. This allows for much smaller file sizes, without loss of detail and with fully customizable options in terms of results compression, allowing smaller storage requirements and easier file sharing. In this work, META capabilities in results compression are presented, along with the effect of different settings on file size and accuracy of results.

CAE PROCESSES AT MAHLE THERMAL MANAGEMENT

Dr. Albrecht Gehring, Dr. Maria Baiker, Dr. Wolfram Kühnel
MAHLE

KEYWORDS –
Digitization, CAE process

ABSTRACT
Diverting solutions for the future mobility offer many opportunities for global suppliers like MAHLE. Beside that the progressive introduction of digitization has an impact on the development process of new products. An efficient CAE process contributes to achieve the customer goals with respect to function, quality and time.

This paper shows the CAE process at MAHLE Thermal Management. The process starts with the CAD import and preprocessing in ANSA and ends with reporting assisted by META. One major aspect is how the link between different CAE disciplines like FEA and CFD is realized. Another important task during the development process is to validate the design in different stages efficiently. This is achieved by tailored user friendly tools based on the scripting interfaces. As the development teams are globally organized an efficient collaboration can be accomplished by the remote desktop sharing tools. To present the simulation results in an easy accessible way VR technologies are introduced beside the typically used reports with pictures and animations.

The single steps of the standardized CAE process are illustrated by the example of a radiator, where some of the implemented tools are shown in detail and also the interaction of CFD and FEA analysis.

AUTOMATED REPORT GENERATION OF CORROSION PROTECTION SIMULATIONS

Yannick van Dijk, Elmar Stegmayer, Timo Hopf
BMW Group

KEYWORDS –
Post-processing, Automotive, Report generation

ABSTRACT
Numerical simulations continue to gain importance in reducing the development time in the automotive industry. Early stage product development is crucial to allow the integration of novel vehicle models in existing production facilities and current vehicle models in new production facilities. Therefore, the BMW Group focuses on simulations regarding paint shop processes. Specifically to ensure basic corrosion protection of all vehicles, simulations are carried out for dipping, electric deposition of E-coat, and curing of process materials in all paint shop ovens. It is challenging to efficiently display complex simulation results in an easily comprehensible manner. The current standard is to manually generate reports, which generally takes up multiple hours.

To combat this time consuming process, a solution approach was set up with the goal to be able to create reports without the need of any intermediate human interaction. The presented solution approach implements automated report generation including the connection to a database for retrieval of part names based on unique part numbers. Moreover, grouping of vehicle modules analogue to a company-wide standard, applying advanced filtering techniques to find, for example, local minimum and maximum values of E-coat layer thickness, and excluding insignificant simulation results will provide a concise report. An effective way of conveying simulation results can be achieved by realising links throughout the report for easy navigation, displaying contour plots in various standardised orientations, and providing detailed information about individual regions of interest. Modification of the generated reports should be straightforward and shall not require programming knowledge, for example by utilising a customizable template. The time saved by automatic report generation is a contribution to increased efficiency for product design. The time saved by automatic report generation can be invested more effectively in the development of simulation techniques, iterations within product design, and allows for an overall larger involvement in different projects.

Session 9B

ARE WE READY FOR HUGE CAE MODELS?

Stavros Kleidarias
BETA CAE Systems

KEYWORDS –
CFD, graphics performance, memory consumption

ABSTRACT
FEA models have come a long way in terms of element count since the early 90's, when they would typically be less than a million elements. In the recent years large CFD models, in the order of tens of million elements, have not been uncommon however such huge models are increasingly used also for structural FEA simulations. The ever increasing demand for detailed modelling of increased accuracy has meant that models of as many as 50 million elements and of thousands of properties are used for crash simulations, with a trend to further increase the element count. This is particularly challenging for FEA software that was developed in accordance with smaller models but which now has that has to cope with much increased FEA data processing.

BETA CAE Systems has invested heavily in improving and optimizing META, the high performance FEA post-processor, to tackle the challenge of huge CFD and structural models with an array of developments in the areas affected by such models: the time required to read huge models, the memory footprint and the graphics performance.

VR-SUPPORTED ENGINEERING PROCESSES AT DAIMLER

Andreas Pau
Daimler AG

KEYWORDS –
Virtual Reality, Collaboration

ABSTRACT
The improved hardware performance and availability of low-cost, powerful head-mounted displays (HMDs) renewed the focus on Virtual Reality as an everyday tool in the engineering area two years ago. After some development time, it was possible for the use of HMDs to be firmly integrated into the daily work routine and existing processes at Daimler.

Apart from just the visualization of data, the focus of development was on interaction with the models and collaboration in 3D. For example, it was possible for functions known from post-processing to be integrated almost entirely into the VR environment. Evaluations are thus conducted collaboratively in various disciplines. Especially with partners spread around the world, this form of collaboration has contributed on the technical and interpersonal levels to improvements in the development process.

Building on this work, new topics, such as brushing, in-VR sculpting with the hands, voice control and haptic feedback, are being integrated.

Along with the software, standardized hardware is being developed. The aim is for the compact hardware to be made available close to each person's workplace and within a very short time in order to allow collaborative meetings to be called on the spur of the moment.

SUBJECTIVE ASSESSMENT OF CUSTOMER-ORIENTED FUNCTIONS BY ENRICHING FINITE ELEMENT SIMULATION TECHNOLOGY WITH VIRTUAL REALITY FEATURES

Matthias Steinecker, Daniel Heiserer, Rainer Abeltshauser
BMW Group

KEYWORDS –
photorelism, virtual reality, post-processing

ABSTRACT
Post processing with photorealism is a task that accompanies a number of features that make the realistic representation of an FE-Model possible. All these features need to be combined and fine-tuned, in order to achieve the visual appearance of the simulation model that will match reality: ambient occlusion, rendering materials, light mapping, environment mapping, texture mapping and controlling/setting individual light sources.

This visual representation is not only serving the purpose of producing a visual result with aesthetic appeal. There is also engineering value assessed, when being able to visually understand simulation results, especially in the effect they have in the reflection of the surrounding imagery. This is essential for engineering tasks, such as the improvement of noise and vibration behavior analyzed on cars. Those vibrations (caused by various sources such the engine, road-noise, the car's sound system etc.), are experienced through the deviation of the reflections that can be seen on the hood, the rear-view or wing mirrors.

Session 9A

IMPACT OF TRANSCATHETER VALVE SIZE ON THE ESTIMATION OF PARAVALVULAR LEAKAGE: AN FSI STUDY

Laura Iannetti[1], Giulia Luraghi[2], Claudio Chiastra[2], José Félix Rodriguez Matas[2], Francesco Migliavacca[2]
[1]BETA CAE Italy
[2]LaBS, Dep. of Chemistry
Materials and Chemical Engineering, Politecnico di Milano

KEYWORDS –
FSI analysis, cardiac valve diseases, haemodynamic.

ABSTRACT
Transcatheter aortic valve implantation (TAVI) is a minimally invasive treatment for high-risk patients with aortic diseases. Despite its increasing use, uncertain influential factors require continuous investigation. TAVI "sizing" [1] (i.e. the selection of the prosthesis within a range of available sizes to ensure its best accommodation into the native aortic root) is an important aspect to be considered for the procedure success. This choice, along with the positioning strategy, strongly affects the onset of paravalvular leakage (PVL), a frequent TAVI complication with increased mortality [2]. From a modeling point of view, the Fluid-Structure Interaction (FSI) methodology represents the best numerical approach capable of reproducing the loading on the valve leaflets due to the fluid coupling [3]. The aim of this work is to study by means of FSI simulations how the choice of the transcatheter valve size affects the PVL after a TAVI procedure. A parametric anatomical-resembling model of the aortic root was realized with the morphing tool and subsequently meshed in ANSA pre-processor (BETA CAE Systems International AG). In particular, a patient with 26 mm of annulus diameter and a severe grade of stenosis was selected to virtually implant both 29 and 34 Medtronic Corevalve Evolut R size. The solid parts of the numerical model include the anisotropic hyperelastic aorta, the calcified native valve, the Nitinol frame of the prosthesis and its pericardium leaflets and skirt, while the fluid parts were created based on the anatomy of the aorta, which was totally immersed in the blood domain. The FSI simulations were then performed using the non-boundary fitted method implemented in LS-DYNA (LSTC). Results from the FSI analyses predicted different outcomes for the different implanted valve sizes in terms of the final configuration of the released device in the implantation site; furthermore, the aorta and calcification stresses, the pericardium leaflets kinematics, and the PVL estimations showed difference among the two different sizes. The calculation of velocity fields and flow rate curves with META post-processor (BETA CAE Systems International AG) allows the quantification of the most common clinical parameters used to assess the presence of PVL, such as the regurgitation volume and the effective regurgitation orifice area.

GAIT SPECIFIC OPTIMIZATION OF ATHLETIC FOOTWEAR

Alexander Tsouknidas[1], Katerina Tzolva[2], Dimitris Drougkas[2], Evagelos Karatsis[2], Maria Papagiannaki[3], Fotini Arabatzi[3]
[1]University of Western Macedonia
[2]BETA CAE Systems
[3]Aristotle University of Thessaloniki

KEYWORDS –
Midsole cushioning, Design optimization, FE, Evolutionary computing

ABSTRACT
During the last century, running shoes have been subject to drastic changes with incremental however improvements as to injury prevention. This may be, among others, due to the limited insight that experimental methodologies can provide on their 3D in-situ response. The objective of this study was to demonstrate the effectiveness of Finite Element (FE) modelling techniques, in optimizing a midsole system as to the provided cushioning capacity.

A commercial running shoe was scanned by means of micro Computed Tomography and its gel-based midsole, reverse-engineered to a 200μm accuracy. The resulting 3D model was subjected to bio-realistic loading and boundary conditions, in terms of time varying plantar pressure distribution and shoe-ground contact constraints.

The mesh grid of the FE model was verified as to its conceptual soundness and validated against velocity driven impact tests. Non-linear material properties were assigned to all entities and the model subjected to a dynamic FE analysis. An optimization function (based on energy absorption criteria) was employed to determine the optimum gel volume and position, as to accommodate sequential cushioning in the rear-, mid- and forefoot, of runner during stance phase.

The in-situ developing stress fields suggest that the shock dissipating properties of the midsole could be significantly improved. Altering the position of the gel pads and varying their volume, led to different midsole responses that could be tuned more efficiently to the specific strike and pronation pattern.

The results suggest that midsole design can be significantly improved through bio-realistic FE modelling, thus providing a new platform for the conceptual re-design and/or optimization of modern footwear.

FATIGUE FAILURE ANALYSIS OF A HUMERAL IMPLANT: A FINITE ELEMENT APPROACH

Shivkumar Umadi[1,2], Vyjayanthi Murthy[2], Dr. Suresh Nagesh[2], Dr. Venkateswaran Perumal[3]
[1]CORI
[2]PES University
[3]Stryker

KEYWORDS –
Finite Element Analysis, Titanium implant, Fatigue Life

ABSTRACT
The purpose of this research is to perform Stress and Fatigue Analysis of an Implant-based on the load cases and parameters typical for such implants. A 3D Finite Element Analysis (FEA) is performed on a generic orthopaedic implant to estimate stress and displacement fields on each component of the implant. A titanium alloy implant is then evaluated for worst-case loading conditions. The pre-processing of the analysis is carried out on ANSA. The finite element results are then further post-processed in a FE-Fatigue software under uniform cyclic loading to evaluate the life and damage. In this study, the Fatigue life and Damage contours of the generic implant subjected to the load is also calculated considering additional variables including the size and orientation w.r.t. loading and boundary conditions. Close to a million cycles have been recorded with the structure showing minimal damage. This is considered safe for the loading conditions with requirements claimed by prior simulation and experimentation.

Session 9C

APPLYING THE VMAP INTERFACE STANDARD IN ANSA FOR MULTI-SOLVER SIMULATION PROCESSES

Athanasios Fassas, Dr. Georgios Mokios
BETA CAE Systems

KEYWORDS –
VMAP, Mapping

ABSTRACT
In most of the simulation processes, the aim is to simulate complex and advanced procedures. As a result, usually, several different software take part in these procedures, to simulate the phenomenon as realistically as possible and produce reliable results. These different software, however, do not use the same modeling parameters. For example, some use 3D elements, other deal with 2D elements, and usually they also use different material models.

As a result, going through the steps of a simulation process, information, including those for materials must be exchanged between the different software. To reduce errors, costs, and effort during this exchange of information, the creation of a 'Material Data Exchange Interface Standard' is considered mandatory.

As part of the VMAP project, BETA CAE Systems closely cooperates with the other project partners to develop a common understanding and interoperable definitions for virtual material models in CAE. The aim of this project is the development of the 'Material Data Exchange Interface Standard'. BETA CAE Systems has supported this format in its products, allowing engineers to apply (map) the results of a simulation on their current models, using the standard format, and proceed with their simulation process.

This presentation examines several use cases, in which exchanging information among different software is required. For the demonstrated case we showcase how the proposed solutions support processes, such as mapping the results of a previous simulation, written in the VMAP standard format, on a current model, so that it can be used in a next simulation process step.

All steps required to transfer results from a simulation and utilize them as boundary conditions for the next simulation is performed in ANSA, with the application of the Results Mapper. ANSA Results Mapper is based on interpolation and the proper interpolation method can be selected among several available interpolation methods. Enhanced with an intelligent position mechanism, the ANSA Result Mapper allows the mapping of information between models, which are not designed at the same location. The transformation of the donor part can be automatically performed, with simultaneous transformation of tensor results, like stress and strains.

MULTI-LEVEL OPTIMISATION FOR MIXED MATERIAL STRUCTURAL PROBLEMS USING ANSA & META

Drew Smith[1], Nick Kalargeros[2]
[1]FAR UK
[2]Jaguar Land Rover

KEYWORDS –
Structural optimisation, mixed material structures, multi – objective problems, AHP

ABSTRACT
Structural optimisation with the use of mixed materials are increasingly applied to lightweight vehicle structures. The optimisation of a vehicle's structural behaviour and performance is relying on increasingly complex simulations under multi objective criteria and constraints. Sub-models of the structures required load cases may improve or hinder 'fit for purpose' and 'cost effective' development.
This paper proposes 'fit for purpose' optimisation models based on an adapted AHP (Analytical Hierarchy Process). The algorithms have been developed using ANSA automated model techniques to compile multi - load / geometry cases using several material combinations. The proposed adapted AHP is carried out in several levels. Each level has different variables, constraints and responses accounted within novel KPMs (Key Performance Metrics). Once these iterations are completed META automated post processing is used to decide the next round of iterations and to provide an interface between results and next variables that need further exploration.

HOW COMPARE-FUNCTION CAN BECOME THE SECRET INGREDIENT FOR REDUCING MODEL BUILD-UP EFFOR

Michael Tryfonidis
BETA CAE Systems

KEYWORDS –
compare, model updates

ABSTRACT
Solutions in automating pre-processing tasks such as cad conversion, midsurfacing, batch meshing or applying pdm attributes such as thickness and material have been proposed already and are also being applied to one extend or the other in OEMs already. But after all automation is said and done, the final simulation ready FE-model still undergoes manual treatment: the parts that failed from the automation or where mesh quality violation has been identified, have to be manually examined and corrected.

When administering FE-model build up especially of multiple car derivatives, it becomes crucial to be able to save work as much as possible, since manpower will still be involved. Or even when the model design enters the next stage: some of the parts the model consists of will stay the same. Evidently in those cases, the effort that has been invested in making the raw batch mesh result fit for simulation has to be saved.

This paper will present how the Compare function in ANSA can become the secret ingredient for reducing the model build-up effort tremendously, regardless of what meshing option or what data management solution has been chosen.

Session 9D

SIMULATING INSTALLED ANTENNA PERFORMANCE FOR AUTOMOTIVE RADAR APPLICATIONS

Dr. Christos Liontas, Stefan Frank
Fraunhofer FHR

KEYWORDS –
installed antenna performance, radiation pattern, automotive radar, finite element boundary integral method (FEBI)

ABSTRACT
Radar technologies play and will continue to play an ever increasing role in the present and future of automotive industry. Especially with the advent of assisted and autonomous driving technologies, acquisition of radar data from the surroundings of a vehicle and fusion with other sensor data becomes indispensable. Radar antennas in cars are frequently placed behind front and/or rear bumpers to protect their sensitive components. Although the bumper material is dielectric, which permits the transmission of radio waves through it, its dielectric properties are different from air. Therefore, the characteristics of the radar antenna are different when it radiates behind the bumper than in free space. For a successful antenna design, a simulation of the performance of the antenna when it radiates in its proper environment (i.e. behind the bumper) is needed. In this paper we will show with the help of a generic example, how an electromagnetic solver that uses the hybrid finite element – boundary integral method (FEBI) can tackle this problem with the help of the ANSA preprocessor for generating the mesh. To this effect, first an antenna array of four patches was simulated in free space, and afterwards behind a generic car bumper. The radiation pattern was calculated in each case and compared subsequently, in order to show how the presence of the bumper alters the radiation characteristics of the antenna.

SPECIFIC ABSORPTION RATE ELECTROMAGNETIC (EM) SIMULATIONS IN ADULT AND CHILD TISSUES

Michel Alhilani[1], Seyed Reza Atefi[2], Lilla Zollei[2], Mohammad Mansouri[2], Filiz Yetisir[1], Michael H. Lev[2], P. Ellen Grant[3], Giorgio Bonmassar[2]
[1]Newborn Medicine, Boston Children's Hospital/ Harvard Medical School
[2]Radiology, Massachusetts General Hospital/ Harvard Medical School
[3]Newborn Medicine, Radiology, Boston Children's Hospital/ Harvard Medical School
Presented by: Milton Pena BETA CAE Nordic

KEYWORDS –
EM Simulations, absorption rate, segmentation

ABSTRACT
The radiofrequency (RF) power normalized to the tissue density deposited in a patient during an MRI examination is referred to as the Specific Absorption Rate (SAR), and it is expressed as watts per kg (W/kg). The issue is that RF power deposition results in heating of patient tissue, which poses concerns on children's safety. In 2014, the FDA regulated the maximum whole-body SAR is 4 W/kg averaged over 15 minutes in the whole body, and 3.2 W/kg averaged over 10 minutes in the head. However, the 2014 standard does not provide any limits to the 10g-SAR which is relevant for heating. Thus, the purpose of this work is to study and compare the 10g-SAR distribution in an adult single tissue model and a new 3-year-old child single tissue model. In this model, different tissues are being manually and automatically segmented from full body MRIs. Then, pre-processing in ANSA is performed in order to perform Finite Element Simulations to simulate the SAR in the single tissue child and adult model at 3T MRI.

The simulations showed that the adult local SAR peak was 2,054W/kg, while the child local SAR peak was 334W/kg or approximately 6x smaller. In both models, the local SAR peaks were located in the neck and armpits. 10g SAR peak in the adult model was 43.6 W/kg, while the child model had 31.88 or a 1.4x smaller peakW/kg. These results offer an initial understanding of the differences in 10g-SAR distribution in child and adult for safety purposes.


Demo Sessions

Featured Demonstration

VR APPLICATION FOR CFD SIMULATION POST-PROCESSING ACTIVITIES IN COLLABORATIVE ENVIRONMENT

René GOSSELIN
RENAULT

KEYWORDS –
VR, METAPOST, CFD, COLLABORATIVE

ABSTRACT
Simulation activities are widely used in all engineering processes and are becoming a usual and accessible tool to assess the design of a product. Current post-processor tools such as METAPOST allow the visualisation of the results for simulation engineers to understand the behaviour of the product they designed and manufactured. However, Design processes are cross-functional and collaborative, which occurs the need to share the analysis among partners and colleagues. Current results sharing methods often rely on image and video extraction. These formats are restricted to two-dimensional views and are not suited for interactions with the three-dimensional model. This study proposes to use Virtual Reality to allow engineers to discuss and share their results in a collaborative environment. It is based on the BETA CAE METAPOST software solution, which enable to work on CFD simulation in an immersive environment with remote colleagues. Post Processing of a powertrain leakage simulation is implemented through a collaborative immersive environment, where engineers interact on the analysis while using Virtual Reality Helmet.

Demo 3E

Graph View for connectivity information

T. Sarridis, K. Skolarikis

A general tool for visualization, inspection and handling of connectivity information between interconnected components. It is embedded in Model Browser, Includes list, Check Connectivity and Kinetic tool.

Demo 3F

META Template Manager

I. Karypidis

META is a powerful tool in terms of Automation and Reporting capabilities. Users can set up complex and long-lasting procedures to run in batch mode and produce PPTX, PDF and HTML reports according to the organization's needs. How does one remove the complexity out of the equation though? How does a user become efficient in creating automatic procedures for simpler or more demanding tasks? This demonstration aims to provide efficient methods and techniques to get from interactive post-processing to creating automated tasks to produce reports with the evaluated results. Best practices suitable both for novice and advanced users will be presented making use of tools like the session language of META, Python scripting, PowerPoint templates and variables in PPTX and Spreadsheet templates. Moreover, new trends in reporting like vectorized 2d plot images and embedding metadbs in the pptx presentation through OLE objects will be demonstrated.

Demo 3G

Surface wrapping and Hextreme volume meshing

M. Di Nonno

This workshop will demonstrate the applications of the Octree entity in ANSA. The octree is the functionality on which the Surface Wrapping and the Hextreme volume meshing algorithms are based. Functionalities like octree visualization and element size preview will be demonstrated, together with leak detection solutions. Live demo of surface wrapping will be performed on a complex geometry, in order to demonstrate the best practices on how to properly setup a case, preview the outcome, find and close leaks and post-process the resulting watertight mesh. In addition, Hextreme volume meshing applications of the octree entity will be performed with both Snap and Trim approaches in order to clarify their differences and specific applications.

META post-processing for CFD

G. Fotiadis

This demonstration is an introduction to META for CFD post-processing.
It starts with the META GUI description and proceeds with an example of loading the geometry of a model and visualizing the results through the use of Cutting Planes, IsoFunctions and Flow Paths, along with other post-processing tools. It concludes with the demonstration of a fully automated post-processing procedure. The demonstration is recommended to CFD engineers who would like to have a quick help in order to get started with META.

Demo 6E

NEERE: New product demonstration

V. Souliotis, S. Kleidarias

Modern, multinational work groups that need to collaborate on a daily basis face a series of obstacles that hinder communication productivity. Ruling out the all-important factor of time zones, team members in different physical locations need to have an efficient medium through which they can communicate their work.

BETA CAE Systems has developed NEERE, a new, state of the art web browser-based collaboration platform for the direct engagement of team members and software users. More importantly, teams can share and discuss CAE model and simulation data and even be experience it in a Virtual Reality (VR) room where participants from distanced locations can work on data in real time and physical size being “virtually there” with their associates.

The state of the BETA Development Platform

Y. Kolokythas

Continuing the effort to further improve the capabilities of the development platform, improvements and new functionality are

introduced. Improvements are oriented towards performance and scaling of solutions, since CAE constantly challenges engineers with big problems. New functionalities are adding capabilities to develop even more powerful custom solutions with built-in like look and speed.

Demo 6F

Latest developments in meshing of structural parts

D. Zafeiropoulos

ANSA is a standard of meshing quality for many years now. This demo will cover the latest enhancements that concern v19 and v20 releases and will focus on Batch mesh, feature treatments, spotweld meshing and ANSA meshing functionality in general

Mid-surfacing of Casting parts - Challenges and solutions

D. Zafeiropoulos

Mid-surfacing of Casting parts is one of the most challenging and time consuming processes in modeling. Since v18.0 ANSA established new standards and presented a completely new way of treating those parts. The goals that we set are automation, speed and accuracy. Through this demo we will be able to understand how ANSA meshing functionality handles difficult parts like that. The demo will focus on results fixing, thickness and property assignment, thick areas handling using solids and finally geometry creation.

Demo 6G

Topology optimization using EPILYSIS and ANSA & META workflow - Beam-section optimization

D. Drougkas

A complete start to finish demonstration of a Topology optimization definition process. Utilizing ANSA's SOL200 Task tool, the process is streamlined and all necessary actions (responses, constraints, objective) are done step by step. EPILYSIS is used for the optimization analysis and after the post processing in meta, an optimized design is generated.

A new Beam Optimization tool is demonstrated that facilitates detailed Finite Element models simplification in a beam-panel model assembly. Beam Cross section Optimization (SOL200, Parametric or Designof Experiments (Doe) study) is automatically prepared on the simplified models. The results from the optimization or DoE can be automatically applied on the initial detailed model, using mesh morphing methods, producing a seamless updated detailed model.

Design optimization set up using the new Optimization Tool

E. Ioannou

This session is a demonstration of new ANSA capabilities on optimization set-up through the Optimization tool. This new tool facilitates DOE and optimization processes. Old and new functionality has been organized into one environment that enables the quick and easy management of design variables, the overview of responses and the definition of design constraints among others. Moreover, designs can be created from various available algorithms and the results can be monitored via plots.

Demo 7E

NVH pre-test analysis and Modal Parameter Estimation (MPE)

Markus Herbst

This demo will demonstrate how to perform a pre-test analysis using available tools within META. This analysis suggests the best possible measurement locations on a component in order to capture its dynamic behavior and the best locations to place a shaker or apply a hammer excitation as well. The eigenvector results of the corresponding FE model are used in that case. Furthermore, the eigenmodes from measured FRFs will be calculated using the Modal Parameter Estimation tool. Based on the estimated modes the FE model can be evaluated performing correlation analysis either on modes of FRFs.

Squeak & Rattle using EPILYSIS

S. Porikis

BETA CAE Systems offers a unique tool for S&R analysis. After having set up the loadcase within the special S&R plugin a single button process follows with the solution in EPILYSIS and the evaluation of the results in META through automated report creation. Moreover, with the use of EPILYSIS, DOE studies are applicable for identifying the best case scenario of S&R performance of a model.

Demo 7F

Durability Load-Cases set-up with the new Load-Case Assistant of ANSA

Y. Asaniotis

The speed-up of Durability Load Cases set-up is now a reality with the new Load Case Assistant. The tool comes to populate the traditional solver headers with more enhanced functionality. A Single environment in tabular form treats Load Case Entities in an intuitive way while multiple scenarios can be manipulated in a single db using numerous Load Case Assistants. In addition, the store of templates in order reuse in new models is another significant achievement.

Modular Run Management in a collaborative environment, for analysts and teams

C. Kougioumtzoglou, I. Makropoulou

The modular management of simulation runs, based on the use of include files, is a standard practice for the handling of large assemblies, especially for crash and NVH teams. Traditionally, this process relies heavily on file system operations, especially local file copies. Unfortunately, file copy is the biggest ""enemy"" of traceability. From the moment a file is ""cloned"" in the user's storage space, collaboration and history tracking depend solely on the user's discretion.

How can a system eliminate the shortcomings of the existing implementation without adding any overhead to the daily work of the analyst? How can a data management system help? Which are the collateral gains from the upgrade of the modular management methodology?

All these questions and more will be answered in this demo session that will touch base the general concepts of data management, modular model organization and model update in ANSA on a use-case coming from the crash discipline.

Demo 7G

RETOMO: The new era of segmentation expoiting Machine Learning

P. Michailidis, V. Karatsis

BETA CAE System's commitment in providing innovative solutions in CT image segmentation has lead to the introduction of cutting edge machine learning algorithms in RETOMO. Benefits include not only improved segmentation results but also a dramatic reduction of required user time. All this is achieved through a minimal and friendly user interface.

The session will cover:
1. The complete brand new machine learning functionality of RETOMO.
2. Comparison of the new segmentation algorithms with the traditional ones.
3. Manual Segmentation tools.
4. RETOMO's capacity to handle extremely large scans.
5. Seamless interaction of RETOMO with ANSA and META.

Material modeling techniques

I. Nerantzis, E. Palaiokastritis

This demo will focus on the latest developments in ANSA/EPILYSIS for solutions of Composite Materials Modeling.

1) Multi-scale material modeling for heterogeneous materials using the Homogenization Tool of ANSA:
- Supported homogenization methods, material models, constitutive behavior prediction
- Representative Volume Element (RVE) Mesh Generation and matrix-fiber interface modeling and FE Homogenization.
- Mapping Material Orientations and Homogenization.

2) Solutions for modelling Laminated Composites:
- A new efficient way to convert laminated shell models to solid, controlling in more detail the information through the thickness such as solid rows per layer, inter-laminate modeling.
- Topometry optimization of Composites with EPILYSIS SOL 200.
- Convert a Laminated composite model to the equivalent PSHELL to hide its lay-up and material information while keeping the information for its static structural behavior.

Demo 8E

Getting the most from a library with standard parts

M. Skordeli

This demo will present how Shape Recognition and Model Build automation can be achieved with the usage of a Standard Parts Library. In particular, we will show how:
- Objects and patterns can be added in the library
- Customizable meta-data can be assigned to each library item
- Stored items can be recognized in any loaded model, based just on their geometry, and retrieved along with their meta data
- Model build and mesh re-use automated tasks can be applied, such as Connection creation

NVH Console: Revolutionising the processes for NVH development

V. Pavlidis

Improving NVH behaviour of a complicated structure involves complexity and time-consuming calculations. NVH Console provides a revolutionary approach that overrules this fact through the ease of use and the fast calculations delivering accurate results for a full vehicle within few minutes on a simple PC. This demo highlights:
- The key features of NVH Console spanning the whole NVH development field (components handling, assembly, loadcasing and calculations/post-processing)
- The multiple Root Cause Analysis options and results
- How easy ""What-if"" studies can be conducted
- Fast DOE studies for Bush properties

Demo 8F

Pre- & post-processing for Occupant Safety

A. Fokilidis, N. Tzolas

The handling of the Dummy - seat system is one of the most demanding processes during a Safety loadcase set up. BETA CAE Systems offers special tools to position the Seat and Dummy according to a position from a real test or a regulation, depenetrate them and finally restrain them with seatbelts so as to ensure a proper Safety simulation to the desired crash solver.

Pre- & post-processing for Pedestrian Safety

A. Fokilidis, A. Perifanis

ANSA and META offer a tool for Pedestrian analysis that leads one from the marking of the vehicle till the evaluation of the respective results. All protocols in the market are available in addition to user defined marking capabilities. An advanced algorithm positions the impactor on all the targets and offers a bulk creation of all the loadcases. META with a special toolbar offers all the needed capabilities for the analyst to evaluate the results in a fully customizable and automated way.

Demo 8G

Best practices for automated reporting

I. Karypidis

META is a powerful tool in terms of Automation and Reporting capabilities. Users can set up complex and long lasting procedures to run in batch mode and produce PPTX, PDF and HTML reports according to the organization's needs. How does one remove the complexity out of the equation though? How does a user become efficient in creating automatic procedures for simpler or more demanding tasks? This demonstration aims to provide efficient methods and techniques to get from interactive post-processing to creating automated tasks to produce reports with the evaluated results. Best practices suitable both for novice and advanced users will be presented making use of tools like the session language of META, Python scripting, PowerPoint templates and variables in PPTX and Spreadsheet templates. Moreover, new trends in reporting like vectorized 2d plot images and embedding metadbs in the pptx presentation through OLE objects will be demonstrated.

User Toolbar Development Kit: A comprehensive solution for developing robust user-toolbars with Python

A. Radopoulos

Several post-processing procedures can be performed a lot more efficiently when using a customized, purpose-built User Toolbar interface and Python scripting. BETA CAE Systems has a lot of experience building such custom tools or assisting clients on how to build their own. These years of experience have culminated in the User Toolbar Development Kit that comprises guidelines for building toolbars, a Python module for core User Toolbar operations and the respective documentation.
This demo session contains:
- an introduction to META User Toolbars
- an explanation of the design patterns found in User Toolbars that use Python
- a brief introduction in Object Oriented Modelling/Programming and how it used in the User Toolbar Development Kit
- a creation of a robust, session compatible User Toolbar that uses Python scripting to compose a Report

Demo 9E

Skinning tools and full vehicle crash optimization with ACP OpDesign

T. Sarigiannis

In this demo two subjects that concern the CAE engineers regarding optimization will be addressed through example cases.
• “Skinning” process of a Body-In-White
Transformation of topology results to 3D geometry model in ANSA
• Sill new design evaluation and optimization
Decoupling & High Fidelity 3G optimization with ACP OpDesign

In the first part of the demo, ANSA functionality for the creation of 3D geometry upon the result of topology optimization for a Body-In-White will be presented. During the “Skinning” process, parts with certain cross-sections will be created interpreting the organic mesh result of the topology optimizer. Flanges will be created at the joints locations together with spotwelds.

In the second part, a process for efficient full vehicle parametric optimization with crash loadcases will be shown. Adding to the complexity of the whole optimization process and data handling, the optimization iterations are very time consuming, due to the loadcases nature. ACP OpDesign process limits the resources and effort needs to minimum by offering automation in substructuring, loadcasing and parametrization of the models as well as data management.
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Topological repair of optimized model

A. Papadopoulos

Optimization of products vary to achieve optimum mass, volume, size, or even shape. With this evolution of the FEA simulations, engineers can simulate and optimize the possible optimization scenarios.
However, direct results, from the optimization solvers, might produce designs that are not suitable for manufacturing, even with 3D printing. Thus, models generated from optimization analyses need to be repaired manually before forwarded for manufacturing. Consequently, specific tools which will help the user retrieve and repair the FEA optimized model and generate a ready-to-manufacture shape are in demand. BETA CAE Systems
provide a complete solution package to completely cover such optimization processes.

Demo 9F

Complete Interior Safety with ANSA & META

A. Fokilidis, A. Perifanis, N. Tzolas

Pre and post-processing for interior safety is applicable through BETA CAE Systems products. One can set up really easy a loadcase for every interior safety regulation available in the market, using ANSA tools. META makes the assessment of the results simple with its advanced post processing capabilities.

Data quality management with SPDRM

S.Tzamtzis

Recent developments in SPDRM have put the topic of data quality management in focus.
In this session we will demonstrate software features that give an answer to questions common to the CAE community:

- How can I ensure that the data uploaded to the data vault meet some minimum standards of consistency?
- How can I distinguish temporary data from verified data?
- How can I trace the history of an include file? From which ANSA file was it created and which PDM structure was used in the first place?
- How can I trace the impact of an error of the input data to the simulations and notify fellow analysts that the reliability of their results may be at stake?
- How can I share with the team issues that came up during model build and analysis, and make sure that a consistent process will be followed to identify the root cause and resolve the issue?

All these questions and more will be answered in this demo session that will touch base the general concepts of data validation, life-cycle management and issue management.

Demo 9G

CFD Model Build with seamless CAD updates through DM and Compare Tool functionality

N. Mitroglou

Recent developments in ANSA have managed to address handling of watertight CFD models and apply the streamlined model build workflow of Subsystems and Simulation Models onto demanding CFD setups with various configurations. Moreover, adaptation of new CAD versions is now seamlessly performed; all with the aid of DM and the new Compare Tool.

Working with Kinetics on full vehicle assemblies

A. Paraschoudis

This demo will focus on several topics in the model setup process of a vehicle using Kinetics and will showcase how:
- to implement tire-road interaction on a vehicle model
- flexible bodies can be represented as display models
- to identify eigenmodes that are not important during a dynamic analysis
- a controller can be implemented through the Model Based Design approach

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