Latest developments in Crash Pre Processing and Post Processing. Innovative Ideas brought to the Industry with ANSA and μETA.

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Summary:

The increasingly demanding and complex requirements in Crash Analysis, require continues and innovative software development. BETA CAE Systems in an effort to meet, and exceed, the demands of the industry is introducing new cutting edge technologies. Both in the pre processing area with ANSA, and in post processing with μETA. This paper presents these new technologies.

With the introduction of a new version of ANSA in 2009 a new user interface was presented. The new interface is a long term effort to give the CAE engineer the capacity to work in a modern software interface environment leading in increased productivity and “ease of use”.

On the same time the development of highly specialized tools can greatly reduce the time of pre processing by automating various difficult operations. Some of these are a kinematic solver that allows the manipulation of complex kinematic mechanisms of crash models and tools that automate the procedures for occupant and pedestrian testing.

In the area of post processing the advances are equally impressive in the latest μETA versions. Better system resources utilization such as smaller memory footprint and a huge speedup in graphics performance, guarantee that the responsiveness and feel of the software environment won’t be compromised even by the biggest models. Additionally advanced functionality, like the direct calculation of section forces, provides the tools that are needed for the evaluation of the results. Recently process automation tools are introduced which together with advanced report generation functionalities make the automation of post processes easy.

Keywords:

Pre-Processor, Post-Processor, Kinematics, Mechanism, Dummy, Pedestrian Protection, User Interface, User Experience, ANSA, META, μETA

1 Introduction

Recent developments in ANSA and μETA have introduced new powerful tools that allow the easy manipulation and management of FE models. This powerful core functionality together with new modern User Interface design, creates a powerful and intuitive working environment. This paper introduces some of these new technologies that have been introduced by BETA CAE Systems SA.

2 Kinematics and Dummies

With the introduction of ANSA version 13.0 BETA CAE Systems has introduced a highly sophisticated set of tools that can handle any kind of positioning or articulation requirements of crash models. Taking into consideration the fact that in addition to dummies, suspensions, roofs and other subassemblies need to be repositioned, a multi body solver has been developed to be tightly integrated with the pre processor.

2.1 Key features of this set of tools are:

Functions that automatically, or semi automatically, help the user to create the kinematic model from the existing FE model. FE Model properties like stop angles in the CONSTRAINED_JOINT_STIFFNESS cards are transferred automatically to the kinematic model.

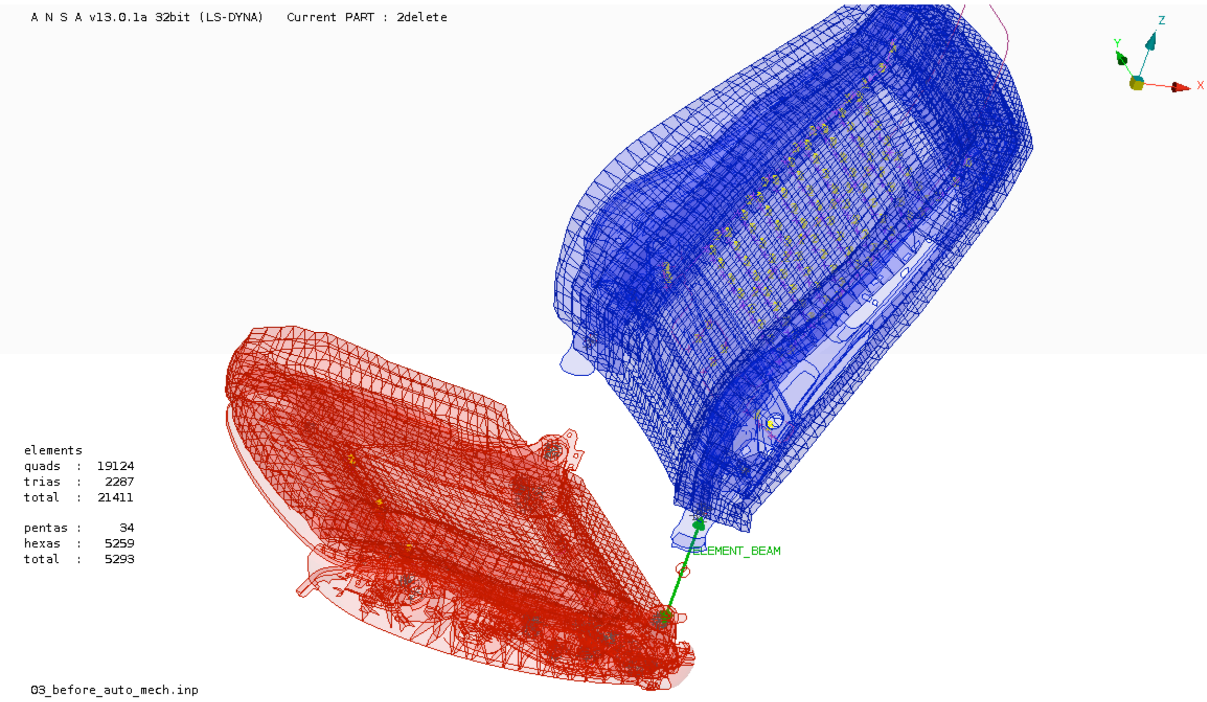

Figure 1. Automatic detection of kinematic subassemblies and joint elements

The multi body, HHT-I3, solver supports all the standard joint types (spherical, hinge, cylindrical etc). Additionally advanced joint types are available such as rack and pinion, and coupler joints that can model advanced mechanical, or electronic, couplings.

The intuitive interface allows for the organization of the kinematic parts so that different movement configurations can be predefined by the mechanism expert. Characteristic examples are the tilt and height adjustments of a seat model. This is important because not all users need to know how the kinematics of the model work, since the software provides an easy interface to move the model from these predefined configurations.

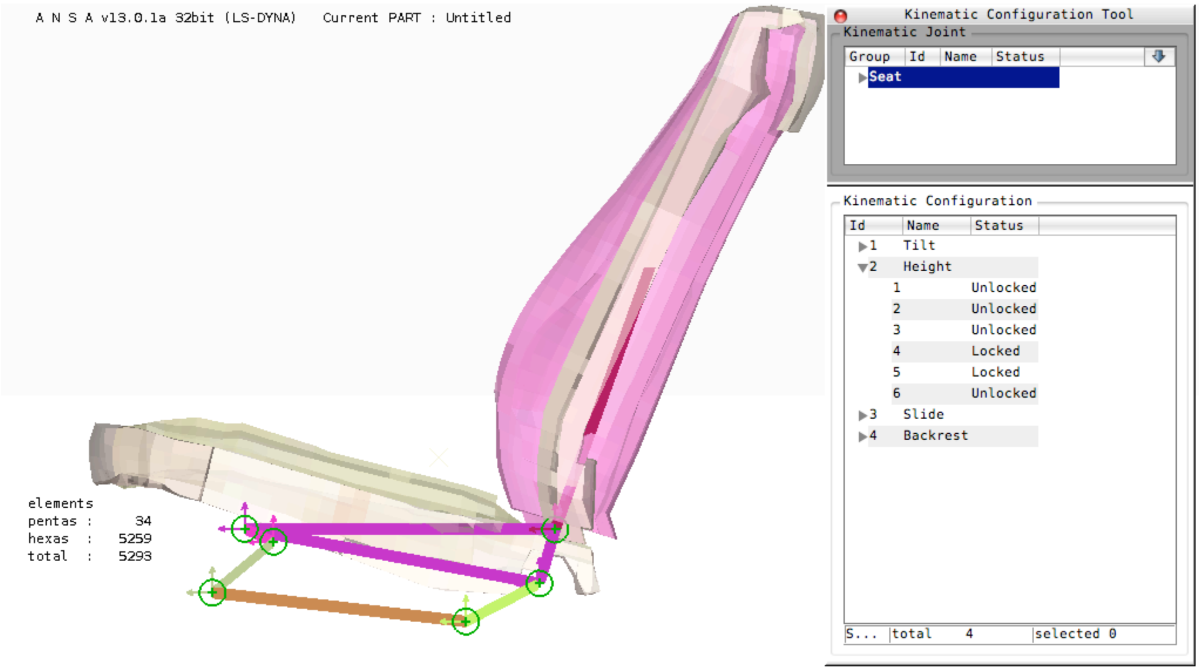

Figure 2. Various possible movements predefined.

Easy ways for manipulation of the mechanisms are provided. The mechanism can be articulated either by setting the values of the joints or by specifying target locations of any number of points in the mechanism.
Especially for dummies, new functionality has been added to interactively articulate the limbs while displaying all relative data on the screen.

2.2 Further Developments.

Although already advanced, the kinematic functionality is currently further developed. Faster solver speed, contact recognition, more joint types and integration with morph are some of the fields currently under development.

3 Pedestrian Protection, Head Impact.

Prior to version 13.0, tools for positioning the various impactors for the pedestrian protection and the head Impact on the interior had been developed. These, following closely the respective regulations (EuroNCAP, FMVSS201u) and using the advanced contact detection algorithms of ANSA, have been used to successfully create the respective load cases.
In version 13.0.1 new functionality has been introduced that automatically applies the regulation directives to identify the target areas and target points. Similar functionality is under development for the automatic identification of the target points in FMVSS201u. This functionality will be available in the near future.

3.1 Pedestrian Protection

The EuroNCAP pedestrian testing protocol has been implemented in the Pedestrian Tool. Bumper and bonnet reference lines are automatically calculated on the FE-model, or on Geometry data, closely following the regulation procedure. The Adult and Child Headform zones are defined and divided into the twelve areas. Moreover the curves that represent the reference lines can be overridden by user created curves. Thus the user can intervene in the process if he wishes.

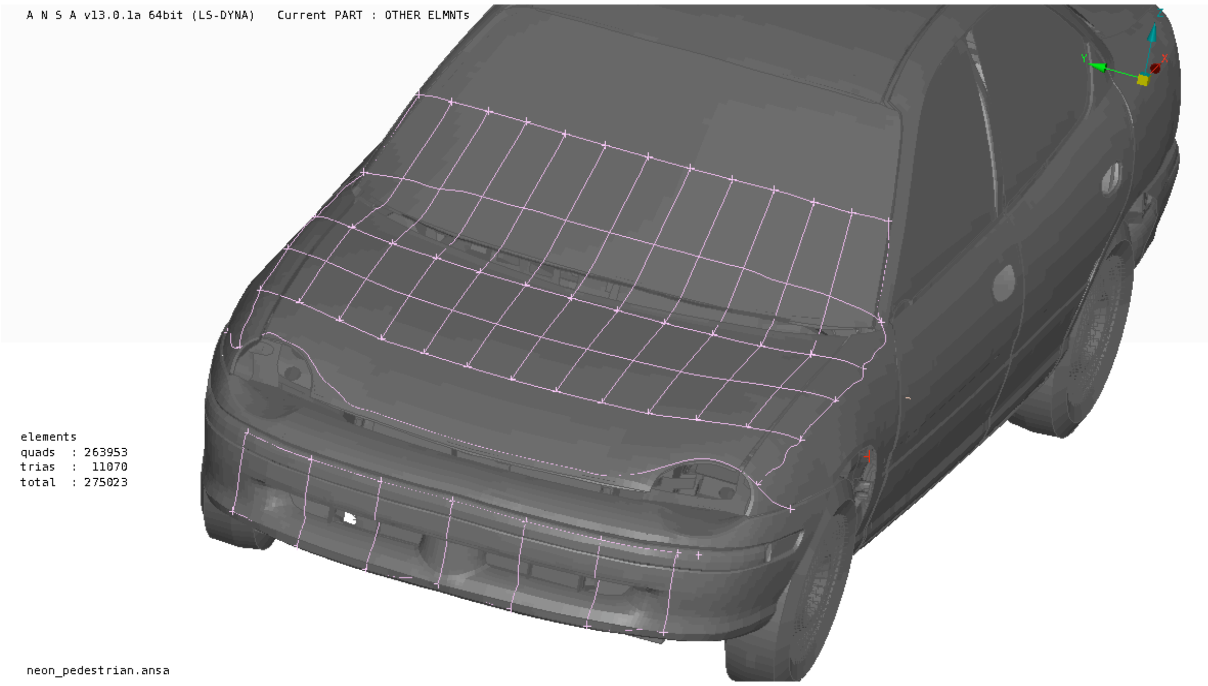

Figure 3. EuroNCAP reference lines automatically created

For the identification of the target points the user has two options. Either create a uniform raster of user defined dimensions or detect a user defined number of the worst-case target points per area. This is achieved by scanning each area for the points with the least distance between the top bonnet surface and the underlying hard parts in the shot's direction.

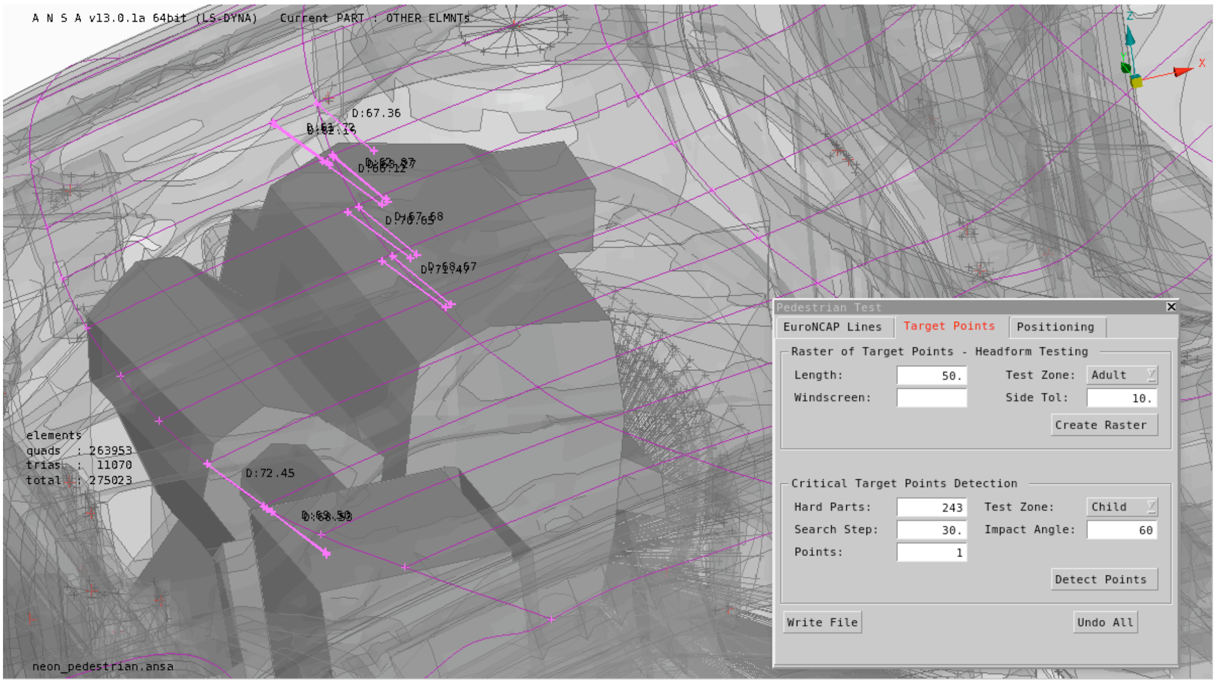

Figure 4. Critical target point detection

Following the definition of the target points the positioning takes place and produces *INCLUDE_TRANSFORM keywords that define each loadcase.

3.2 Interior Impact

The same automatic procedures are currently being implemented for the automatic determination of the FMVSS201u target points and areas.

4 User Interface

As of ANSA v13.0 a big effort has began for the overhaul of the ANSA's user interface. The reason for this move was necessary in order to meet the current standards of Graphical User Interface design.
Most of the advanced CAE pre processors, and other CAE software, have their design roots in the late 80s and early 90s. This is evident to anyone who is working in the CAE field. While through out these years a strong effort has been put in the development of powerful algorithms, which is the main field where big time savings can be achieved, the user interface has been neglected. This practice has started to show its shortcomings as CAE becomes mainstream and more and more new engineers work in the field. Young engineers that have experience with other kinds of software like office productivity suites, the modern UIs of operating systems and web environments find it hard to learn and adapt to the archaic and outdated idioms of the CAE programmes. This results in great loss of productivity and inability to adapt to new tools and processes. Another fact that puts a lot of pressure on the interface design is the rapid rise of the model complexity. The CAE user faces a huge task which is to deal with this complexity. It's the goal of modern User Interface to relieve the user of this burden.

It is apparent that Modern User Interface alone cannot meet the challenges of the CAE pre processing. User Interface design, in order to be meaningful, always needs to be on top of smart and powerful algorithms which is the core of CAE. The new user interface allows for easier implementation of advanced functionality and gives the ability for fast learning for new users.

Having the above in mind, new tools have been designed and introduced in ANSA. These changes will be deployed progressively throughout the v13.x series of ANSA.

4.1 Model Browsing

Model browsing is done with the help of the Model browser which is the central information centre of the programme. The model browser is a unified single browser for all the entities in a model (including geometric entities). The user can control everything from the visibility of entities, to accessing the entities' cards, to creating new entities and many more.
Its structure and look is that of a hierarchical tree list accompanied by the expanded list of the selected item. Various interface elements like history, search, context menus (right mouse click menus) etc have been implemented to add functionality. These are creating a familiar working environment to users since these concepts are widely used in today's software applications (file managers, mailers, web browsers, etc). This leads to uniformity and reduced training time for the users to become productive. Nevertheless various additions and extensions have been implemented to better handle CAE workflow.

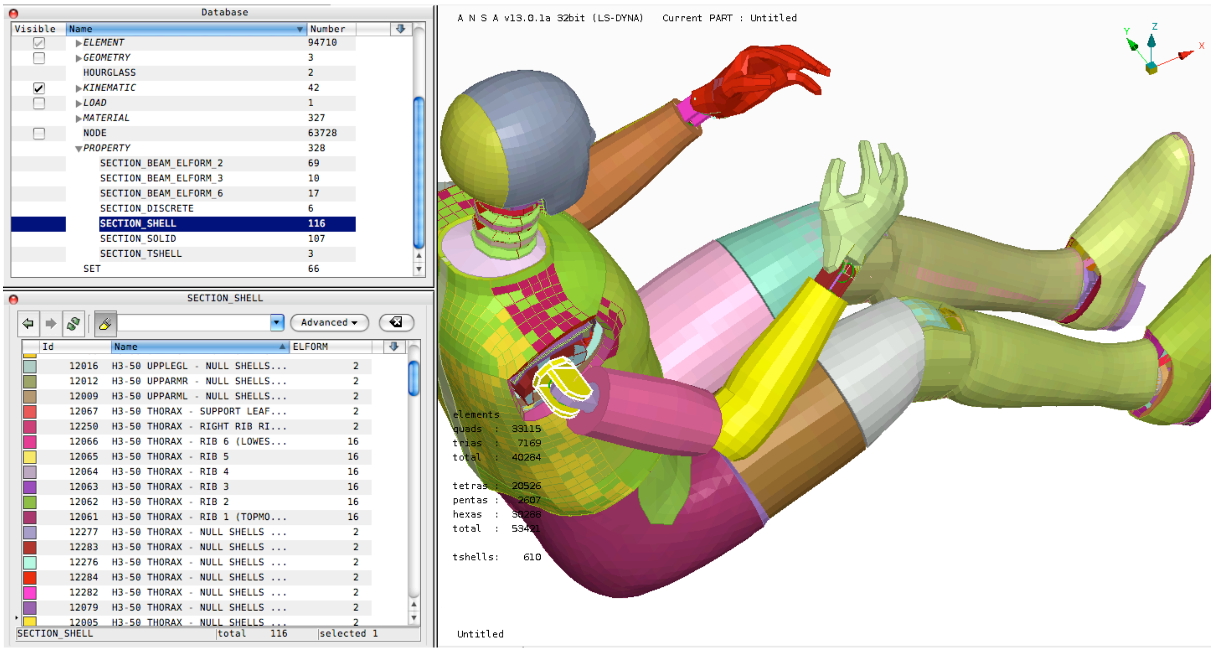

Figure 5. Model Browser

4.1.1 Filters

As the user builds confidence using the tool the tool itself scales up nicely providing advanced functionality. One such functionality is the concept of filters. Filters are used to search easily and select model entities based on various attributes. More importantly filters can be saved and used as dynamical updated smart containers of entities.

4.1.2 Drag 'n' Drop

Another common idiom that has been imported is that of drag and drop. The user has the ability to select entities from the browser (or the screen) and drag and drop to other objects to create new entities such as includes, SETs etc. This functionality together with the advanced selection and filtering option give the ability to work in a very friendly and intuitive environment. This environment allows the set up of complex entities like *SET_GENERAL and *SET_*_ADD in ANSA v13.x to be a pleasant experience.

4.2 Dynamic Draw

Another area of great importance for the model comprehension and handling is the drawing of the various entities on the graphics screen. Through the graphics display the programme communicates with the user and helps him understand the model and interact with it. Unfortunately the complexity and size of modern models lead to graphics clutter, information overload along with programme unresponsiveness.
Various new technologies have been designed and implemented to address these issues.

4.2.1 Detail on Demand

With the introduction of the "Detail on Demand" concept the graphic representation of the various model entities is dynamic and follows the user workflow. The most basic and notable change is that elements that are not in the user field of interest are drawn with reduced detail. The screen clutter is strongly reduced while at the same time more information is provided in the area of interest. The end result is a much clearer view of the model, more valuable information provided automatically and fewer user clicks.

4.2.2 Transparency on pick

On the same line of thought a second concept was developed that helps the user when performing any action that requires selection from the screen. In order to unclutter the display only the elements that are relevant to that action being performed remain visible, while the rest become transparent and dimmed. So while they don't obscure the picking process at the same time the user remains well oriented in the model.

4.3 Graphics speed

Through various changes and optimizations the average frame rate of the programme has been boosted in the range of 25% to 400% for big models. This highly increases programme responsiveness to user actions. More development is currently under way to improve even more dramatically the graphics performance throughout the v13.x series of versions.

5 Latest μETA Developments

In the area of post processing the advances are equally impressive in the latest μETA versions. Better system resources utilization such as smaller memory footprint and a huge speedup in graphics performance, guarantee that the responsiveness and feel of the software environment won't be compromised even by the biggest models. Additionally advanced functionality, like the direct calculation of section forces, provides the tools that are needed for the evaluation of the results. Recently process automation tools are introduced which together with advanced report generation functionalities make the automation of post processes easy.

5.1 Performance improvements

μETA v6.3 contains significant performance improvements that are summarized in the following figure.

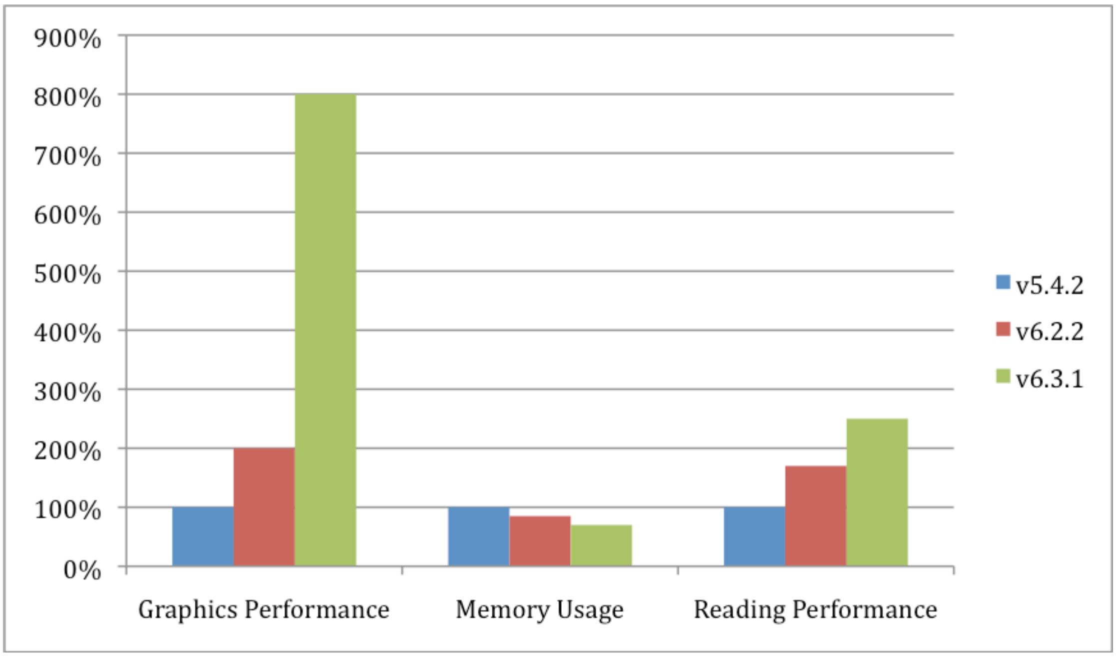

Figure 6: Performance improvements

In more detail:

5.1.1 Memory

In version 6.3.0 a 25% reduction in memory requirements compared to past version has been achieved. Also the 64 bit version has smaller memory footprint.

5.1.2 Graphics

A new algorithm has been introduced that improves drawing performance significantly. A speedup factor of 2 to 8 is expected depending on the graphics card of the machine. This speedup is even higher in contour plots and fringe plots.

5.1.3 Computation Speed

The latest versions includes optimization of the code for multi-core system. This reduces computation time for intensive operations like section forces calculation, reading geometry and results, evaluating user field functions, etc.

5.1.4 Reading results

The reading speed of the software is improved for all types of results. Additional method for reading femzip compressed d3plots on the fly, without decompressing first on the disk. This reduces also the maximum memory requirements during decompression and improves performance in case the user wants to load only a subset of d3plot states.

5.2 Section Forces Calculation

The calculation of section forces is an important aspect throughout the design cycle of a structure. However, section forces must be predefined in the input deck, thus making unavoidable a second run in case it turns out that it is needed to investigate the force distribution in arbitrary areas of the structure. The section forces tool in μETA is capable to compute forces and moments at any section defined by the user or predefined in the input deck, achieving very good correlation with the solver calculated results.

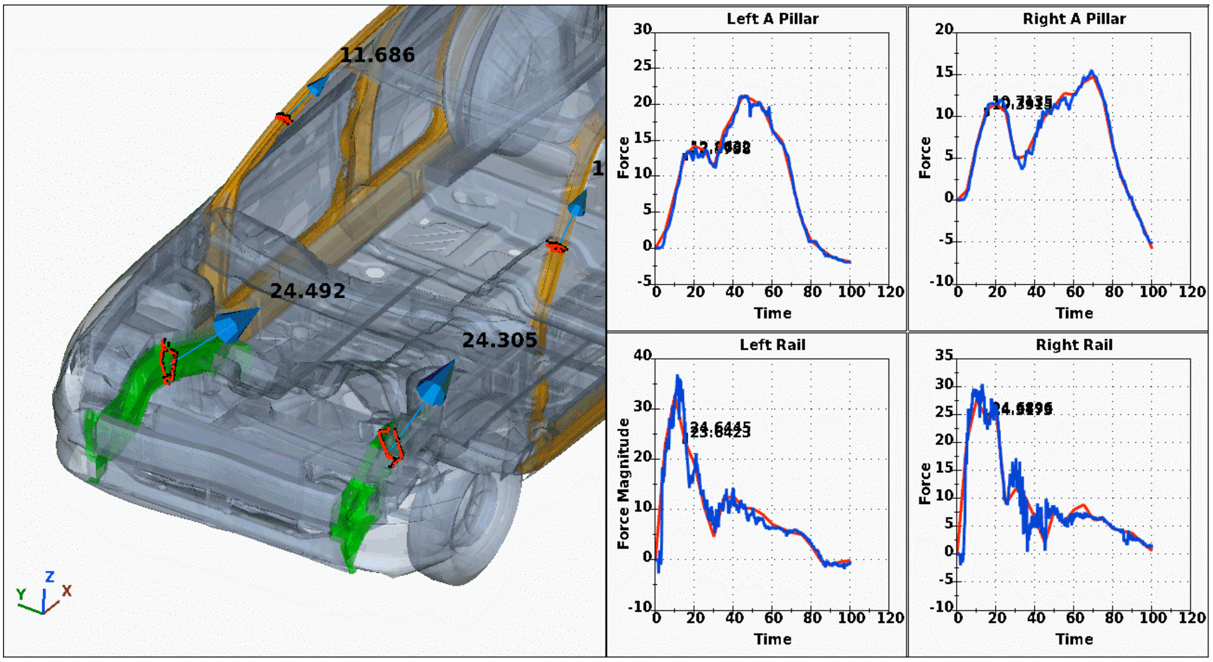

Figure 7. μETA calculated section forces compared to LS-DYNA

5.3 Report in powerpoint pptx

The new report composer tool allows the user to create a pptx report effortlessly, with powerpoint like functionality including Slide Master creation, Themes templates and drag & drop handling of objects. It is also possible to read and edit an existing pptx report, as well as to embed μETA viewer objects that include a 3d model or 2d plots that the user can handle interactively.

Additionally the Copy/Paste functionality to Clipboard helps users to easily transfer images and data from μETA to other software.

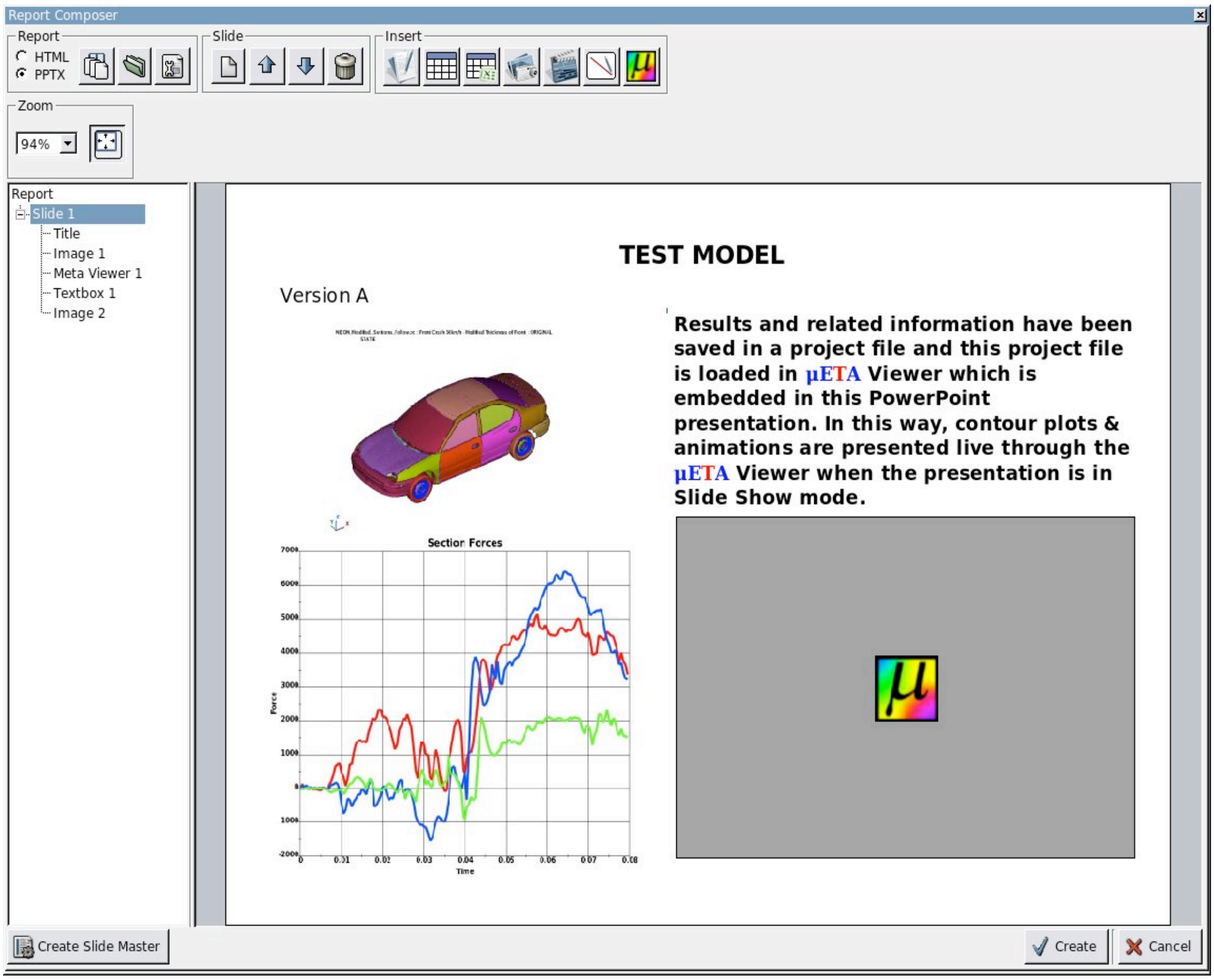

Figure 8. µETA report composer.

5.4 Automation

The automation toolset of µETA is enriched with the recent process automation tools. The session editor with the advanced session parameterization tools, the debugging capabilities, easy creation of toolbars and the compressed package creation manager, facilitates automation.

BETA scripting language and the embedded script editor offers enhanced flexibility and elevates the automation capabilities of µETA to a far greater extend.

5.5 Compression of Simulation results

A New capability will be added in v640 for data compression of simulation results. Apart from a standard gzip-like file compression, the size of result files is further decreased through the option to keep only necessary variables and up to the necessary level of accuracy, achieving high compression ratios (original/compressed size > 10). This technology will reduce storage requirements for huge models, but also will improve loading performance since smaller files needs to be transfer through network.

6 Conclusion

Simulation and CAE in the recent years has become more mainstream and a more mature technological field. BETA CAE Systems heavily invests in order to offer the best possible software products both in its core functionalities and algorithms, and in Usability.

7 Literature

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