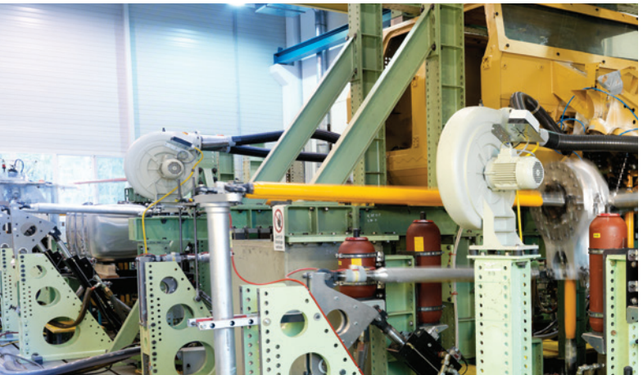
Your Benefits

- Reliable and effective multiaxial fatigue assessment of axles, suspension systems, frames, engine components, BIWs, ...
- Interfaces for history data from multibody simulation and measurement data software
- Channel based or transient load definition
- Cutting plane and FE node filters for high analysis performance
- Up-to-date material-sensitive equivalent stress hypotheses
- Analysis of damage/life, endurance safety factors and degree of multiaxiality
- Fatigue life prediction of fiber reinforced plastics including orthotropic material data
- Unlimited number of load channels
- Option for compressing large time histories
- Compatible to FEMFAT weld (arc weldings) and FEMFAT spot (spot joints)
- Continuous fiber-reinforced plastics analyses in combination with FEMFAT laminate in ChannelMAX
- Add-on tools such as Harmonic and Elastoloads for modeling and analyzing vibrational phenomena or elastomeres

FEMFAT Interfaces

• Abaqus • ADAMS • ADVC • ANSYS • COSMOS • CREO
• DIADEM • DIGIMAT • HYPERMESH • I-DEAS • LS-DYNA
• MARC • MEDINA • MoldFlow • MotionSolve • NASTRAN
• nCode • Optistruct • PATRAN • PERMAS • Pro/MECHANICA
• Radioss • RPC • SIMPACK • TECMAT • TOSCA



FEMFAT max
FINITE ELEMENT METHOD FATIGUE

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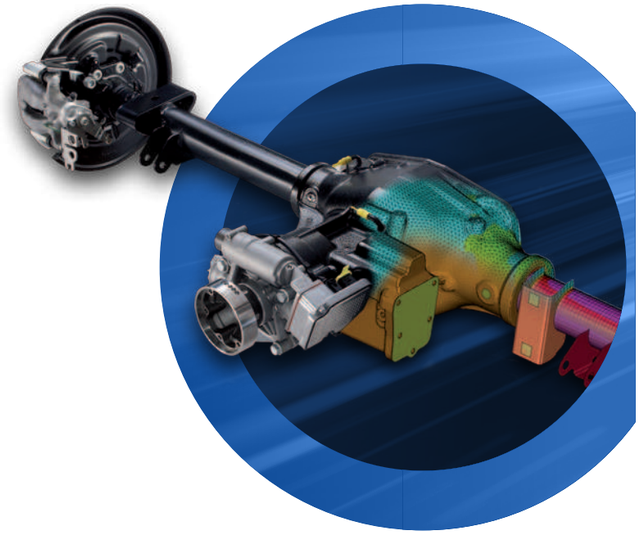

Finite Element Method Fatigue

Multiaxially loaded components such as body in white (BIW), suspension components, frames or crankshafts cannot be investigated by simple methods like equivalent uni-axial loading. FEMFAT max has been developed to assess these complex loading situations in an accurate and efficient way.

The methods applied are taken from the appropriate literature, the latest internal developments, cooperation research studies and are verified by countless engineering projects. Typically multi-axial components (wheel axles, body in white) are loaded in different directions. Simultaneously forces from acceleration/ braking, curve driving and curb weight affect the structure dynamically at different load histories. The load history can be acquired by various means, such as measurements, finite element analysis or multi body simulation.

In FEMFAT channelmax each load case and the associated load history is called a load channel. Stresses for these load channels can either be computed using a quasi-static approach (e.g. „inertia relief“) or using the modal approach (e.g. Craig Bampton), which is more appropriate if vibrational effects occur.

In case of transient or sequence stress results FEMFAT transmax can be used for fatigue prediction. The advantage of a transient definition is that the non-linear effects taken into consideration in the FEM. FEMFAT max is able to handle fiber reinforced plastics, taking material anisotropy and fiber orientation into account.

Multiaxial Fatigue Analysis

- Complex load conditions
- Transient and channel based
- Critical cutting plane method

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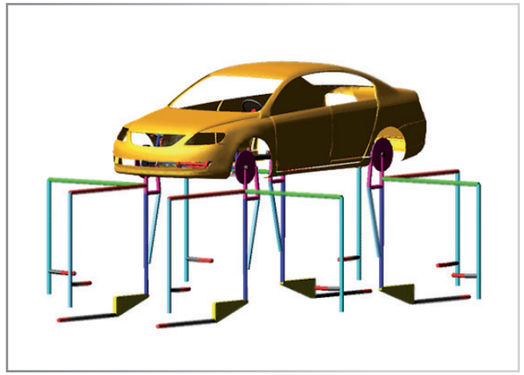
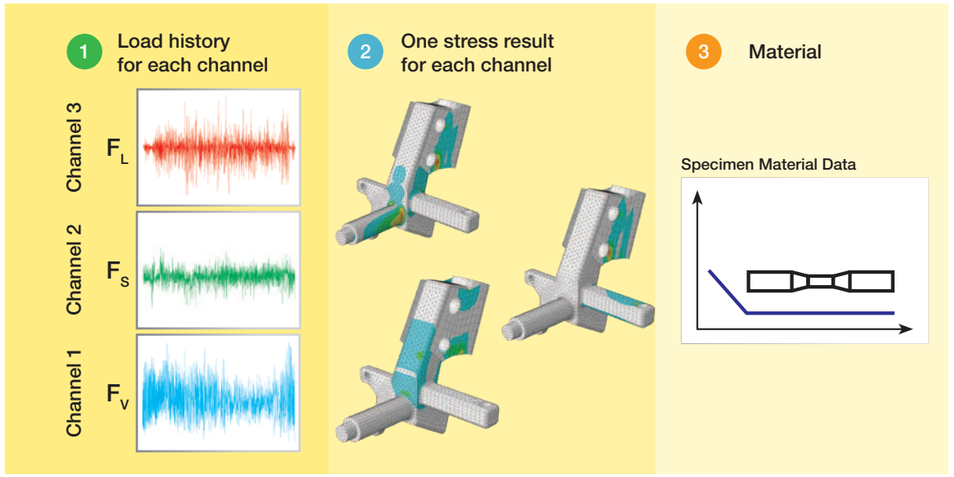
Method

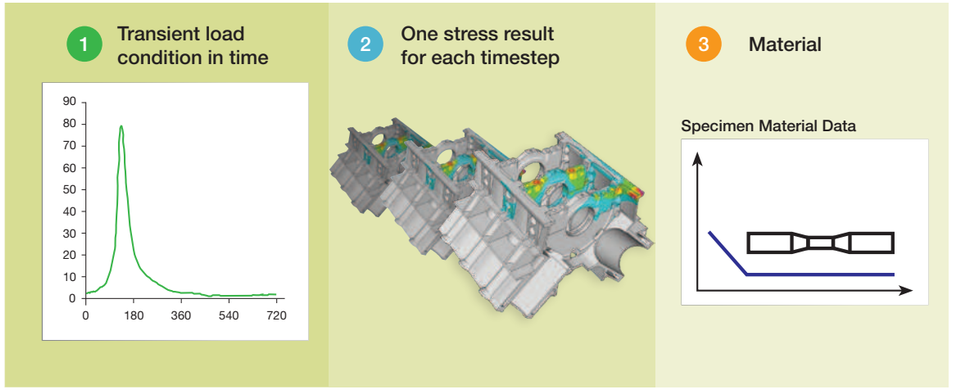
All load history information is summarized by means of standard (e.g. principal stress) or the critical cutting plane hypothesis, specially developed for multiaxial fatigue analysis.



Multi body system

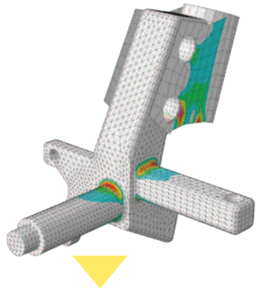
In order to analyze the interaction of all loads, all stress information is superimposed, transformed to an equivalent stress and rainflow counted. Next the fatigue analysis begins with the help of local S/N curves including relevant influences such as notches, mean stress, isothermal temperature… The results are damage values, endurance or static safety factors.



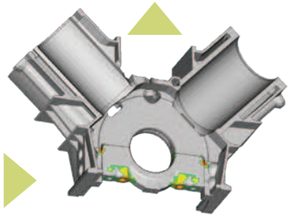


Data processing in FEMFAT max

Channel based modeling requires the definition of unit loadcases for each loading direction.



- **Endurance safety factors**
- **Static safety factor**
- **Damage values**
- **Life time**
- **Degree of multiaxiality**

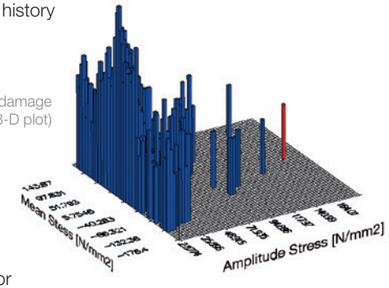


Transient simulation requires stress data in time.

Postprocessing

A multitude of graphical and tabular outputs are available to present and deeply understand the results:

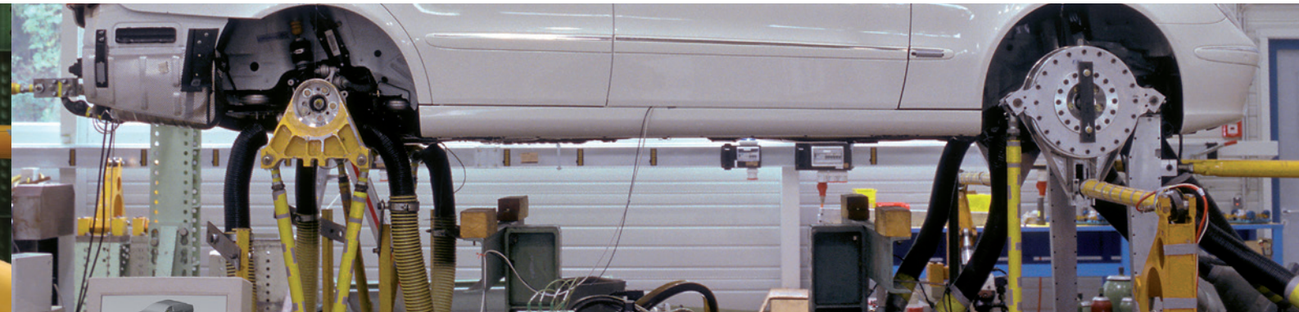
- A critical load case representative of the most damaging load
- Cutting planes and critical plane in a Haigh diagram
- Unit stress and maximum stress of channels
- Rainflow and damage matrix (3D-plot)
- Partial and total damage results
- Equivalent stress history



Rainflow and damage matrix (3-D plot)

Tools

We provide two stand-alone tools for creating special types of loadings. Both tools can be used with Windows and Linux workstations. Those tools are free for customers with valid FEMFAT maintenance contracts.

HARMONIC uses various methods to generate load-time profiles from modal response calculations for multi-axial fatigue analysis of harmonic vibrations.

ELASTOLOADS Generation of ABAQUS input files and Channel-MAX load histories for the multiaxial fatigue analysis of nonlinear systems (elastomers, contact) with long transient time histories.