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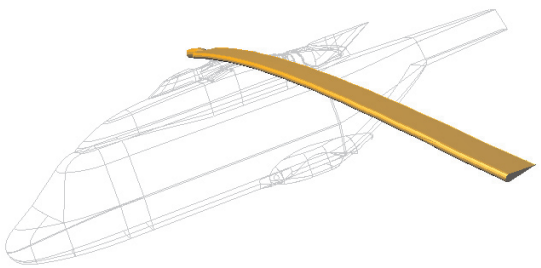
New Tools for MBS-FEA-Interfacing:

FEMBS 6 and Load-X-Port

An efficient and accurate implementation of flexible bodies is one of the major advantages of SIMPACK. With the new Version 6 of FEMBS and the new interface Load-X-Port, it is now possible to import flexible structures even more conveniently into SIMPACK and to export the loads, acting on a flexible body, from SIMPACK to FEA-codes. The easy-to-use interface of Load-X-Port provides all the data necessary for the FEA tools to calculate deflections and stresses. This can lead to enormous potential savings in terms of time and money within the development process.



Flexible Bodies in SIMPACK Using FEMBS 6

The SIMPACK Interface used to import flexible bodies, FEMBS, is currently available as Version 6 for the FEA codes ABAQUS, ANSYS, I-deas, NASTRAN and MARC. Here - in contrast to other MBS tools - SIMPACK can take into consideration the geometric stiffening effects, allowing for the increased bending stiffness of the rotor blades while rotating. This method is as accurate as using a FEA tool but the calculation requires less computation time and much less user effort, than if the flexible body was subdivided into separate flexible bodies and later merged in a multi-body system software.

The capabilitiy of the new Version 6 of FEMBS has now been expanded by a new feature. In SIMPACK, flexible bodies are connected to the multi-body system by force elements constraints and a joint. Sometimes these interconnections cause local deformations at the attachment points of the structure. Consider the deformations of a railway car body which is connected, at distinct points, to an electrical transformer. To treat such local deformations, it is either possible to use so-called static modes or to use a large number of normal modes. Generally, the normal mode approach is less efficient due to a large number of additional degrees of freedom corresponding to the normal modes. The static mode approach is frequently difficult to apply, because it is sometimes impossible to define an appropriate set of boundary conditions for the static mode calculations. This can be particularly problematic when looking at floating vehicle components such as flexible car bodies. In contrast, FEMBS now uses the frequency response mode approach. This applies to floating vehicle components and has become the most appropriate solution approach for flexible bodies in SIMPACK. The deformed shape of an elastic part, due to external forces acting on the body, can now be taken into consideration much more easily. An additional calculation step is all that is required within FEMBS to yield the results, which means that it is not necessary to repeat the FE analysis. The set of additional frequency response modes can represent elastic body deformation for all parameters (stiffness, damping, etc.) of the interconnections. With a single set of modes the user may perform parameter variations, whilst obtaining accurate elastic behaviour. Therefore, the number of models exchanged between FEA-codes and

SIMPACK is decreased, as well as improving the handling quality of the whole design process.

Calculation of Loads on Flexible Bodies in SIMPACK

Having imported a flexible structure to SIMPACK, all the forces acting on the body can be calculated in SIMPACK using the time integration module.
As a first step, the user of FEMBS has to select nodes on the FEA–model which should be transformed to markers in SIMPACK. All these markers are then available to apply external forces in the multi-body simulation, i.e. constraint forces, spring and damper forces etc.

Load-X-Port

After the time integration has been performed, the forces acting on the flexible structure are available for any attachment point and time step. However, the external forces produced by the springs, joints, etc. are not necessarily in equilibrium, i.e. an overall acceleration of the body would appear in the FEA-code. Therefore Load-X-Port automatically adds the movement of the body fixed reference frame calculated by SIMPACK to the load vector which is exported. The FEA-code then calculates and takes into account the corresponding inertia forces for a quasi-static overall motion.
Evaluating the result of the time integration, the user can decide which time steps should be written to the result file by Load-X-Port. The files serve as the input for the quasi-static time domain calculations in the FEA- codes, giving the stresses and deflections.
A selection tool helps to quickly define either the number of time steps with a certain increment or the time interval in which to perform the calculations.

The result file is stored as an ASCII file. Currently the user has the choice between the formats of ANSYS and NASTRAN. Load-X-Port will be available for Life time calculation tools in the near future.

New BEAM Available Soon

For simple, beam-like sectioned structures with constant cross sectional areas, for instance stabiliser bars and shafts of drive trains, the SIMPACK pre-processor BEAM can provide the same input for SIMPACK, as a FEA package creates together with FEMBS. By 2001BEAM will be able to consider three-dimensional frameworks. A graphical user interface directly integrated into SIMPACK will also be available.

Benefits

SIMPACK offers the user high-end simulation technology for the consideration of flexible structures. All the additional features make the handling of common tasks by simulation experts much easier and allow a more integrated design process.
These abilities are essential for an accurate and efficient simulation of flexible parts such as stabilisers, leaf springs, sub frames, twist beam rear axle suspension systems and car bodies in automotive and railway design.