BMW AG

Generation and animation of transient stress and deformation results

The new toolbar generates transient stress and deformation by combining unit loads with their respective load time history. This helps identify the critical load-channels during the design process.

Load-cases with transient superimposed operating loads can lead to complex deformations and stresses. This significantly impacts the design of a BiW, as well as other parts of a vehicle regarding its durability.
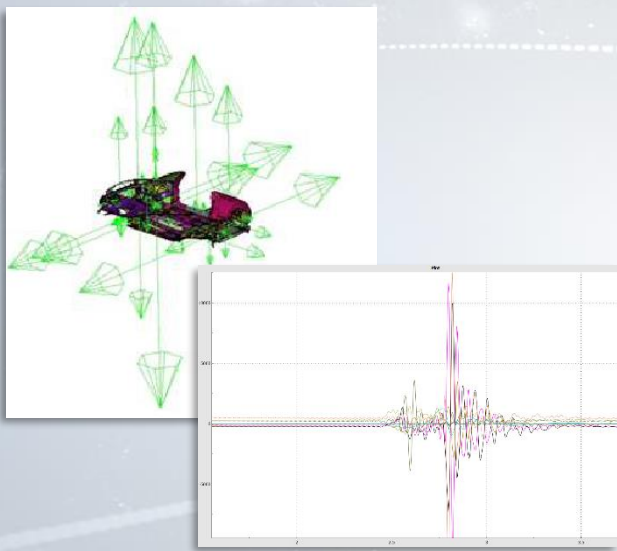
Static plots from durability simulations alone do not provide sufficient information to effectively identify the critical load-channels and the deformation they cause. This lack of insight for critical load-channels, results in an inefficient trial-and-error approach that leads to complicated decision making within the development team.

Thus, an efficient tool that combines all load-cases with their respective time variations, and that generates automatically stress and deformation results over time for the entire BiW, would greatly assist in identifying critical load-cases and would also help in avoiding trial-and-error approaches.
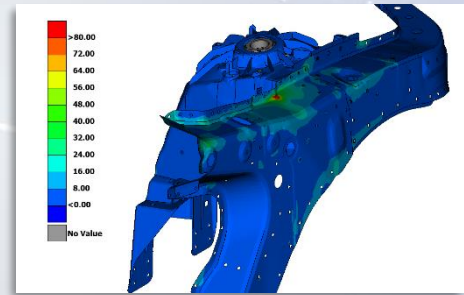
"The new toolbar provides the capability to point out the damage relevant load-channels, while also enhances the comprehension of the durability problem, which strikingly exceeds the information of a mere static durability plot. Thus, the tool also effectively communicates the necessity and quality of respective design proposals.

The implementation of the toolbar by BETA in META post- processor was swift and easy to use, as always."

Nils Himmelsbach
Function responsible BiW
BMW AG

Unit loads and time history

Transient stresses and deformation

Challenge

The current procedure for durability simulations, calculates stress tensors caused by unit loads. For such simulations, a typical fatigue analysis concentrates on resolving local issues, missing out on identifying broader concept issues. Examining the transient stresses and deformations caused by the combination of unit loads and their respective load-time history, would make it possible to identify such broader concept problems.

However, performing a transient finite element (FE) simulation would require the creation of new load-cases, resulting in a significant and unjustifiable increase in simulation workload. Same time, any manual operations on load-time histories and stress results are prone to time consuming processes and potential errors. Especially for demanding cases such as the identification of the "critical maneuver" of the BiW which involves a global torsion induced by a specific adverse incident on a single side of the road.

Approach

To address the aforementioned challenge, a dedicated, user-friendly META toolbar has been developed, to provide the capability to:

- Read time histories curves and the static subcases

- Automatic match of static subcases with time histories.

- Ability to selectively retain only the relevant area of the curves.

- Generate transient stresses and deformation results using the principle of linear superposition.

Results

The newly developed META toolbar empower engineers to visualize deformation and stress results in various combinations. This makes easy the detection of broader concept problems for critical areas of the BiW resulting from different combinations of load histories and unit loads. This capability surpasses what can be achieved through static solutions alone, while also eliminates the need for time consuming finite element transient simulations.

For more about BETA CAE Systems, visit www.beta-cae.com