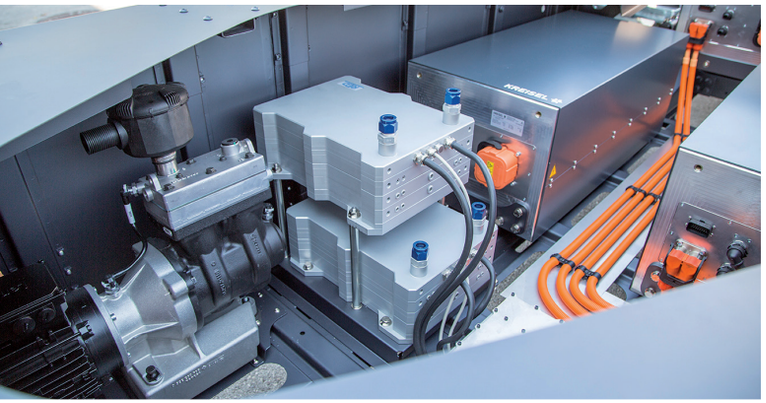
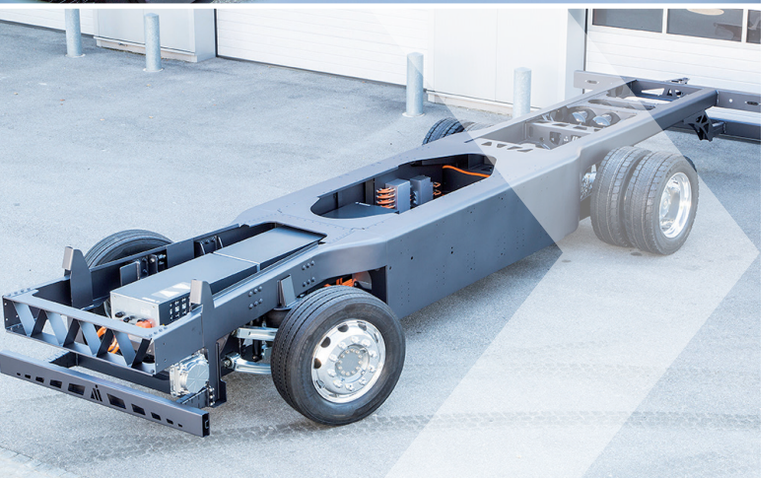
Your Benefits

- Result improvement in case of structures containing spot welds and bolted connections
- Efficient dynamic joint contact simulation for long time history
- Two options for joint contact analysis
  - As flexible body within a multibody dynamics model
  - As single flexible body with interface loads
- MAMBA integrates easily in existing process chains for structural analysis
  - MAMBA Pre which adds contact modes to flexible structure
  - MAMBA Sub for analysis of joint contact within MBD solver or
  - MAMBA Solver for analysis of a single flexible structure

Interfaces

FEM Solver: MSC Nastran, OptiStruct, Permas
MBD Solver (optional): Adams, MotionSolve, Simpack





MAMBA software
MAGNA MODAL BASED ANALYSIS

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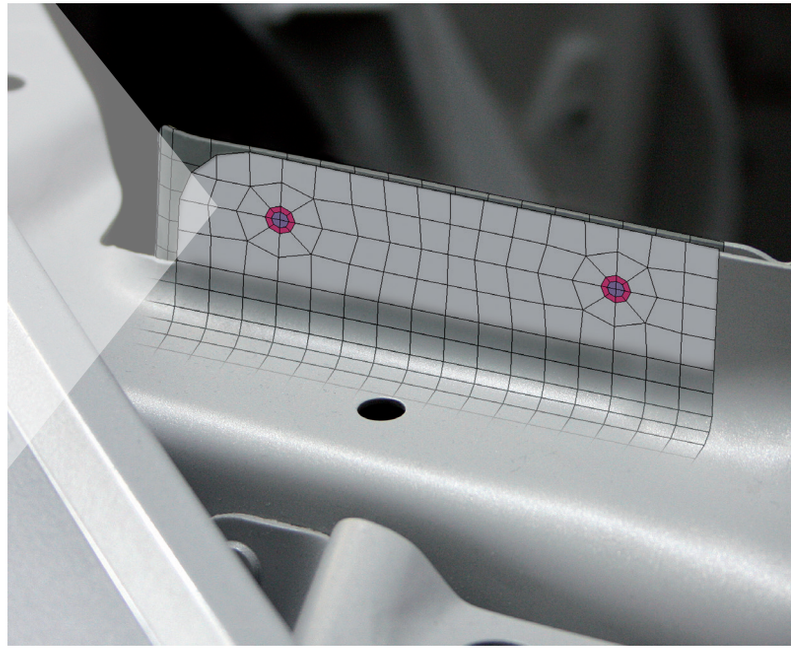
MAMBA software
BY MAGNA POWERTRAIN

Magna Modal Based Analysis

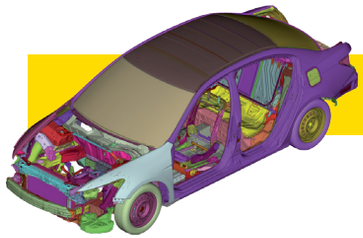


Structural Dynamics of Built-Up Structures

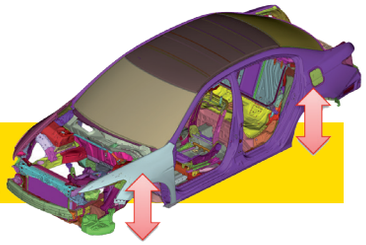
mamba.magna.com

Joint Contact Phenomena

The nonlinear behavior of joints, such as those on bolted housings or spot-welded sheets, can substantially influence the local and global results of a dynamic simulation.
MAMBA is a software application allowing efficient consideration of contact and frictional forces within a multibody dynamic (MBD) simulation or within an internal solver.



Multibody Solution
Full Vehicle Model
on Virtual Road or Test Rig



Standalone Solution
Body Structure
and imposed Interface Loads

An example of the global influence of a joint is the frictional damping. This damping is approximately an order of magnitude higher than the material damping and essential for the vibration amplitude of dynamically loaded components. An example of local influence are spot-welded sheets. Correct consideration of local loading is critical for damage analysis of the spot welds. It is known that considering the contact of the surrounding sheets can significantly influence the spot lifetime prediction.

Common Industrial Analysis Approaches

First option is an implicit FEM analysis considering nonlinear contact. Only the analysis of a few states, ignoring dynamic effects, is economically reasonable if using this method. The second option is based on the use of a reduced order FEM model with linearization of the joint contact. Result quality is variable and unpredictable, depending on the problem.

MAMBA based approach

The deformation is represented by a special mode base. With the aid of relatively few additional degrees of freedom, so called contact or joint interface modes, it is possible to achieve a result accuracy comparable to direct finite element method (FEM), without losing the efficiency of the modal approach or being limited to very short time series. The MAMBA method can be divided into two major steps. The first step is the creation of a lean simulation model and the other one is the contact analysis based on this streamlined model.

1. Creation of an extended flexible structure

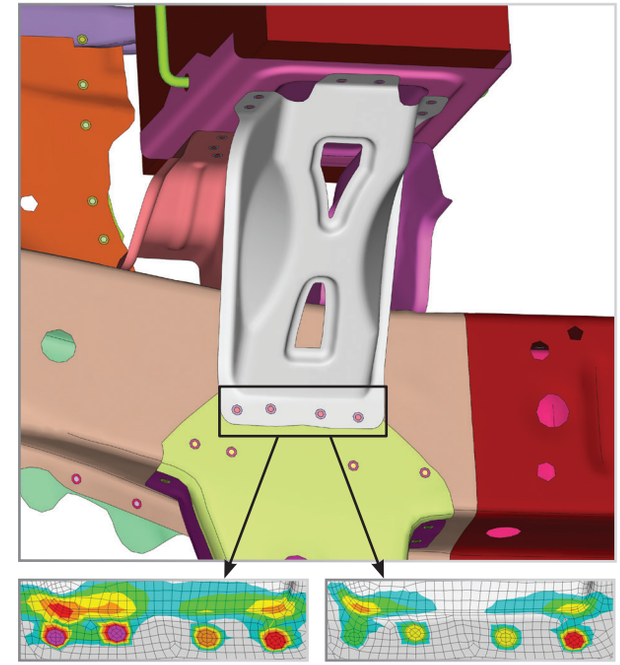
- FEM model of jointed structure (non matching mesh is possible)
- MAMBA automatically detects the joint areas in the FEM model
- Computation of contact modes using MAMBA and FEM code

2. Contact analysis

- Multibody solution: Integration of flexible structure as part of a MBD model
- Standalone solution: Interface load time history assignment within an internal solver
- Parameterization of contact model
- Joint parameters can be modified without repeating step 1
- MAMBA considers the nonlinear contact

Exemplary Application

A battery carrier is dynamically loaded due to vehicle vibrations. The sheet metal structure is connected via spot welds and especially in these areas contact between the sheets can occur. Without contact simulation the spots are loaded too high, whereas with contact stresses the results are more realistic.



No Contact Stresses

Contact Stresses considered with MAMBA