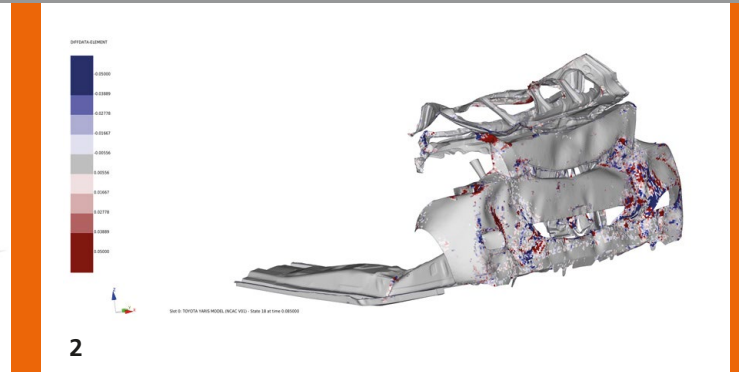


- 1 Highlighted parts with largest deviations in "max. plastic strain" between the two simulations
- 2 Differences in element function "max. plastic strain" shown on highlighted parts



SimCompare

Towards Automatic Event Detection for Crash Simulations

SimCompare is a tool for detecting events – in this context deviations, such as anomalies or strange variations in deformations – arising in the results of similar simulation runs for crashworthiness analysis using finite element (FE) models. It provides a comparison of two FE simulation results based on arbitrary node/element data functions, e.g. displacements, plastic strains, or thicknesses, and time step. The parts with the largest differences are automatically highlighted based on several comparison measures and an appropriate threshold.

User benefits

In computer-aided engineering (CAE) numerous design changes are applied within the overall design development process until the final model satisfies all design criteria. Each of the design changes has to be analyzed and its influences on the simulation results

have to be compared and evaluated. *SimCompare* is a tool to easily analyze the impact of design changes in terms of data functions.

SimCompare automatically highlights the most relevant parts together with local hotspots with respect to design changes. Thus, users are provided insight starting with only two simulations, without the burden of manually determining the differences or the necessity of setting up a simulation data base. To document the influences of design changes, a report can be generated which is automatically adjusted for each analysis setup.

Automatic event detection

The *SimCompare* developers at Fraunhofer SCAI combine mathematics and machine learning to integrate existing application knowledge in data analysis methods. This enables us to provide *SimCompare*

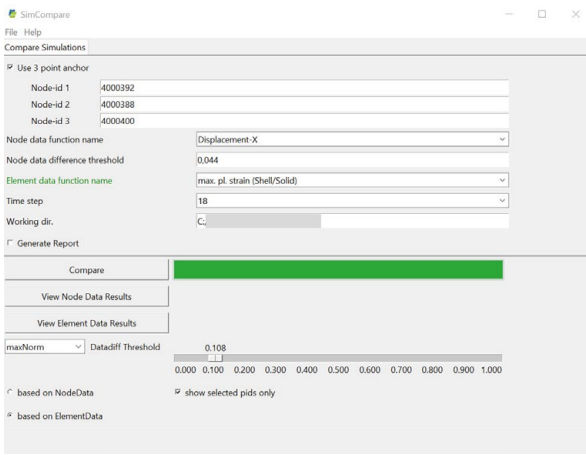
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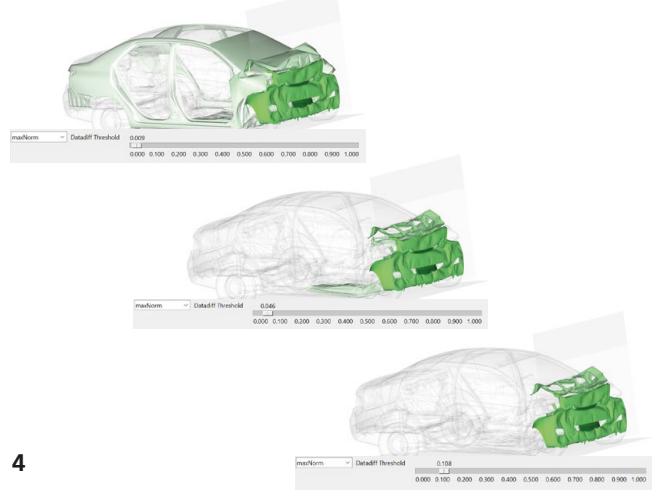


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as an important step towards automatic event detection in an overall simulation data analysis workflow. Our tool allows to systematically analyze a design tree and to detect deviations caused by design changes. *SimCompare* can be used hand-in-hand with the SCAI tool *ModelCompare* for the identification of design measures realized through model adaptation.

A seamless interface as a plug-in

SimCompare is available as a plug-in for GNS Animator or as stand-alone batch tool. Results are visualized directly within Animator. Thus, the CAE engineer needs no additional tool and can easily integrate the *SimCompare* analysis in a well-established analysis workflow.

Comparison based on node and element data functions

Arbitrary node or element data functions available in the simulation models (e.g. signed plastic strains, displacements) can be selected for comparison via the plug-in GUI or by a settings file. For analyzing displacements, rigid body motion can be extracted by setting corresponding anchor points. Thereby, detailed insight in local influences on, e.g., deformations, plastic strains, stresses, can be evaluated with respect to a certain design change (measure).

Filtering of the most influenced parts

Differences are computed partwise for similarly discretized FE models. *SimCompare* uses specialized and well established mapping techniques known from the SCAI tool *ModelCompare*. This enables comparisons of models with changed or combined parts. Filtering of the most affected parts is supported interactively and automatically enabled in order to systematically detect influences of design changes.

Several metrics for different purposes

Several comparison measures (metrics) are available to focus on global or local influences. These can be extended to other engineering-based metrics, including expert knowledge, on request.

Visualization of local events

Deviations are visualized on both models, node- and elementwise. This simplifies the detection of local hotspots. The whole vehicle or the relevant parts are shown to get an overview of design change impacts.

Automatic report generation / storing of results

Automatic pdf report generation makes it easy to archive analysis results. Additionally, all differences are stored node-/elementwise for loading in the preprocessor tool. The comparison results are stored partwise in structured JSON files supporting further post processing. Therewith, the integration of results in a Simulation-Data-Management (SDM)-tool of your choice is highly simplified.

- 3 *SimCompare Animator Plug-in*
- 4 *Interactive filtering of the most influenced parts – above: threshold 0.009, 94 parts selected; middle: threshold 0.044, 24 parts selected; below: threshold 0.109, 11 parts selected*