

Dummy Positioning and Restraining

Introduction

The Crash and Safety simulations have helped the automotive industry not only to drastically reduce costs and time during the development stages but also to design “safer” products. BETA CAE Systems, through its flagship products ANSA and μ ETA, has played an important role in the developments in the Crash and Safety CAE discipline on which continues to focus during the development of its products to bring to the market the best CAE software technology.

ANSA, a multi-purpose CAE pre-processor, offers a rich suite of state-of-the-art tools, specialized to Crash and Safety. This paper presents ANSA’s dummy positioning and restraining functionality, which is becoming a standard widely used in the automotive industry.

Supported Dummies

ANSA supports the reading of dummy models, and their hierarchy tree, from all the major dummy providers, such as LSTC, Humanetics, Dynamore , Simulia, etc. Rigorous software development and verification tests ensure that every ANSA release is up to date with the latest dummy models versions.

Dummy Positioning

The Tool

The ANSA Dummy Positioning Tool allows the engineer to position the dummy on the seat, in a fast and easy way, and to manipulate the dummy’s limbs. The movements can be done either by graphics interaction or by numerical values input.

Graphical information on the screen provides the user with important data for the completion of the tasks, such as the joint axis, stop angles, current angle etc.

Due to the fact that the dummy is a model validated by its supplier, the user may not want to export it from a pre-processor. ANSA gives the option to input the dummy as a read-only include file. Thus after the dummy positioning process is completed, transformation keywords can be exported relative to the initial position of the dummy.

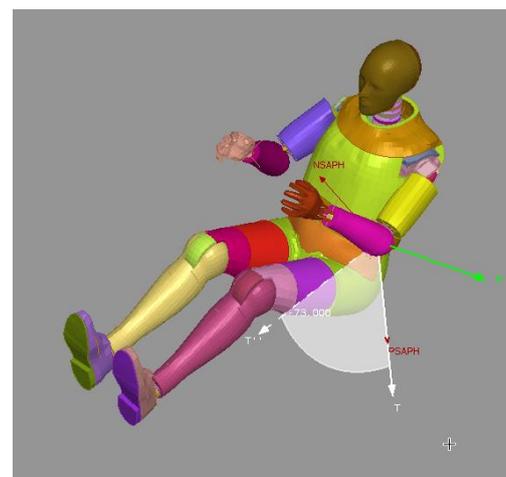


Figure 1. Graphical information



Dummy-Seat Kinematics

Coupled dummy-seat movements can be performed within ANSA with the use of the ANSA Kinematics tool. The ANSA Kinematics tool is an implicit Multi Body Dynamics Solver, wrapped around a user-friendly interface, that provides the functionality to easily move complex mechanisms such as an automotive seat.

The tool will extract all the kinematic information from the dummy and the seat and allow the user to set up coupled movements.

While movements are performed, the seatbelt can be automatically refitted to the new position of the dummy.

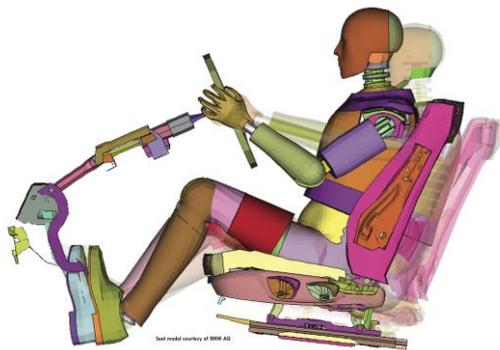


Figure 2. Depicting dummy-seat coupled movement

Seatbelt Tool

ANSA has a very powerful tool that handles the creation of seatbelts. Some of the characteristic capabilities of the tool are:

- The ability to create any type of 1D, 2D, or a combination of 1D and 2D seatbelts

- The full support of modeling a belt with LS_DYNA 2D *ELEMENT_SEATBELT entities.

- The ability to interactively edit the path of the seatbelt, while the seatbelt is already created, in order to route the belt through the desired path

- The seatbelt is an ANSA entity. This means that all the necessary information that is needed for the belt creation is stored in this entity. Thus if the belt needs to be re-created, it can be done with the push of a button.

- The option to automatically create slings, retractors, pretensioners at the anchor points of the belts.

- The ability to automatically define the contacts between the belt elements and the dummy.

- Functionality that allows for automatic passing of a 2D belt through a 3D sling.

- The ability to automatically extract seatbelt information and create a seatbelt entity from a seatbelt that was not created within ANSA.

Seatbelt Path Editing

During the seatbelt creation process it may be difficult to get the desired path at the first try. ANSA's seatbelt tool provides the ability to interactively edit the path by moving control points that appear on the seatbelt. This allows for great control of the belt path, making the belt editing process very easy for the user. The tool remembers



the edited path, so if the belt needs to be re-created it will follow the last (edited) path.

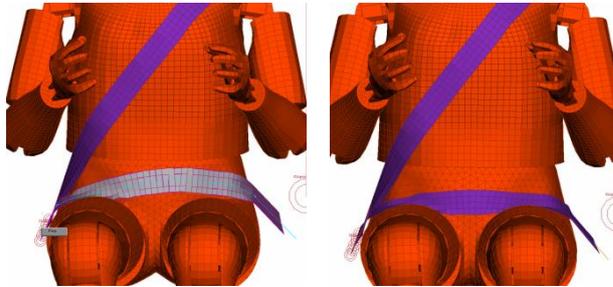


Figure 3. Interactive editing of the belt's path

LSDYNA 2D *ELEMENT_SEATBELT

The definition of seatbelts that implement the 2D *ELEMENT_SEATBELT keyword of LS-DYNA can be a very complex process. ANSA's seatbelt tool manages this difficulty for the user and hides the underlying complexity of the needed keywords.

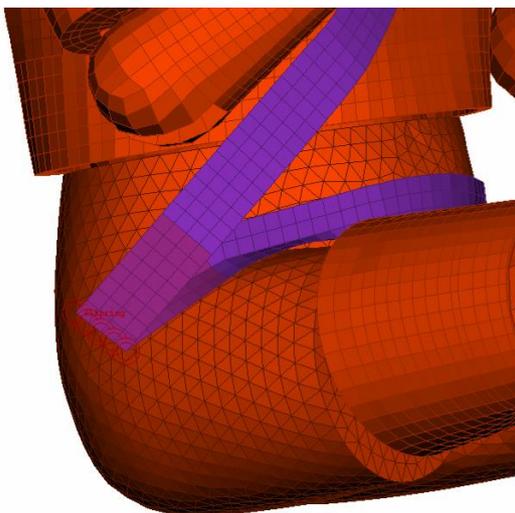


Figure 4. Belt with 2D *ELEMENT_SEATBELT definition

3D Slipping Passing Belt

Modern seatbelt modeling techniques require that a seatbelt follows a 3D slipping and not through an *ELEMENT_SLIPRING. Modeling such type of a belt can be difficult. ANSA provides functionality that will generate the path of the seatbelt through the slipping automatically for the user.

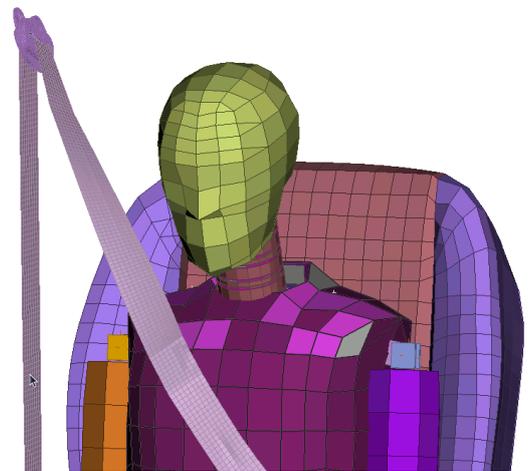


Figure 5. A seatbelt going through a 3D slipping

Dummy-Seat Depenetration

A solver-based tool that takes into account the foam material of the seat performs the Dummy-Seat Depenetration. The foam is compressed as to avoid penetrations between the dummy and the seat.

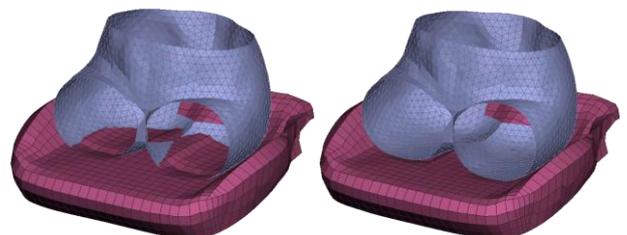


Figure 6. Before and after image of the dummy seat depenetration tool.



Conclusion and Benefits

BETA CAE Systems offers through its software products high-end technology to the Crash and Safety CAE engineer that among other functionalities supports the dummy positioning and restraining. The engineers can be benefited from:

- The reliability, stability of the tools
- The predictability of the results.
- The incorporation of these Tools into ANSA
- The interaction with the rest of the modelling tasks and operations
- Fast model configuration and update

References

ANSA version 13.2.1 User's Guide, BETA CAE Systems, December 2011

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