

New SIMPACK Version 8

The most important changes to the latest version of SIMPACK are a new pre-processor, a redesigned plot and animation tool, a further improved solver technology, switch crossing modelling in Wheel/Rail, the up-to-date Automotive[®] version and a unique feature for multi-body simulation programs – the automatic multi-objective parameter optimisation. Also, the interface to FEA-packages has been enhanced.

The continuing development of SIMPACK at the German Aerospace Center (DLR) is aimed at achieving two major objectives: to provide new and innovative simulation technology and to implement user requests and suggestions. Leading edge technology is provided by SIMPACK *Optimisation*, the further improved solver in time- and frequency-domain and the interfaces to FEA-programs. The new pre-processor, animation and plot tools were revised to reflect the user's wishes as closely as possible. A number of new modelling elements have been added to SIMPACK, some of them as a result of several years of continuous research at the DLR. Behind the fairly inconspicuous term *one sided constraint* for example lies an extremely advanced and complex method, which opens up new areas in contact modelling.

New Modelling Elements

With SIMPACK 8 it is now possible to model surface contacts for elastic bod-

ies. The new element *moved marker on elastic bodies* enables the modelling of contacts on bodies that were imported from FEA programs. This enables, for example, the modelling of vehicles on flexible tracks. The contact simulation is even further improved by using equations of variable structure, whose mathematical background was presented by Dr. Thomas Klisch at the last user meeting. These equations are used for *one sided contact constraints* which allow the time integration to be stopped and restarted after the equations of variable structure have been adjusted to the current contact situation. This results in reduced computational times, especially in models with very high contact stiffness, because instead of integrating a stiff dynamic system with high frequencies a kinematic system is integrated stepwise.

Pre-Processing

The complete functionality of SIMPACK's new pre-processor for cre-

News
Dr. Alex Eichberger
INTEC GmbH
SIMPACK en France

EU-Research
Prof. Willi Kortüm
Deutsches Zentrum für Luft- und Raumfahrt
Mechatronik Train



New Software
Werner Stoab
INTEC GmbH
Elastic Bodies within Pro/ENGINEER



New Software
Gunter Schupp
Deutsches Zentrum für Luft- und Raumfahrt
Switch Crossing Simulations



New Software
Johannes Gerl
INTEC GmbH
Optimisation

SIMPACK Main Window's New Layout





ating general multi-body models is accessible from pull down menus now. The most important functions are also accessible through icons, complete with description text known from recent versions which appears when the mouse pointer moves over the icon. The windows of the separate modelling elements are mostly unchanged, however, in some instances the number of sub-windows is decreased. Context sensitive menus provide specific information and can be opened by pressing the right mouse button in certain windows. Zooming and positioning the model in the 3D window can now be achieved by using the right mouse button, similar to CAD-software.

Plot and Animation Tools

Many new features have been added to SIMPACK's plot tool. These new features are especially useful when dealing with large models. The results of very detailed automotive or rail vehicle models can sometimes add up to as much as 100MB of data, especially when high sample rates and long integration times are needed. The handling of the result data has become much easier now.

Like version 7.1 SIMPACK 8 allows the user to create an alternative database which only contains requested results. The configuration of plot pages, including filters and titles, can now be saved in the SIMPACK database independently of the model. A user friendly data converter establishes the connection between plot variables and model variables. That is, multiple used and standardised plot pages like for instance the forces acting on a rail vehicle's wheels

have to be configured only once and can be used throughout many models of a similar type.

A single curve, a graph or an entire plot page can be saved directly into the SIMPACK database and used elsewhere to compare results of several models in a single plot. It is now also possible to export results to MATLAB, GNU-Plot and Microsoft Excel compatible ASCII-files.

Finally, the set up of plot pages is enhanced by a new clip-board function. A certain curve, coordinate system or plot page can be copied and pasted elsewhere.

Filters can now be grouped and saved as so-called filter macros in the plot tool and in SIMPACK's parameter variation so that the same set of filters can easily be applied to several model variables.

The 3D-animation of integration results is greatly enhanced and much more user friendly by using a so-called movie player. This enables the user to run the animation picture by picture, animate only a set of pictures, adjust the speed of the animation and also fast forward and rewind. Animations can be saved in a neutral format (Animated GIF) independently from the model.

New Solver Technology

The control of all the available time domain solvers in SIMPACK 8 has reached a very high degree of user friendliness. All the integration control parameters for the different integration methods are accessible through very similar menus, that only differ slightly from one another when special inputs are required. Some control parameters that had to be entered manually in pre-

The SIMPACK Pre Processor's New Icons



vious SIMPACK versions are now calculated automatically. To optimise the integrator for special situations like real time applications, the accuracy of each state variable can be set individually now, so that maximum integrator performance can be achieved for a specific model and simulation scenario. Finally, the automatic linearisation of non-linear models in SIMPACK 8 is performed significantly faster.

FEMBS and LOADS

A new feature has been added to version 5 of FEMBS, which allows an adjustable coupling between a flexible body and its surroundings in a multi-body system. Using a modal approach to represent finite element structures in multi-body systems generally requires identical mounting conditions in both packages if only dynamic modes are used. In practical use this means additional expenditure if the mounting conditions of the elastic body have to be optimised within the multi-body system - each mounting stiffness can require a new FEA model.

In FEMBS 5 static modes are used to represent the deformation of the elastic structure due to the load introduced by external forces like mounting forces; i.e. the general adaption of the FEA model data to the mounting condition can be carried out automatically by FEMBS.

The interface LOADS allows results from SIMPACK calculations to be used for quasi-static stress analysis within a FEA program. To this end, LOADS exports the external forces, that act on the flexible structure, as well as joint forces, spring forces, etc. and determines the appropriate inertia compo-

nents to ensure that the equilibrium conditions are satisfied.

Automotive*

SIMPACK's add-on module for automotive applications, developed in cooperation between DLR and INTEC, will be completely available in SIMPACK 8. Automotive industry has been involved intensively in its development in terms of providing valuable advice, testing, definition of common goals and specifications. Consequently, a tool has been created with outstanding power, high efficiency, flexibility and reliability.

Since the last pre release, introduced recently in SIMPACK News, new library elements have been added and TNO's MF-Tyre has been connected to SIMPACK. A new evaluation tool for kinematic and elasto-kinematic analysis provides an optimum efficiency for the lay out of wheel suspensions.

The latest substructures added to Automotive* are a brake system model and a steering model with cardanic joints. The brake model allows the definition of an over-all torque to slow down the whole vehicle and the adjustment of the resulting torque on each front and rear axle as well as the left and right wheel via user-defined functions.

The new steering substructure - fully parameterised as any other Automotive* element - extends the already available one by a handle bar with cardanic joints. Possibly deviating rotational velocities of the steering input are fully considered by this substructure. Their influence on the vehicle's behaviour can be studied by whole

More About SIMPACK 8

The modelling of changing rail profiles used for switch crossing simulation within SIMPACK Wheel/Rail and the automatic multi-objective parameter optimisation module SIMPACK Optimisation are both described in other articles within this issue.



Handle Bar with Cardanic Joints

vehicle simulations as the steering model can be connected to any Automotive+ front wheel suspension model. As already known from the standard steering model, the driver's input can be modelled kinematically, by functions (for instance sinusoidal input) and by SIMPACK's steering controller that aims to keep the vehicle on a user defined track.

The handling of such extensive road holding studies was further optimised by introducing the road models into the SIMPACK data base; i.e. in the final version it is now possible to receive any desired component for a vehicle simulation from the data base by combining verified sub-models with standard roads (global track plus overlaid excitation load) and simulation scenarios with - as experience shows - unknown efficiency in model set-up and calculation.

As already described in the last issue, the MF-Tyre package of TNO Road Research Institute is now available in SIMPACK. The tyre model, that is based on Pacejka's magic formula, has been added to SIMPACK's general tyre interface. That is, the flexible tyre modelling with its connection to the data base is extended to the MF-Tyre and the available tyre models can be varied with little effort. A common data base is used for general parameters that are required for any tyre and further data bases are used for specific input.

Finally, a new suspension analysis tool helps to clarify the kinematical and elasto-kinematical behaviour of a wheel suspension model with a very low effort. SIMPACK provides test stand models to apply a defined load

on the wheel. These can be combined with any wheel suspension models both from the standard Automotive+ data base and any user defined or modified model with a few mouse clicks. Now available special sensors for the steering and the wheel hub kinematics provide standard outputs such as spring ratio, camber angle, toe angle, etc. for pre-defined plot pages. A well tuned integrator manages to create results with the accuracy and reliability SIMPACK users are used to. Of course, the new tool is fully compatible with the parameter variation module and therefore makes it easy to lay out a design based on extensive parameter studies. Thinking of the possibilities offered by SIMPACK's new optimisation tool described in this issue finding the optimum design under given constraints reaches a new dimension with respect to kinematical analysis.

More About Automotive+

Please order the new SIMPACK Automotive+ brochure for more information