LS-DYNA® "Model Compare" in Visual-Environment

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Abstract

A downturn in the industry drives companies to execute projects with fewer resources. The demand for product innovation and productivity improvements has increased exponentially. In order to meet the customers' demand, ESI's Visual-Environment provides new features and improvements to achieve productivity, better usability and workflow. One such new feature is "Model Compare". Using "Model Compare", a user can compare models to identify the changes in geometry and LS-DYNA entities such as material, section, contact and, constraints. These differences can be copied from one model to another. This feature improves productivity by eliminating manual bookkeeping.

In this paper, the key features of Visual-Environment for LS-DYNA and usefulness of these features in FEA simulation are discussed with examples of productivity improvements and process automation.

Keywords: LS-DYNA, Model Compare, Visual-Environment, Productivity, Process Automation, FEA.

Introduction

Visual-Environment (VE) is an advanced pre-post processing solution platform for LS-DYNA solver. It is a context based environment based on different FE Simulation[1] needs such as Visual-Crash Dyna (VCD) for LS-DYNA, Visual-Mesh (VME) for meshing and model assembling, Visual-Viewer (VVI) for post processing, Visual-Safe (VSA) for advanced safety applications, Visual-Process (VPR) for CAE process automation and so on. All the contexts of Visual-Environment[4] are integrated seamlessly, facilitating the user to navigate within one environment to access multiple solvers. All the dialogs are easily scriptable through Python language for quick customization.

Visual-Environment Contexts

As mentioned above, VE provides several contexts out of which a few are explained below from the LS-DYNA user's point of view.

Visual-Mesh

Visual-Mesh(VME) is the complete meshing tool, which supports CAD Import, 1D, 2D and 3D Meshing and editing features. It also provides batch-meshing utility based on topology meshing with user guidance as well as automatic approach.

Visual-Crash Dyna

Visual-Crash Dyna (VCD) is the most competitive environment for LS-DYNA solver. It helps engineers perform crash and safety simulations in the smoothest and fastest possible by providing lot of productive features. This environment provides quick model browsing and advanced model setup capabilities. VCD allows graphical creation, modification and deletion of all LS-DYNA entities like contacts, materials, constraints, control cards and all crash entities. In VCD there are lot of features which helps to improve the productivity[2], thus saving time and resources.

Visual-Viewer

Visual-Viewer (VVI) is the advanced Post-Processing tool with state-of-the-art Plotting/Viewing utility. Viewer works with multi page/multi plot concept, which enables the user to group data into pages and plots. Users can create presentation ready high quality reports. Complete plotting session is captured and it can be re-executed without losing any data. It is also fully command-driven that enables the user to execute at command-line.

Visual-Process

Visual-Process(VPR) is an advanced CAE environment for process customization and automation. The process templates establish high productivity and standardization by customizing any regulatory CAE procedure such as FMVSS, ECE etc and corporate best practices. The environment's state of the art process execution methodology allows carrying out the jobs automatically and semi automatically for consistent results. The Visual-Process Executive has more than 30 standard process templates such as Occupant Safety, Pedestrian Safety, Impact Tests and Model Checks,

Model Compare

The detailed modeling enabled by improvements in hardware and software technology is increasing the size of the input file. Also users are doing a lot of iterations to improve the quality of products. **Finding the difference between two models is an essential process to control the changes and evolution of models**. These differences could be geometry changes, weld changes, materials changes, section changes, curves changes, contact changes or any LS-DYNA entity changes.

Visual-Crash DYNA, which has already achieved a remarkable success in providing the users with a complete end-to-end environment for LS-DYNA solver, takes one more step to facilitate the LS-DYNA user with a tool named "Model Compare". With this tool, the user is empowered to compare two models with a click of a button. The comparison is done based on LS-DYNA entities. This helps the user to understand what and where the difference lies in the two models. It also helps user to copy the difference from one model to another.

Display options like Overlay, Highlight, Window Coupling and Locate add even more comfort and support to this process of model comparison. Model Compare eliminates the manual bookkeeping. Without this feature user had to maintain a note of all the IDS and Entities to track the changes while handling the huge input files. Model Compare is bound to improve the productivity of today's user by eliminating the time and error involved in tracking and controlling the changes. Basically it helps in the evolution of better CAE models.

Model Compare can be accessed via Tools Menu in Visual-Crash DYNA context of ESI's Visual Environment.

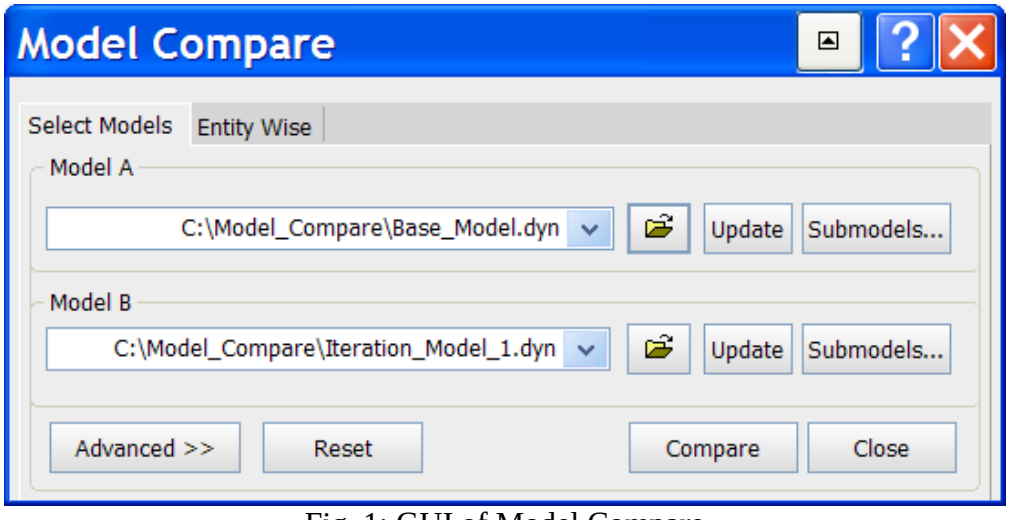

Fig. 1: GUI of Model Compare

Users have option to select complete model or some include files for comparison. If more than two models are loaded, the current model will be taken as Model A and then the reference model can be selected graphically and updated as Model B using the “Update” button. On selecting the

“Advanced ≫” button, the user interface (GUI) extends to show all the LS-DYNA entities

available in the data file, which are selected for comparison. User is required to check the entities of interest. By default, all entities are selected. Refer Fig. 2

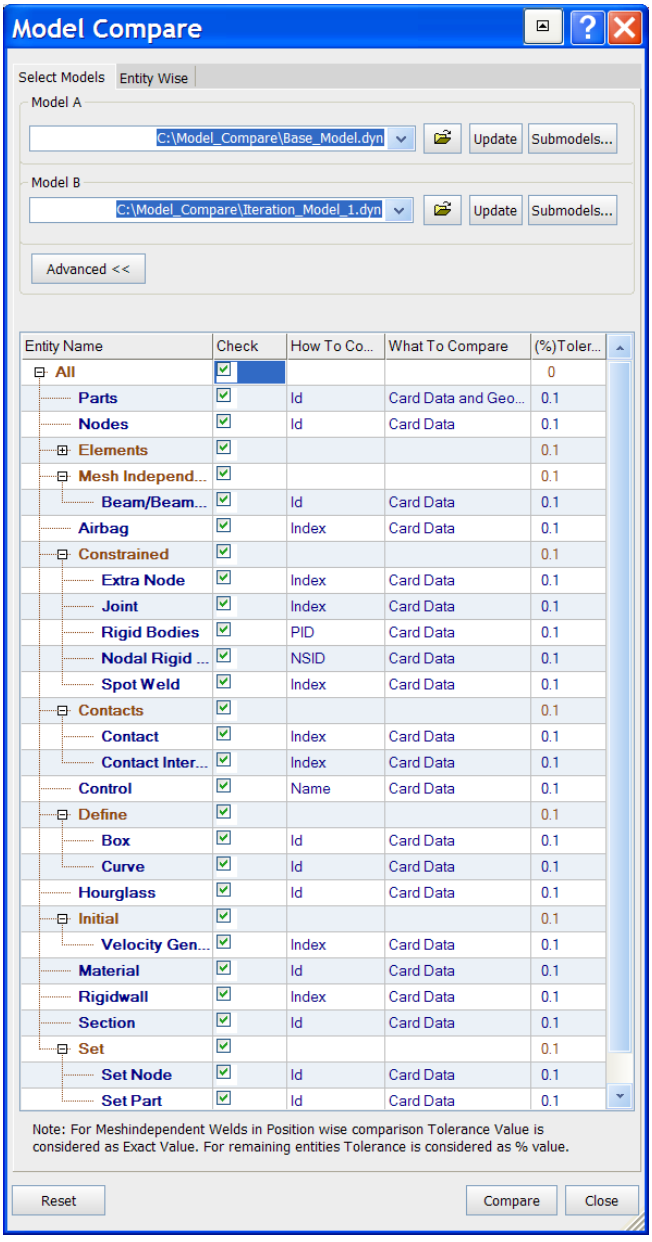

Fig. 2: GUI of Model Compare with ADVANCED features.

Comparison is based on the users selection of LS-DYNA keywords[3] , "How to Compare" , "What to Compare " and "% Tolerance" options.
"How to Compare" is done on the basis of either by ID or by Name. For those entities, which do not have ID field, then Index criteria is default option. For example in case of Mesh Independent welds users have option to perform position based comparison, connected parts IDs and different weld types. Similarly, for Constrained Nodal Rigid Bodies, NSID based comparison criteria is provided. For Materials, comparisons by MID, Material Title, Part Id or Part Name criteria are provided.

"What to Compare" is a comparison criterion to find the difference between the selected models. Base on entity type, any one or more of the following options are available.

1. Card Data (LS-DYNA keyword)
2. Card Data and Geometry
3. Card Data and Others.

First option is used to compare only keyword differences. The second option is used to compare keywords along with geometry data (mass, area, volume, number of nodes and number of elements). The third option is used to compare the keywords and their references.

"% Tolerance" is applicable for position-based comparison of geometry and connection entities, to track position/location changes between models. The default tolerance is 0.1 %.

Display options like "List All Entities", "Window Coupling", "Overlay" , "Locate" and "Highlight" are provided at the top of the GUI. These options help users to visualize the changes and differences. On clicking the "List All Entities", all the entities that have difference will be displayed. Window coupling feature helps the display operations (like Rotate, Pan, Zoom options) of both the model windows simultaneously. Overlay option allows the overlaying of selected entities to show the geometric difference. Locate option helps to locate the selected entity in the model window. Differences are marked in red color for easy identification. On clicking the red colored entity the difference of its data is shown in the bottom list. Using copy option, user can copy specific data from one model to another. Similarly, not only the difference but also the unique items from one model can be viewed and copied to another model.

Following examples shows some of the differences between selected models.

1. Actual difference of keywords (Fig 3)
2. Geometry changes (Fig4)
3. Thickness Changes(Fig5)
4. Set Changes(Fig 6)

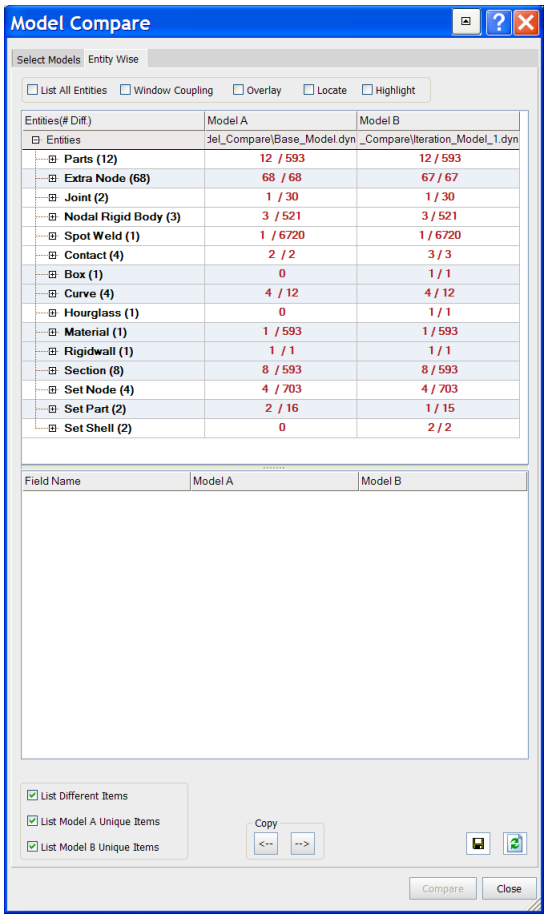

Fig. 3: Model Compare showing the actual keyword differences between two models

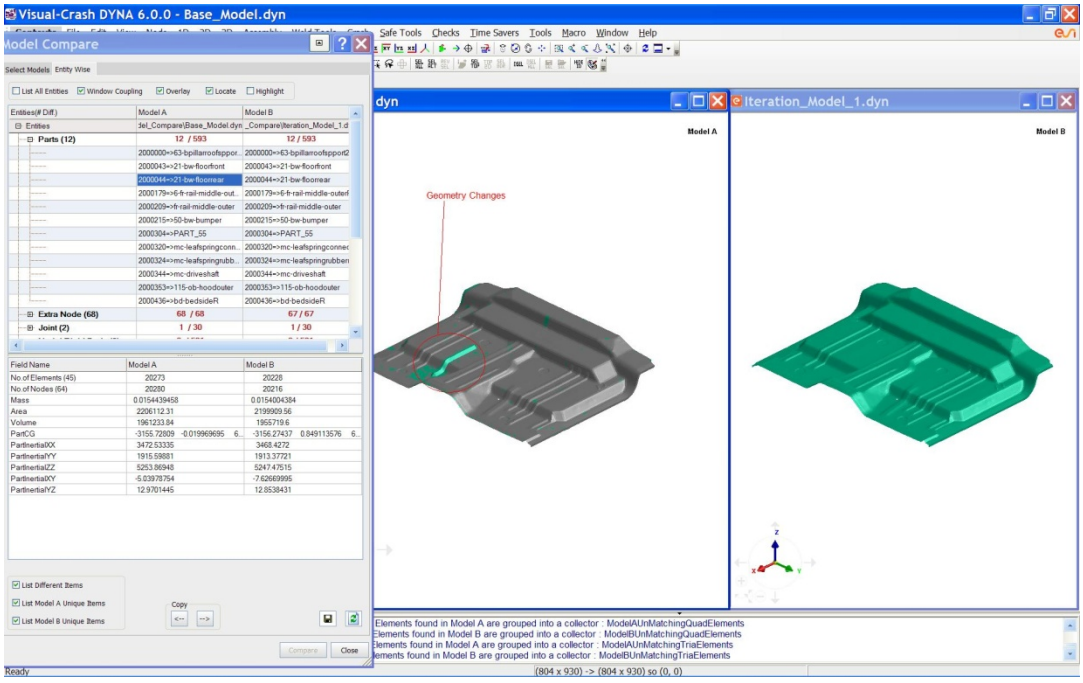

Fig. 4: Model Compare showing the geometry differences between two models

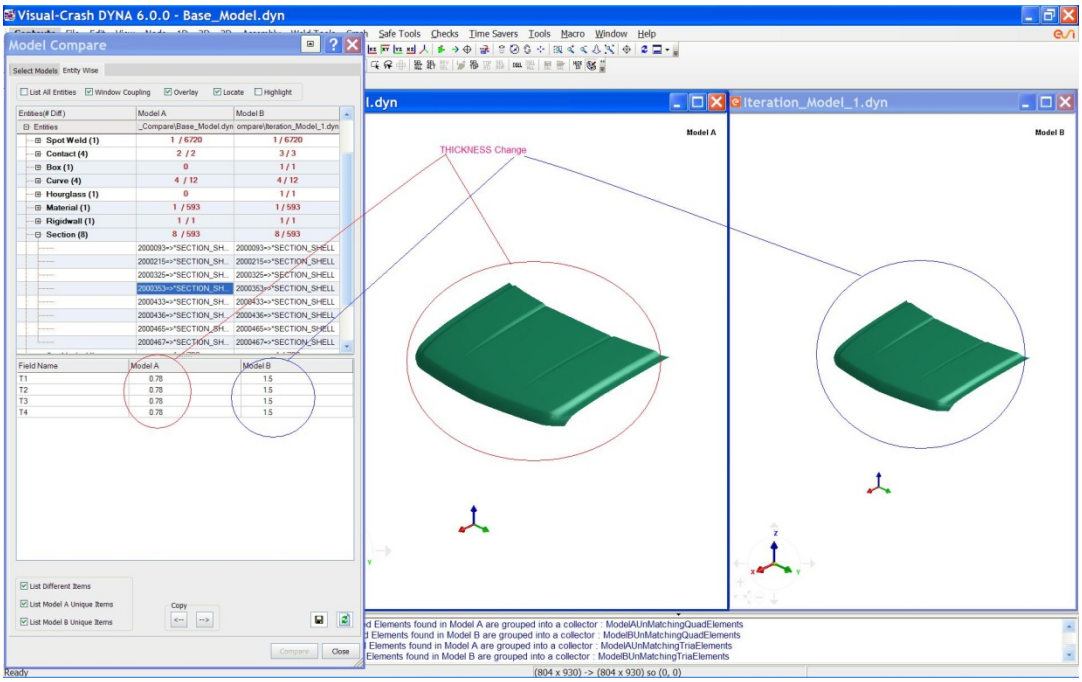

Fig. 5: Model Compare showing the thickness differences between two models.

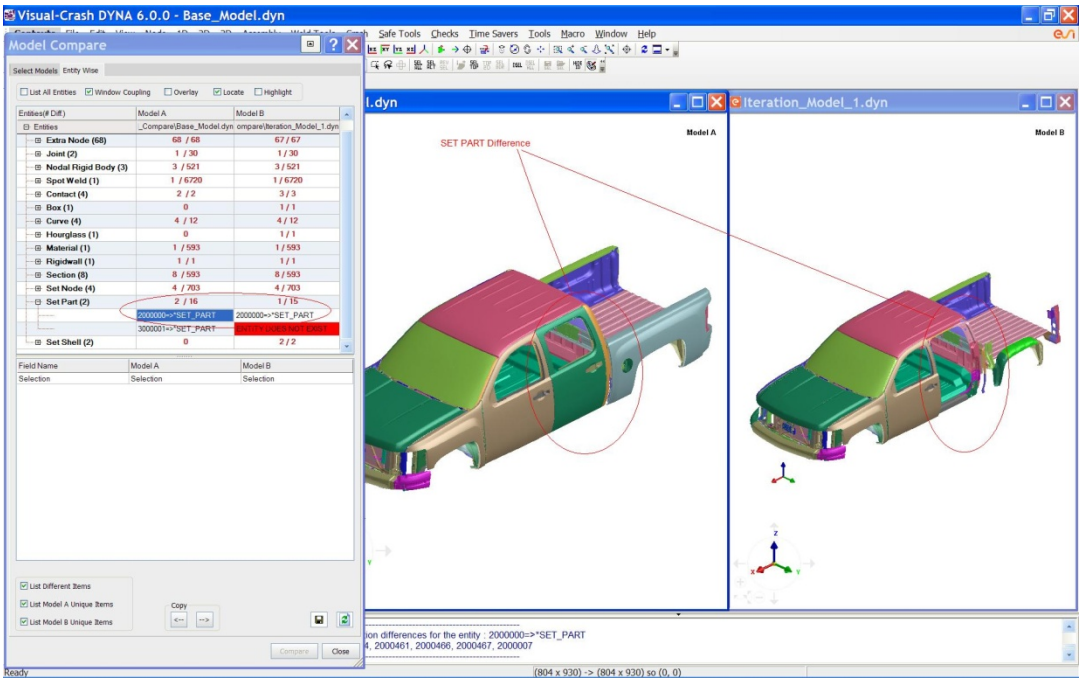

Fig. 6: Model Compare showing the SET PART differences between two models.

Comparison of Results files (d3plot)

Visual-Environment not only supports data file comparison, but it also supports results files comparison. Visual-Viewer context of Visual-Environment helps to identify the differences between two d3pot models. The changes in the results file could happen because of the changes

in pre-processor file. Users can display only the differences in contours and animate to visualize the impact of these changes in the simulation.

User can find the differences in nodal and elemental results between two models. Comparison is based on ID. During comparison, Visual-Viewer checks geometry changes and prompt users about these changes.

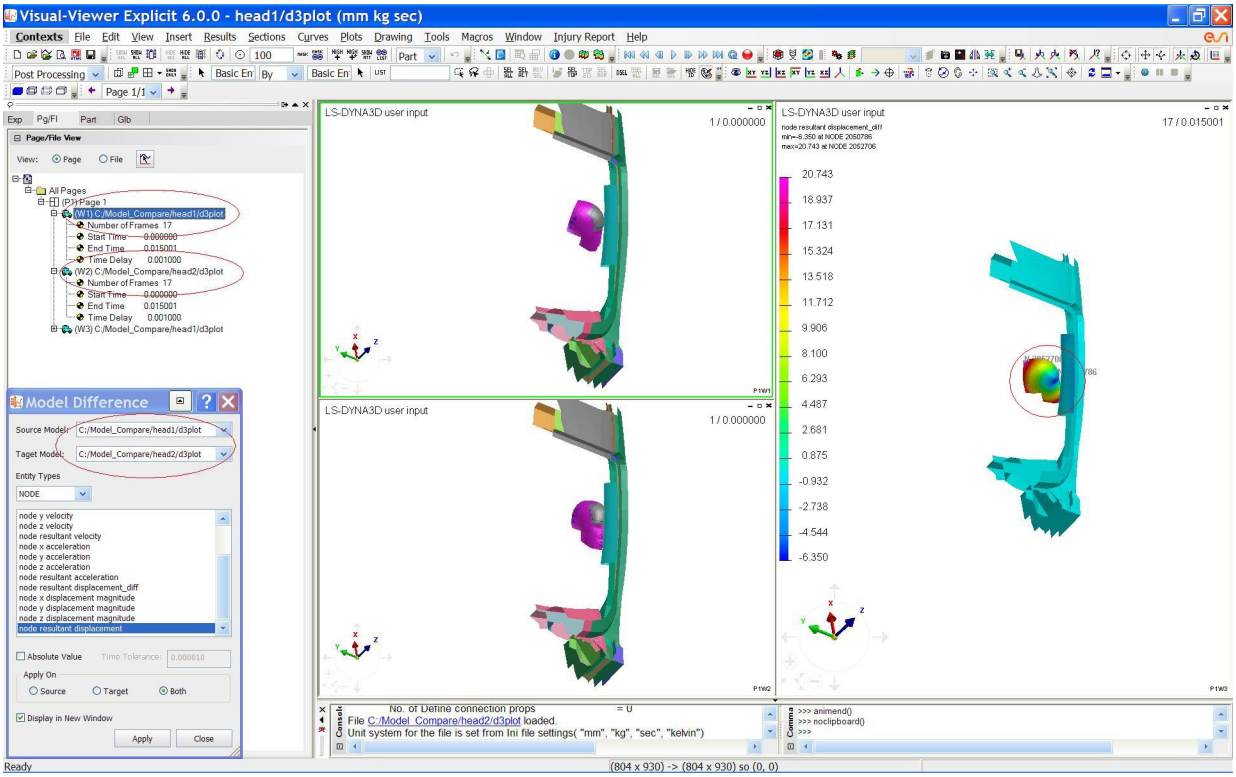

Fig. 7: Model Difference showing the differences in displacement between two d3plot models.

Summary and Conclusion

LS-DYNA user needs a tool, which can quickly find the difference between two models to control the changes and evolution of CAE models at various stages in the product life cycle. This paper has presented ESI's Model Compare tool to satisfy the same need of the user. It comes with many additional features to track the model changes and remove book keeping.

References

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