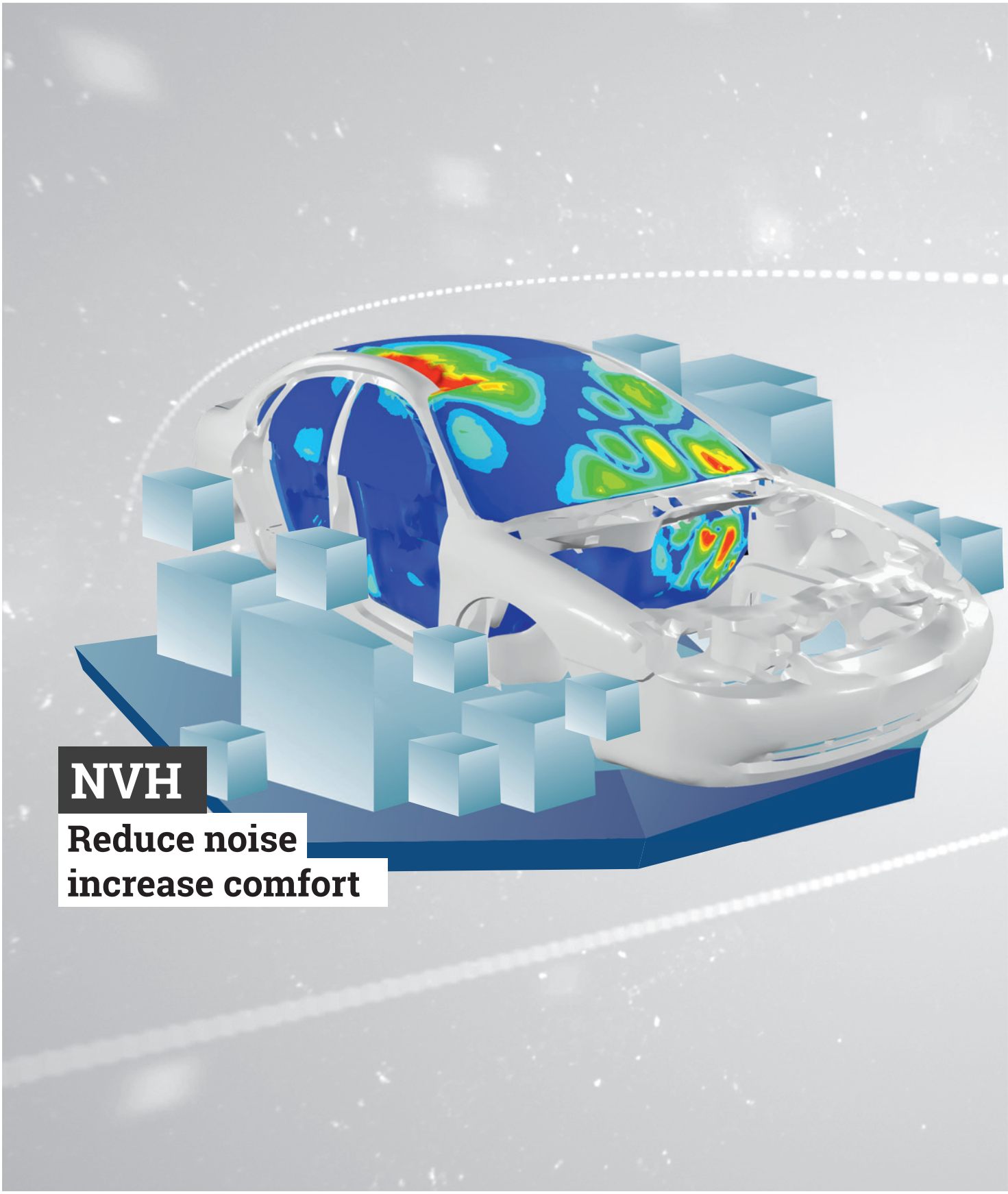
BETA
SIMULATION SOLUTIONS

physics on screen



NVH

Reduce noise increase comfort

ANSA
PRE PROCESSOR

Employ the right tools for NVH modeling

ANSA is a standard and robust solution for NVH simulation pre-processing that addresses the industry needs for process efficiency and simulation results reliability. It constitutes a complete platform covering equally and at the highest level all pre-processing activities from CAD input to the output of a ready-to-run model. Through its integrated and interoperable tools such as batch meshing, morphing, and coupling with optimizers, ANSA further augments the pre-processing range covered and through its automation tools, such as the Data Manager and the Task Manager, productivity is further increased ensuring robustness and repeatability during the creation of multiple high quality models. In addition, a set of tools dedicated to NVH, addresses efficiently all specific needs of an NVH analysis. ANSA supports industry standard codes for NVH analysis.

Model Handling, Assembly & Updates

- Multiple visualization and navigation modes include among others: per part & per include.
- One-click replacement of any FE part with a newer version. Version control is further streamlined through the use of Data Manager.
- One-click conversion of a part or a sub-assembly to its lumped mass representation, or to its trim representation (the mass of the converted part is distributed on a user selected area of the rest of the model).
- Generic connection entities holding the properties of a connection can be created either from respective CAD or PDM data or directly within ANSA. All available connection types such as spot-welds, adhesives, bolts & seamlines are supported. Sub-assemblies can be easily composed based on these entities. The FE representation of these connections can be easily switched massively to any conventional type. Various visualization modes are available such as per type, per number of connecting parts, per status, per representation, and per diameter. Complicated queries can be easily applied.
- Connectors are generic entities corresponding to kinematic joints and facilitating the assembly of sub-assemblies. Following the same concept as connections, the FE representation that is assigned on them can be easily switched to any conventional type.
- A significant advantage stemming from the usage of connections and connectors is that these entities can be reapplied automatically upon any modification or replacement of one part/sub-assembly with another thus, increasing robustness and repeatability.
- Comparison tool: It provides detailed and real-time comparison between different versions either on part or sub-assembly level along with their connections, thus enhancing decision making and effortless model update minimizing the risk for errors.

Mass Trimming

- Detailed mass trimming can be achieved through respective generic entities that follow the same features as the connectors. Therefore, the applied FE representation can be easily switched to any available type and automatically reapplied after any modification or replacement of the part that they are applied. Mass trimming can be easily defined based on either target or added mass and follow various distribution patterns either per user defined area or per property.

Load cases & Analysis set-up

- Wizard-like assistants that accomplish complicated tasks with minimum effort are available. These assistants facilitate the definition of complicated keywords, boundary conditions and output requests. Their realization pattern can be stored and reused for the build-up of the next model.
- Multiple comprehensive model checks, such as for the appropriate definition of RBE3 DOFs or for the

Features

- Interoperable Decks
- Process automation
- Model assembly
- Include files handling
- Connectors concept
- Modal Model & Display model
- Mass trimming
- Damped carpets modeling
- Acoustic cavity meshing
- Quality validation & fixes

NVH console

- Drives pre-processing, solving and post-processing
- Dynamic model reduction of components
- Automatic connection of components
- Simplified overview of complex component models
- Error-free handling of large files
- Fast calculation of whole assemblies, suitable for “what-if-studies”

Benefits

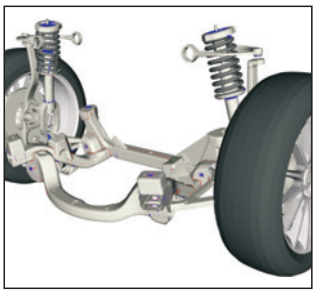
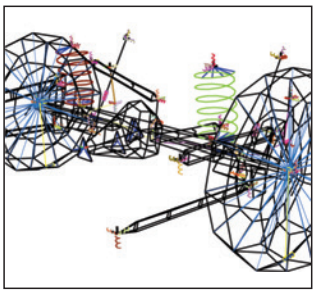
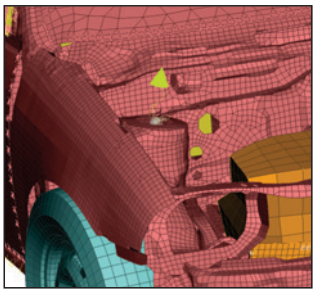
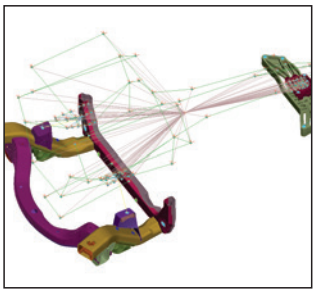
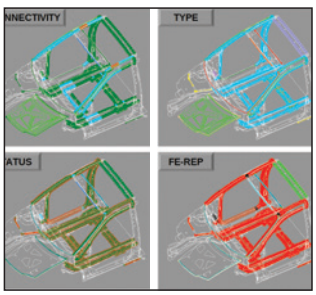
- Supports NVH tasks
- Efficient model handling & assembly
- Easy to use cavity meshing and fluid-structure coupling within a single software environment
- High level of compatibility for common NVH tasks with ANSA & META
- Efficient modal model components handling
- Automation techniques that minimize costs and time to market
- Early-stage analysis iterations, and optimization possible with respect to NVH aspects and interface for most common optimizers

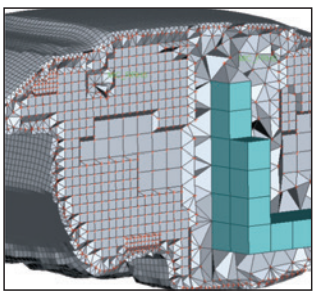
existence of dependency errors ensure the integrity of the model. Zero length line elements can be easily identified and visualised in an exploded mode and complicated beam cross-sections can be displayed.

- Multiple variants of a model are supported from within the same ANSA session by means of several configurations which can be easily controlled through a tree-editor list by switching on/off various parts/sub-assemblies that comprise each configuration.

Reduced Modeling

- Full FE components can be easily replaced by their equivalent dynamic model in Nastran bulk format to allow for sorter turnaround solving times. “What-if” studies can be then conducted by simply switching on/off any of the modes of this reduced model or by modifying any of the calculated modal parameters (modal mass, modal stiffness, modal damping). These reduced models can be created through a streamlined process that includes the creation of a display model, the launching the solver and execution of META to calculate & output the modal model in Nastran bulk format.
- In a similar manner, NASTRAN external superelements are handled and can be created through streamlined processes.
- Simplified display models used only for visualisation of results can be created fast, either with PLOTEL elements or with Shell elements for parts, groups, or sub-assemblies.



ANSA
PRE PROCESSOR

Poroelastic materials & Damped carpet modeling using laminates

- Nastran poroelastic materials are created and maintained through a dedicated tool.
- Damping patches for improving acoustic performance can be defined as composite materials through the integrated Laminate tool offering higher accuracy in approximating damping characteristics of the patch, faster modification per layer, and detailed reporting of the composite structure along with the ABD matrix calculation.

Cavity meshing

Along with all the integrated shell and volume meshing algorithms, ANSA provides meshing solutions for acoustics simulation. The Cavity Mesher, specifically designed for the fast creation of a volume mesh for an acoustic simulation, offers:

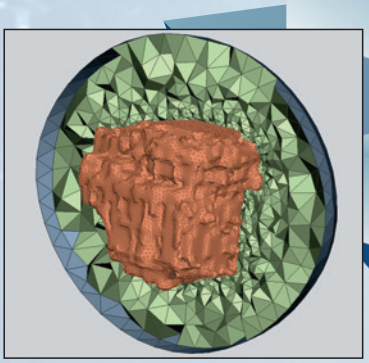
- Automatic closing of holes and gaps with full and intuitive control of the identified openings.
- Detection and meshing of cavities, without the prerequisite of a closed volume.
- An algorithm based on inner wrap methodology for accurate recognition of features from the structural wetted surface.
- Hexa dominant and pure tetrahedral meshing algorithms.
- Automatic creation of fluid properties.
- Specification of sensor points as part of the created volume mesh.
- Definition of seats and coupling of the Cavity mesh with them directly (as pasted nodes) or indirectly (via MPCs).
- Optional creation of the NASTRAN ACMODL keyword and the respective fluid and structure sets to drive the fluid-structure coupling in NASTRAN.
- Optional generation of PANELS for panel participation analysis in NASTRAN.

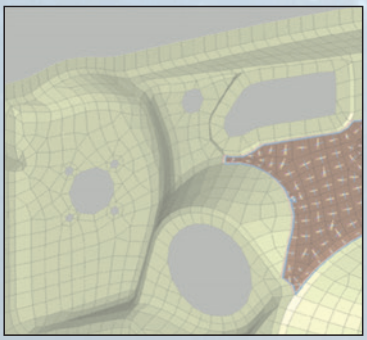
Exterior acoustics

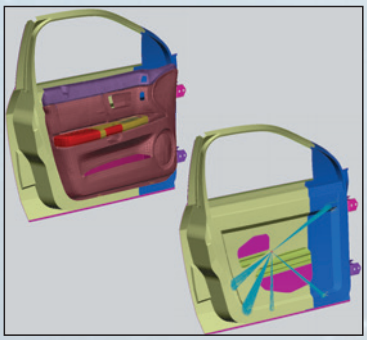
- Fast creation of exterior cavity mesh that is further assisted by standard built-in volumes such as spheres and boxes. Furthermore, the use of the available boolean functions for handling/creation of volumes simplifies the definition of more complicated volume types.
- Wizard for setting-up ACTRAN exterior acoustics analysis.

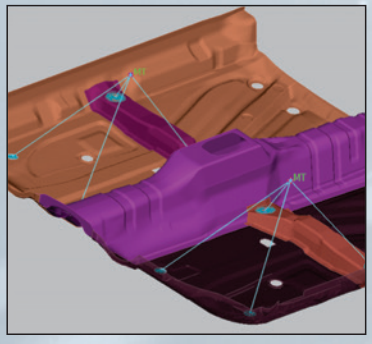
NVH Console

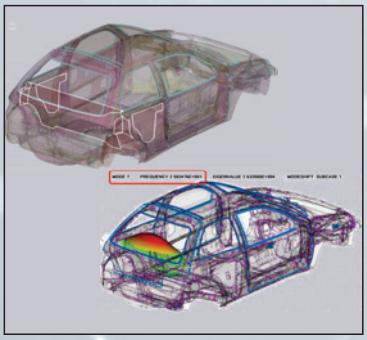
This is an integrated simplified environment that completely facilitates reduced modeling, the assembling of sub-assemblies, the definition of complicated loadcases, and the calculation and post-processing of responses. Through its diagram view, it provides a concise overview of the whole assembly while enabling the full control in complete synchronisation with the 3D display. Hybrid modeling is served through the wizard-based creation of reduced models, such as modal models and FRFs (test based reduced models are also supported). The handling of different files and reduced representations is accomplished in the background from the tool. Connectors between different components can be massively created and controlled through a simplified interface while variant components and connectors are easily defined and can be switched on/off according to the model variant that is under investigation each time. Conducting “what-if” studies is easily achieved with different runs saved in XML files which are small in size and can be used as templates for the case of reapplying the same connectors or loadcases to a different model. Responses and animation of operational modes along with standard NVH analyses, such as Transfer Path Analysis and modal contribution, are driven from within the NVH console by driving META. Alternatively, in case of components being either FE or Superlements, NASTRAN can be driven for the calculations of responses. Multiple checks to ensure the integrity of the model are also performed in the background upon job submission.

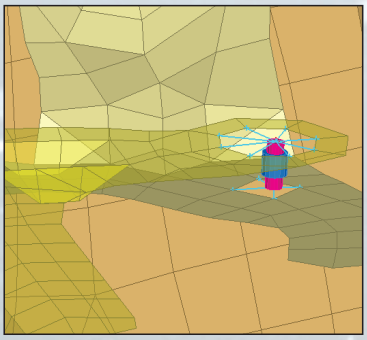












META
POST PROCESSOR

See how your model sounds

META brings a new dimension to the NVH post-processing by successfully addressing the bottlenecks and constraints involved. Its optimized performance for graphics & memory usage and processing time along with a broad range of features and calculation options, makes it an efficient environment for handling all NVH post-processing requirements.

High-end software

NVH models constantly increase in size and complexity, hence challenging the hardware and software limits. META, with its unparalleled graphics performance and its proven effective model-handling, provides the means to smoothly post-process big and complex models. Due to the optimized memory usage and the high data access performance, loading and processing a massive amount of data from large results files is not only feasible but also fast and productive.

Modal modeling

In certain cases, analysts reduce the NVH models by substituting assemblies with their equivalent modal models. In this way, a considerable amount of solver-time is saved. These Modal Models can be built inside META out of the Eigenvectors results in just a few clicks through an intuitive interface.

Visualization of results

Contour display for 3D post-processing, as well as magnitude-phase, real-imaginary, polar 2D plots, and contribution color-maps support a broad range of modal response results including Panel participation factors, Normalized Grid Participation factors, Modal Participation factors, Acoustic Results, and Mechanical & Sound intensity, with the latter calculated inside META. Different results for the same model can be easily displayed simultaneously in different windows, providing a complete overview of the analysis with the minimum memory requirements. The list of supported results is enriched with FEMZIP compressed Nastran results, Abaqus standard results, ANSYS results, test results in Universal format, as well as Design Optimization results.

Calculation of modal responses & modal correlation

- Modal correlation is performed through an easy-to-use tool and also MAC plots can be created. The suite of correlation tools is further enriched with AutoMAC, CoMAC, AutoFDAC, FDAC and FRAC tools.
- Frequency and transient structural and acoustic responses can be calculated swiftly and easily inside META either as curves in the 2Dplot or as field data for contour display based on the modal basis of a model. Existing structure-fluid coupling data can be used or simply generated quickly within META. Panels can be defined and panel participation factors can be calculated. The large amount of results created are handled easily through several grouping options.
- All types of contribution analysis (Mode contribution, panel contribution) are facilitated through synchronised plots (magnitude-phase, polar plot and fractions bar chart) and through an intuitive interface to control the top N peaks displayed in the synchronised plots.

FRF assembly

The handling of hybrid models is available. Various components along with their results, either measured/calculated FRFs or modes, can be connected inside META with various types of connections (rigid, bushing or MPCs). Responses are then calculated for the assembled model. Connection forces can be plotted. Transfer path analysis (TPA) can be easily conducted and TPA results can be handled through synchronized plots (transfer paths, connection forces, transfer functions, fractions bar chart and polar plot) and an interface that displays the top N peaks each time. Bushing properties are defined in META and their assessed sensitivities form the basis for deciding the design variables for the optimization procedure which is contacted using a genetic optimization algorithm embedded within the tool. An innovative “sensitivity-type” analysis, Path Stiffness Analysis, can also be performed to identify the most contributing path within the same component, thus indicating the direction of geometry modification on this particular component that will lead to an improvement of the overall performance of the assembled model.

Features

- Plot types: Magnitude-phase, real-imaginary, polar, contribution color-maps
- Mode correlation tool
- Modal Model builder
- Calculation of structural & acoustic modal responses, mode & panel participation
- Calculation of operating modes
- Calculation of mechanical & sound intensity results
- FRF assembly with TPA calculations capabilities
- Innovative Path Stiffness Analysis
- Ultimate automation capabilities
- Complete reporting tool

Benefits

- Easy handling of large models
- Facilitates demanding results visualisation
- Results are reached within the minimum time through advanced algorithms for calculations
- What-if studies can be performed in no time
- Complicated repetitive processes can be automated and errors are avoided
- Significant time is saved due to high performance, automation capabilities, direct report editing, and standard toolbars

Other tools

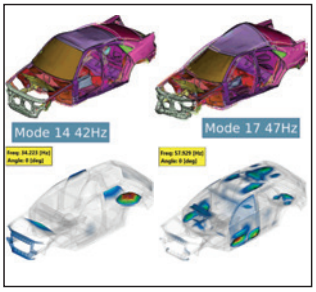
A better insight of data can be obtained by using other general tools in META, such as the advanced filtering, the iso-contours, the cross-sections, annotations, and the detailed statistics in spreadsheet form. A complete list of mathematical functions including Fourier Transformations and a broad range of filters facilitates demanding curve data processing. Powerful specific lists for connections, includes, boundary conditions, and sets allow for, among other, the effortless management of connections and the more efficient handling of the model. In the end, post-processing is finalized by saving the database in a META native binary format which can also be previewed with a free META viewer.

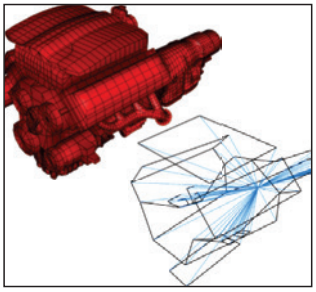
Reporting

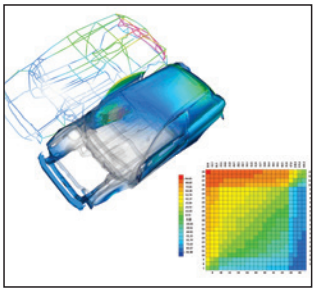
The communication of results is further promoted through readily created reports either in html, PostScript or MS Office PowerPoint .pptx format. Reports can be filled in by dragging or dropping images, spreadsheets or other data from META to the report composer. Report templates can be used and pptx reports can be imported and viewed in slideshow.

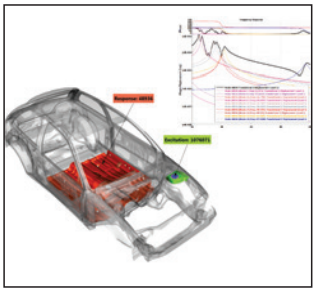
Automation

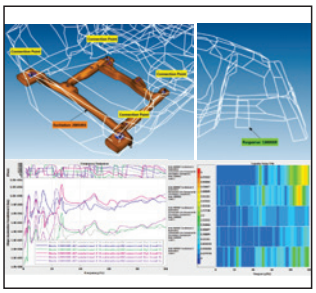
A high level of process automation from results input to report output is achieved through parameterized session files, custom user toolbars and scripts, all of which can be easily created through intuitive editors embedded in META. Also, standard toolbars are available for facilitating a normal modes analysis through automatic creation of reports, the easy production of strain energy bar charts, and distinguishing global from local models. Furthermore, there are standard toolbars for reporting modal correlation results (MAC) and for Equivalent Radiation Power (ERP) calculation and post-processing. The automation capabilities contribute to the easy and unhindered coupling of META to external optimizers. A simple-to-use toolbar, that streamlines the coupling, is provided with the standard package.

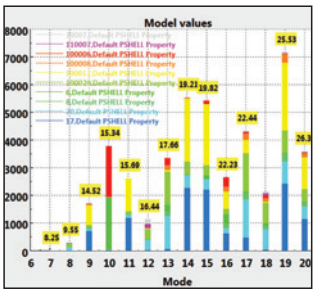


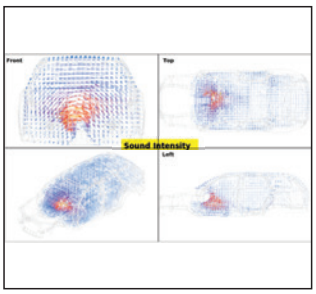


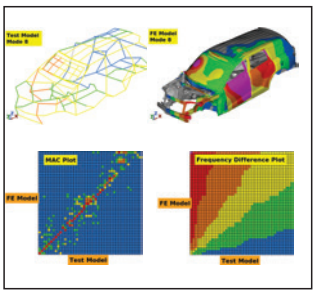












BETA
SIMULATION SOLUTIONS

physics on screen

www.beta-cae.com