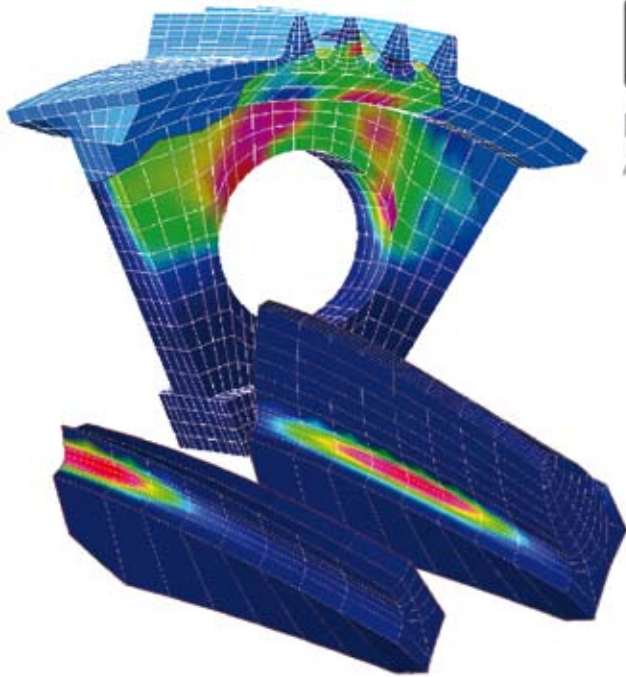


# SIMPACKNews

VOLUME 12, FIRST ISSUE

APRIL 2008



## The FVA Chooses SIMPACK as Common Multi-Body Solution

The FVA, Forschungsvereinigung Antriebstechnik (Research Association for Drive Technology), under whose direction such programs as RIKOR, STplus and DRESP have been created, has now chosen SIMPACK as the common platform for their multi-body related activities in research and software development.

### THE FVA

The FVA, originally founded by eight German industrial companies over 40 years ago, today brings together the knowledge and expertise of more than 180 commercial companies and 40 research institutes throughout Germany. All corporate members are involved in the production of drivetrain components, systems and accessories.

Through collaborative research in drive technology the FVA enables participants to improve their technical know-how and product quality on the international market. Research activities are coordinated by the scientific advisory council of the FVA which consists of industrial representatives. Currently around 90 research projects are in progress. All members have access to the results and findings of the collective research.

The FVA's activities are not limited to the generation of research reports but also include the development of technical software which is used by the members for research and design.

Some of the most well known software tools are, for example, the tor-

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sional vibration software DRESP and the gearwheel calculation programs RIKOR, STplus and BECAL.

Lutz Mauer, INTEC GmbH  
Steven Mulski, INTEC GmbH



Fig. 2: The Contractors Norbert Haefke and Lutz Mauer



Fig. 3: FVA SIMPACK Training

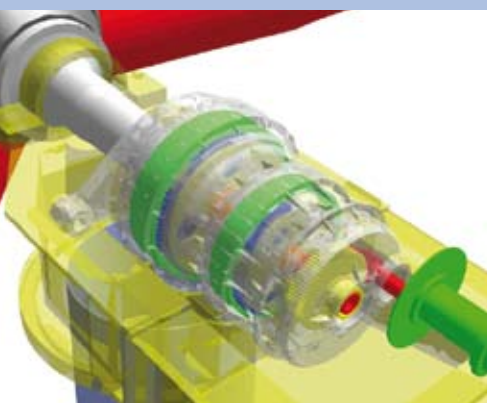


Fig. 4: SIMPACK Driveline Model  
(Courtesy of TU-Dresden, IMM)

## NEW REQUIREMENTS

Due to the continually increasing complexity of drive systems which has also resulted in higher requirements for analysis and optimisation, the need for multi-body system (MBS) simulation has arisen. Particularly when the analysis of the complete system is to include three dimensional effects, the use of MBS simulation becomes essential.

An MBS simulation program has the added benefit of being a good platform for integrating specialised drivetrain software. This enables software development from different research locations to be easily implemented into one common tool.

In 2006 the FVA started the project MBS-Study. Using four academic institutes and member surveys, future MBS solutions were investigated.

## THE DECISION

After careful consideration, and a market analysis of commercially available tools, the FVA task group came to the decision not to develop an FVA specific MBS tool due to large time and cost requirements.

After a detailed evaluation of seven commercially available software tools, the decision was taken to use SIMPACK as the MBS platform for all new relevant MBS software development. All regular FVA members and research bodies will now have access to SIMPACK's Pre- and PostProcessor as well as SIMPACK's powerful solver for future research and analysis.

## SIMPACK

SIMPACK software is built upon the state-of-the-art methods and software technology. The equations of motions are generated using minimal coordinates which enables the solver to be accurate, fast and robust.

SIMPACK's solver is therefore particularly ideal for the analysis of complex models which contains rotating components and high frequency contents, as is the case with drive systems.

## THE FUTURE

With the successful conclusion of the cooperation negotiations, of SIMPACK within the FVA is wide open. The new FVA logo indicates the dynamic and goal orientated steps now taken by the FVA.

SIMPACK's already leading position in the three dimensional simulation of drivetrains in the commercial sector is now further fortified by the decision of the FVA. Some future developments of the FVA are expected to be integrated into SIMPACK as standard elements, enabling access to non FVA members and therefore further increasing SIMPACK's position on the worldwide market.

## ON THE WEB

Info about FVA and FVA Members:  
<http://www.fva-net.de/>  
(Mitgliedsfirmen=Members)

Alexander Eichberger,  
INTEC GmbH

# INTEC Established its First Office in North America

Due to the growth rate consistently exceeding 25% per year, INTEC GmbH has decided to boost SIMPACK's international presence and worldwide support. The huge success of SIMPACK in automotive, engine, rail, wind turbine and land machinery engineering in Germany is the perfect foundation on which to bring the world leading multi-body simulation software to engineers in North America.

To ensure quick reaction times and a short distance between our customers and our development and technical expertise, INTEC GmbH has founded a subsidiary in the United States of America.

The INTEC Group now consists of five members: INTEC GmbH, INTEC Japan K.K., INTECFrance S.A.S., INTECDynamics Ltd (UK) and INTEC US Inc.

## INTEC US INC.

North America, alongside Europe and Japan, is one of the most vital markets for multi-body simulation. The "Big 3" and locally settled German and Japanese auto makers, along with first tier suppliers, ensure a highly competitive environment where new leading edge technologies will decide on sustainable future success. This also holds true for the drive and power train industry. In addition, completely new branches like the wind turbine industry are evolving rapidly in the US.

In Europe, INTEC considerably benefited from a consequent focus on function

and technology in the development departments of premium companies in the automotive, truck and drive train industry replacing many licenses of competitive MBS codes with SIMPACK. We expect the same technology push in the US. Consequently the time was right to establish INTEC US Inc.

A big win for INTEC was the acquisition of a profound expert in the worldwide business of multi-body simulation: Bob Solomon.

Mr. Solomon is now the US country manager and president of INTEC US Inc. He has gathered more than ten years experience in the field of multi-body simulation. In addition to having been the product manager for a competing MBS software, Bob was also responsible for many premium key accounts in the automotive and aerospace industry all over the world.

INTEC US Inc. is located at the International Center for Automotive Research (ICAR), Clemson University's research park near Greenville, South Carolina ([www.clemson.edu/autoresearch](http://www.clemson.edu/autoresearch)).

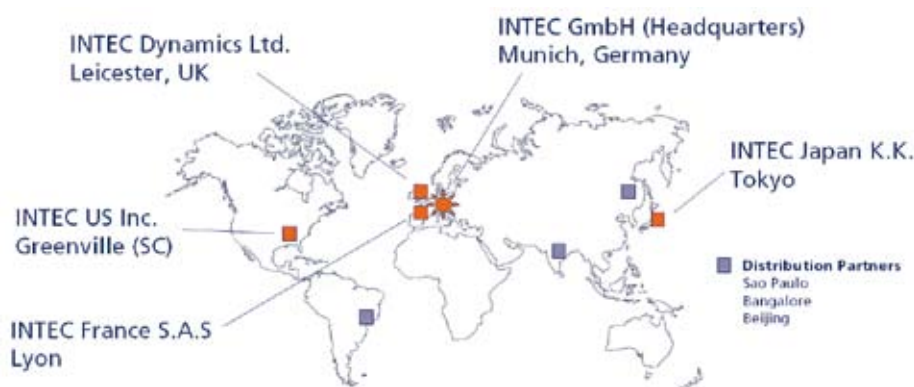
The main reason INTEC has chosen Greenville, as opposed to Detroit, is in order to be a part of the advanced vehicle research facility ICAR. In addition to donating the SIMPACK software for use at ICAR's graduate school of automotive engineering, INTEC is providing training and internships for students.



Fig. 1: From Right to Left:  
Alexander Eichberger  
Bob Solomon  
Imtiaz Haque  
Steven Mulski



Fig. 2: Alexander Eichberger  
Presenting at ICAR



Daniel Kaufer,  
Universität of Stuttgart, Germany

## Aeroelastic Simulation of Wind Turbines by Coupling a Free Vortex Wake Model with SIMPACK



The component most responsible for downtime is the gearbox. Furthermore, gearbox replacement and lubrication account for 38% of the parts cost for the entire turbine system. This calls for the implementation of new and advanced simulation techniques to be integrated into the gearbox design process so that they can meet their design life. There has been an incredible increase in the development of wind turbines during the last 50 years. The machines have developed from 34 m rotor diameter 100 KW machines to today's 120 m rotor diameter 6 MW machines. The speed of the scale-up has had a strong impact on the design process of these machines.

in the field of intelligent grids, energy in the built environment, solar energy, wind energy, biomass, hydrogen and clean fossil fuels. The ECN wind department will provide the Aerodynamic Wind turbine Simulation Module (AWSM), which is developed by Arne van Garrel [1] for the project.

### THE AERODYNAMIC CODE

The idea is to develop a more realistic aerodynamic simulation code when compared to the standard BEM codes in use today. Special attention is directed to the wake physics, an important aspect of wind turbine load simulation. By these shortcomings in the modelling of e.g. yawed inflow, aerodynamic effects at the blade tip and root can be overcome. AWSM is based on the nonlinear lifting line vortex wake theory. A major assumption is that the lift, generated by a lifting surface, is modelled through vortex rings, which act at the quarter chord line of the blade. One vortex ring is applied to one blade stripe. The strength of each vortex ring is determined by the local onset velocity vector. The simulation is restricted to slender and planar or slightly curved blade geometries, which do not comprehend strong radial flow interactions. Viscosity effects are taken into account by the user assumed lift, drag and pitching moment coefficients and are a function of the local flow direction.

There is a need of more accurate simulation tools which fully consider the interaction of aerodynamics and structural dynamics. Different tools already exist, but they are usually based on the fast but simple Blade-Element-Momentum theory (BEM) and use very few modal degrees of freedom. The coupling of a free vortex wake module and a multi-body-simulation code is the next logical step to improve the accuracy of aeroelastic simulations.

### THE INVOLVED INSTITUTES

The project is coordinated by the Endowed Chair of Wind Energy (SWE) at the Universität Stuttgart, Germany, and the Energy Research Centre of the Netherlands (ECN). The SWE is Germany's first dedicated research chair in wind energy. The main research field of the SWE is the system characterisation of wind turbines. The main fields of expertise are structural dynamics, load monitoring, control and operation of onshore and offshore wind turbines and composite materials. Among other projects, the SWE is supporting INTEC in developing new SIMPACK Wind functionalities. ECN is the research centre of the Netherlands dealing with renewable energy sources and is located in the north of the Netherlands. ECN carries out research

Incompressible flow is assumed since the velocities are much smaller than the speed of sound. Thickness effects are not modelled so that the flow field is only determined by the vortices and the wind speed. A sketch of the situation is displayed in Fig. 1. The geometry of the wake is determined by the time stepping method. At every time-step, the last calculated vortex rings flows off the trailing edge of the blade stripes. The wake sheds are connected at the corner points and are transported by the wind speed and the induced velocities of every vortex ring. This procedure enables the roll-up effect of the wake.

Blade and Wake Representation  
- Neglecting Thickness effects

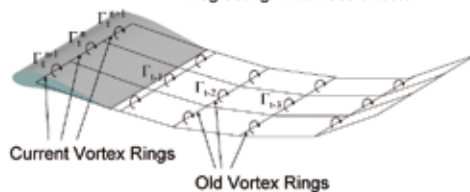


Fig. 1: Vortex Ring Distribution



Fig. 2: Wind Turbine at ECN

## THE WIND TURBINE MODEL

The 1,5 MW reference wind turbine was taken from the National Research Energy Laboratory (NREL). Within SIMPACK, this model consists of the tower, the nacelle with the gearbox, high speed and low speed shaft, the generator and the rotor.

The three blades and the tower are modelled with the SIMPACK FEMBS module as finite beam elements. For the soft blades, 37 segments are used. The structural properties (i.e. the blade and the tower eigenfrequencies) are very close to the reference data. The largest differences appear in the 2<sup>nd</sup> eigenfrequency in fore-aft direction of the tower, but this can partly be traced back to the rough discretisation of the tower, only input data for four elements was available. The SIMPACK model is shown in Fig. 3. The aerodynamics are represented by the tilted and pitched rotor only. Thus, no tower effects are included so far. The lifting surfaces are separated into parts and segments and are constructed by the use of leading and trailing edge points. The structural motion is defined by the user given time series or, in case of the coupling with SIMPACK, by generating "snapshots" at each communication time.

## THE COUPLING STRATEGY

The designed coupling [2] between both codes is completely independent of the input data (i.e. number of blades, number blade cross sections etc.). AWSM is coupled to SIMPACK by means of a force element User Routine. A serial coupling is implemented for the data transfers. All geometry information is then delivered to AWSM (i.e. rotation angle, pitch angle, deformations) and AWSM returns with the calculated local forces and pitching moment.

## RUNNING A SIMULATION

Two initial conditions are important to perform successful simulations. The first condition is the equivalence of

the modules in SIMPACK and AWSM because separate input files have to be created, followed by the demand of corresponding solver parameters for the communication.

In the consequence of developing the coupling, the generator model has two modes to dramatically reduce the simulation time: It can be used either as a driving motor or as an actual generator. Simulations are performed from idle and motor mode in order to help to accelerate the wind turbine rotor. At a certain rotation speed it is switched to the generator mode and operates normally. With this possibility, steady runup phases can be simulated and a simulation time of 15 s is enough to reach a static stationary rotation speed. In Fig. 4 an exemplary coupled simulation over 24 s is displayed. The picture shows the wake transport behind one rotor blade and the deformed blades are also visible. The wind is streaming from left to right. The wind turbine starts from hole-up and the generator is allowed to accelerate the system. The computational time depends on the solver parameters, especially the aerodynamic part, and can vary between five minutes and several hours for twenty seconds of the simulation time. Very precise parameters are used in the case of Fig. 4. Strong roll-up of the wake was allowed.

## RESULTS AND PROSPECT

The coupling project was successful and aeroelastic simulations are possible with AWSM coupled to SIMPACK. However, different improvements could be implemented. For instance, the SIMPACK model could be extended with the pitch-controller and the SIMPACK rotor blade generator could be used to generate various blades.

Within AWSM, the most important issue is introducing a standard turbulence model for the simulation.



Fig. 3: SIMPACK Model

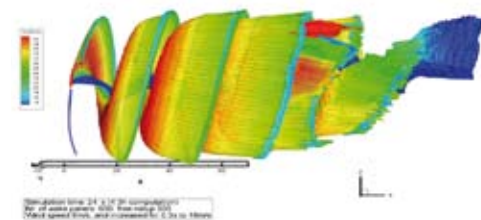


Fig. 4: : Results of Coupled Simulation

### » LITERATURE:

- [1] Garrel, A. v.: "Development of a wind turbine aerodynamics module", Report ECN-C--03-079, ECN 2003
  - [2] Kaufer, D.: "Coupling a Free Vortex Wake Model and a Multi-Body-Simulation Code for Aero-Elastic Simulation of Wind Turbines", Student Thesis, 12/2007, SWE/AG -Universität Stuttgart
- Further information:  
[www.uni-stuttgart.de/windenergie](http://www.uni-stuttgart.de/windenergie)

Steven Mulski, INTEC GmbH  
Rainer Keppler, INTEC GmbH

## Code Export Excel Plug-In



Fig. 1: Title Page to Carry out Simulations

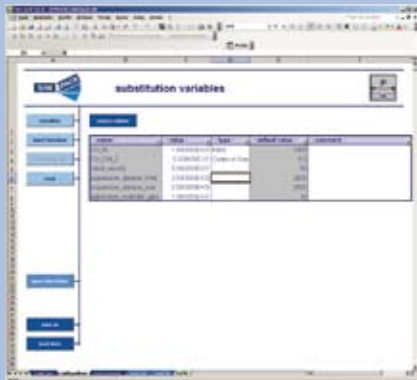


Fig. 2: Parametrisation of Substitution Variables

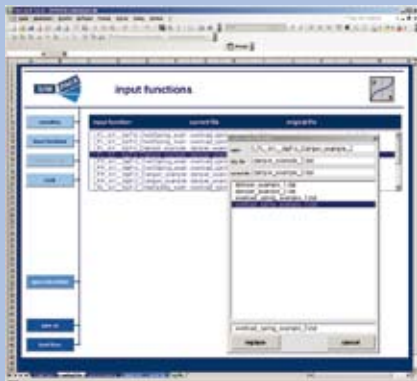


Fig. 3: Parametrisation of Input Functions

SIMPACK Code Export has been extended with the ability to automatically generate model specific user interfaces for Microsoft Excel. Users can now configure models, run simulations and postprocess results all within the Excel environment. With this functionality, SIMPACK has now opened the door for non-multi-body experts to work with complex SIMPACK models.

The computer on which the exported model is executed does not require an entire SIMPACK installation but only the directory structure generated by the export process. In addition, only the code execution and SIMPACK solver licenses are required during runtime. Simulation results can be plotted directly within the Excel Plug-In. For animations, if required, the free-of-charge SIMPACK Viewer may be used. Additionally the SMPACK PostProcessor can be used for full postprocessing capabilities. Users of the Excel Plug-In only have access to parameters and files specifically made available by the SIMPACK user who originally exported the model, thus ensuring model integrity.

The Excel Plug-In capability is shipped and licensed as part of the standard SIMPACK Code Export.

### WHAT PROMPTED THIS NEW DEVELOPMENT?

For years now SIMPACK has been leading technology in the field of code export. User created SIMPACK models can be exported as either C or Fortran code for use within external environments. Up until now exported models have been primarily used as SIMULINK plug-ins for use in Software-in-the-Loop (SIL) or Hardware-in-the-Loop (HIL) applications. Currently customer real-time models have around 140 degrees of freedom with frequency content of up to 20 Hz (sampling rate 1 ms).

Several years ago a SMPACK user who needs to simulate a vast amount

of vehicle variations with many standard manoeuvres realized that SIMPACK Code Export could also be used in combination with model specific user interfaces (MAN Nutzfahrzeuge AG, "The Easy-to-use Steering Design Tool SimuLENK as an Application of SIMPACK Code Export", [www.simpack.com](http://www.simpack.com), software/publications/User Meeting 2006). With this functionality in Excel, trained and proficient SIMPACK users are no longer required for running and analyzing this vast amount of variations. Human resources can be more efficiently utilised.

INTEC quickly realized the potential of this functionality and has therefore created a simple and automated method suitable for all SIMPACK users, the Code Export Excel Plug-In.

### WHY EXCEL?

Microsoft Office products, especially Microsoft Excel, have become more or less standards within the worldwide engineering community. Because of Microsoft Excel's widespread use and ability to modify parameters, carry out calculations, plot results and set cell protection, Microsoft Excel was the obvious choice for model specific graphical user interfaces.

### THE USER INTERFACE CODE EXPORT TITLE PAGE

From the title page (Fig. 1) a user may edit the simulation parameter (e.g. time and output stepsize) and run simulations. During simulations the progress and status of the solver run is shown on screen.

The page also contains information concerning the creator of the Excel Plug-In, creation date and SIMPACK version used to export the model. Full documentation on the Plug-In may also be accessed. An editable comment field for the user is also available at the bottom of the page.

## PREPROCESSING

A configuration page (Fig. 2) offers the possibility to modify values of substitution variables, exchange Input Functions, Function Arrays and Track files from local database.

The Substitution Variables, which were selected to be available in the exported code, are listed in a table. From here the values may be changed and the corresponding parameter type (e.g. mass, length, etc.) and additional comments entered. All columns of the table can be filtered by Excel standard features for column operations. Parameter configurations, together with simulation results, can be saved and later selected. Furthermore, an information folder can be accessed on the configuration page, where additional information such as model contents, pictures, documentation files, etc. can be stored.

All Input Functions and Function Arrays used in the model are listed in a table containing the SIMPACK name of the function element, the corresponding file name and the original file (Fig. 3).

A double click on an Input Function opens a dialog window of all available Input Functions, from the local database, from which any may be selected. A similar table is used for selecting track files (Fig. 4).

## POSTPROCESSING

All output results, defined y-output vectors in original SIMPACK model, may be viewed as Excel plots within the postprocessing page (Fig. 5). The page is accessed either by selecting the "view results" button on the title page or through the page tabs on the bottom of all pages. Results and plotting configurations can also be saved and selected. The "get current results" button reloads the latest results. With "create diagram sheet" a new page is opened containing the plot of the

selected curve and enables the usage of all features of Excel's plot functionality.

If necessary, the animations may also be viewed using the SIMPACK Viewer (Fig. 6). If more detailed postprocessing is required, and the corresponding SIMPACK license is available, the SIMPACK PostProcessor may also be used.

## EXCEL PLUG-IN USAGE

By no means is the Excel Plug-In limited to only automotive applications. The functionality may also be applied to almost any SIMPACK model, regardless of the engineering discipline (e.g. wind turbines, general machinery, etc.).

The Excel Plug-In may also be used as a tool in academia to help students get a better understanding of the principles of mechanical vibration.

We are all enthusiastically looking forward to seeing not only the number of users of the Excel Plug-In over the next few years but also the wide range of applications to which the Excel Plug-In is applied.

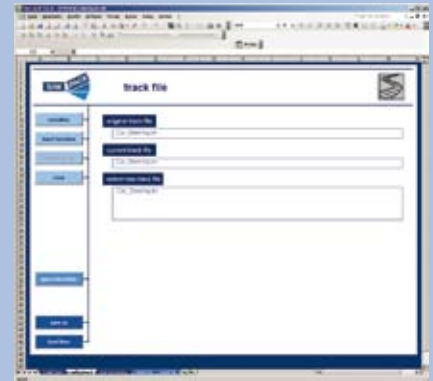


Fig. 4: Parametrisation of Track Files



Fig. 5: Postprocessing, Plot Contents of Y-Output Vector

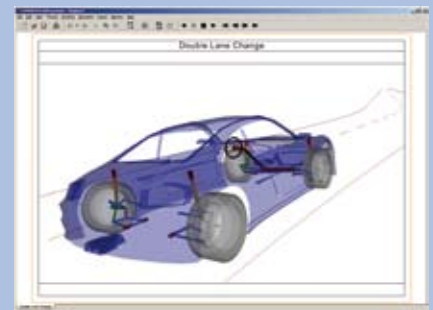


Fig. 6: Postprocessing, Animate Results with SIMPACK Viewer

# SIMPACK 8.9 – New Functionality

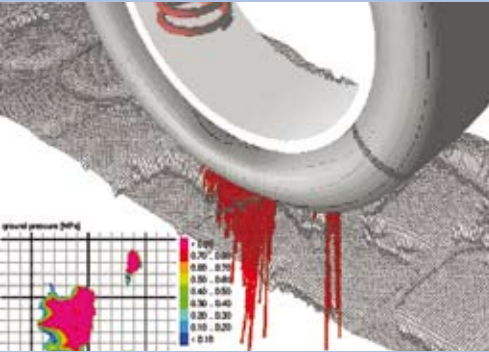


Fig. 1: FTire



Fig. 2: Silent Chain

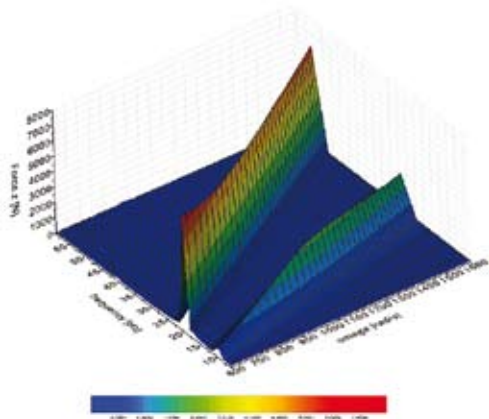


Fig. 3: 3D Plot

SIMPACK Version 8.9 comes with a rich set of new functionality as well as many improvements to existing modules. New products such as the rotor blade generator, for SIMPACK Wind, the SIMPACK Excel Plug-In and the SIMPACK Viewer are accompanied by many enhancements to existing functionality. With version 8.9 there is a significantly increased solver speed, a 3D plotting environment, flexible body stress contouring, a completely redesigned SIMPACK Rail, an new installer and a powerful new licensing environment.

## GENERAL ENHANCEMENTS

An new installer is now available with version 8.9 which significantly simplifies the installation process and user configuration. The new installer is a single self extracting executable, used for all platforms supported by SIMPACK. Installations can be performed from within a GUI or a command line, which is especially suited for rolling out SIMPACK in large installation bases. Both local and server installations are supported.

With OLicense INTEC is introducing a new and powerful licensing suite into SIMPACK. OLicense can be easily administrated via a web frontend. Because OLicense operates on the http web protocol, seamless integration into corporate networks is possible. License borrowing is now available. Via U3 USB sticks a preinstalled plug and play license server can be shipped which does not require installation. Of course traditional licensing based on classic hardware IDs in single or highly redundant server setups are possible as well.

With OLicense INTEC can now offer SIMPACK users and administrators a highly flexible, customizable and transparent licensing system.

## SOLVER NEWS

SIMPACK has always been known for outstanding solver robustness and

solver speed. With SIMPACK 8.9 INTEC has significantly increased the performance of all integrators available in SIMPACK whilst still retaining SIMPACK's renowned accuracy.

Highly optimized matrix operations, a fine tuned Jacobian evaluation scheme and specific optimizations for state-of-the-art INTEL and AMD processor architectures along with a 64 bit version of the solver, lead to performance gains of 1.5 - 3 compared to SIMPACK 8.8. The speedup was seen with models encompassing the entire SIMPACK application range. Even greater benefits can be seen for models containing a large number of states or with 64 bit solver executables. An all new SODASRT 2 integrator has now been implemented which is the successor to SIMPACK's robust and proven SODASRT. The user can now specify an output file path and split large result files.

## FLEXIBLE BODIES

SIMPACK 8.9's PostProcessor can calculate, plot and animate stress in combination with ABAQUS, ANSYS and NASTRAN. Export to the durability software FEMFAT-Max is also now part of the PostProcessor. Stress and durability calculation can be used both in combination with the scripting environment or from a command line. Memory usage could be significantly reduced for flexible bodies which do not contain geometric stiffening, thus enabling a significant increase in the number of represented modes. NASTRAN plot elements can now be visualised in SIMPACK's PostProcessor which enables a lightweight flexible body representation. The NASTRAN DMAP functionality is no longer required to prepare the finite element models for SIMPACK. Instead, standard NASTRAN super element techniques may be used. An improved representation of centrifugal forces of flexible bodies at high revolution speeds has been added to the NASTRAN interface.

With SIMPACK 8.9 the actual cross section of SIMBEAM models can be visualised along with displacement contouring if desired.

## AUTOMOTIVE

With SIMPACK 8.9 automotive users can now use a 3D triangular road surface description, ideal for off-road vehicles. Many enhancements to the FTire interface have also been implemented.

## ENGINE

New primitives have been added, enabling quick and easy 3D representation of the individual components, e.g. engine blocks, crankshaft, connecting rods, valves etc. Also two new chain types have been added, the silent (toothed chain) and the SMART chain, which minimises the polygonisation effect. The New IST Tower Version 6.5 for modelling EHD elements has now been implemented. Also advanced modes for the hydraulic lash adjusters (HLA) and chain tensioners are available.

## RAIL

SIMPACK 8.9 is the first release that comes with the redesigned SIMPACK Rail functionality. The main feature is a fast and reliable calculation method for the contact between rail and wheel. The so-called "equivalent-elastic contact" has been implemented in close collaboration with the wheel-rail contact specialist ArgeCare. The new SIMPACK Rail provides an easy-to-use handling of all contact related data and much more flexibility with respect to the kinematic tree, e.g. for independent and resilient wheels. The nearly unrestricted use of Substitution Variables and Substructures allows a clear distinction between vehicle model and simulation scenario. Moreover, the all new internal design allows easy maintainability and extendibility of the contact algorithms.

## WIND

The new rotor blade generator for SIMPACK Wind users is now available. Using simple input tables, flexible rotor blades can be automatically generated which include a three dimensional representation.

Either a "Simple" or "Sophisticated" blade, which includes bend-twist coupling among many other terms, can be easily created. Non-linear bending, geometric stiffening, and shear bending may also be taken into account.

## POSTPROCESSOR

In SIMPACK 8.9 the PostProcessor was expanded with a flexible general ASCII file import mechanism complete with a preview GUI. Readers for SIMPACK afs (array function set), if2 and su2 files and readers for standard measurement data formats .mdf and .tdm (National Instruments) expand the list of supported input data formats. Diagrams with a 1:1 axis ratio have been added, useful for displaying contact surface contours.

Both the result tree and the session tree have been extended with quick search mechanisms, especially useful for large models.

## 3D PLOTTING

Plotting complex 3D simulation results, e.g. frequency and order analysis, run-up simulations, waterfall plots, Campbell diagrams and parameter variation results, is now available with SIMPACK 8.9. Multiple curves can be plotted as either several side-by-side 2D curves or a complete 3D surface. Wire frame and shaded colour contouring, stepped and smooth, are all available.

## 3D ANIMATION

Forces and torques, as well as output values of selected force elements, can now be easily visualised within the 3D animation as scaled force arrows. The desired result channels need only to be dragged and dropped into an animation cell. Overlaying animations with different result files is also now possible. For a simpler and faster navigation of the 3D scene the view handling was reworked to offer even more comfortable panning, zooming and rotating of the scene with the main advancement being an easily definable centre of rotation.

## SIMPACK VIEWER

With SIMPACK 8.9 INTEC launches the SIMPACK Viewer. The SIMPACK Viewer is a lightweight standalone tool for viewing SIMPACK results as 3D animations and curve plots.

The SIMPACK Viewer operates as a standalone application, ideal for sharing animations, as well as a plug-in for Office tools such as Microsoft PowerPoint, Excel and Word and Internet Explorer.

Since it plugs into the MS-Office environment SIMPACK Viewer is ideal for incorporating results and animations directly into presentations and documents. Animations can be visualized by simply loading an sbr file.

The SIMPACK Viewer will be available free of charge with SIMPACK 8.9.

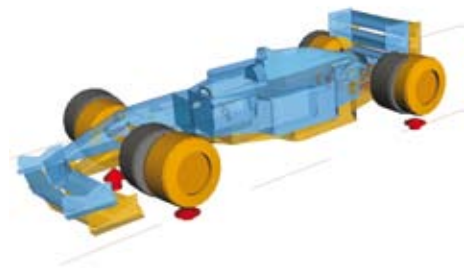


Fig. 4: Animation Overlay

# Modal Stress Recovery in SIMPACK's PostProcessor

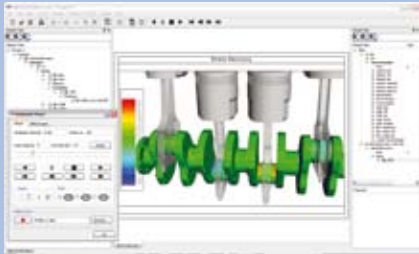


Fig. 1: Stress Contouring of a SIMPACK Crankshaft Model



Fig. 2: Export to FEMFAT from the PostProcessor

The new SIMPACK version 8.9 includes the first version of modal stress recovery. SIMPACK Stress is available in SIMPACK's PostProcessor. The stresses will be represented as contour plots vs. time.

This will help the user to:

- assess the mechanical strength of a component,
- detect the weak spots of a component under many different realistic loading conditions and
- obtain hints to improve the design.

In addition, these assessments can be achieved without transferring the results back to a finite element solver or to a finite element PostProcessor, for example by identifying critical loads or critically stressed spots in SIMPACK's PostProcessor, see Fig. 1 and Fig. 3.

When the critical loading conditions have been identified, the corresponding data may be exported to the durability software FEMFAT-MAX where the safety factors and the damage factors of the component are to be calculated. The export to FEMFAT is available either in the PostProcessor, see Fig. 2, or in the case of automated calculations as a command line call.

Since stress recovery in SIMPACK is based on a modal approach, the PostProcessor requires modal stresses that are to be calculated by a finite element code.

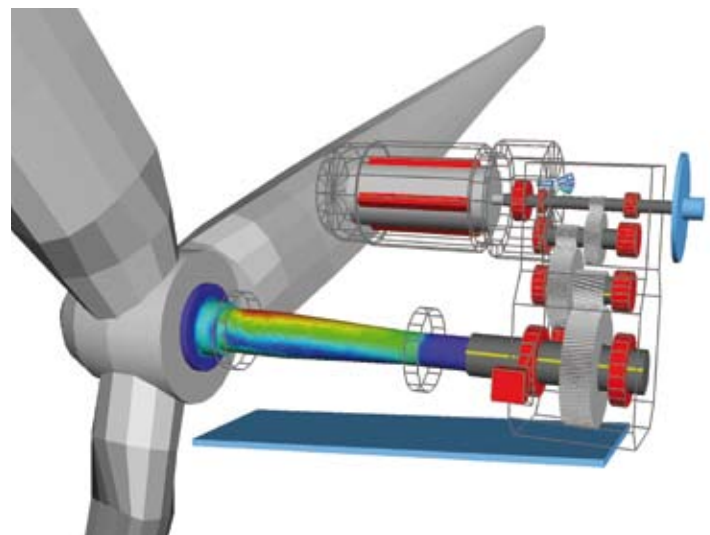
The input data for the calculation of the modal stresses is automatically generated in SIMPACK prior to the time integration in the measurement configuration. SIMPACK currently supports the finite element codes ABAQUS, ANSYS, NX NASTRAN and MSC.NASTRAN. When the calculations of the modal stresses are finished, SIMPACK's time integration and measurements should be started.

As a result the user obtains the time series of the scaling factors of the modal stresses. These are stored in an extra SIMPACK binary result file for stress recovery.

This file also includes references to the results of the finite element analyses. Before the stress recovery sbr-file is written, the normal modes used for the modal stress calculations are compared with the corresponding normal modes in the current SID file by the modal assurance criterion (MAC matrix). If necessary, the time series of the modal stresses are adjusted automatically. To see the contour plots of the stresses, load the stress recovery sbr-file into the PostProcessor, drag the body into the animation page and select stress contouring and the stress component to be displayed in the property dialog of the animation page.

The first part of the functionality includes the generation of data for stress recovery in combination with the connected FE-tools, stress contouring in the PostProcessor as well as 2D plots. The second part of the stress recovery connects the PostProcessor to durability tools such as FEMFAT-MAX.

Fig. 3: Customer Model, Komai Wind Turbine



# SIMPACK Events

## SIMPACK ACADEMY COURSES 2008

11<sup>st</sup> to 13<sup>th</sup> June 2008 (Location: Schlossgut Gross Schwansee):

### *Wind Turbine Dynamics and Design*

Part 1: Fundamentals and System Design of Wind Turbines (1,5 days)

Part 2: Design and Analysis of Drive Trains in Wind Turbine and other large Industrial Applications (1,5 days)

10<sup>th</sup> and 11<sup>th</sup> July 2008 (Location: La Villa):

### *FEM-MBS-Interfacing*

9<sup>th</sup> and 10<sup>th</sup> September 2008 (Location: La Villa):

### *MBS Numerics*

#### Schlossgut Gross Schwansee

Am Park 1  
23942 Gross Schwansee  
Germany  
[www.schwansee.de](http://www.schwansee.de)

#### La Villa

Ferdinand-von-Miller-Straße 39-41  
82343 Niederpöcking  
Germany  
[www.lavilla.de](http://www.lavilla.de)

## SIMPACK TRAININGS

We also offer several SIMPACK Training Courses during the whole year. Please find more information about SIMPACK Trainings on our website [www.simpack.de](http://www.simpack.de).

### NEW TRAINING

#### SIMPACK Drivetrain Training

Due to the huge success of SIMPACK in the area of drivetrain simulation, INTEC GmbH is now offering a one day drivetrain course as a standard training.

Please note that this training is currently listed as a "SIMPACK Gearwheel Training" on our website. The first drivetrain training has been held on the 21<sup>st</sup> of April. The next drivetrain training will be held on the 24<sup>th</sup> of July. If you are interested in this training please contact us.

The SIMPACK Drivetrain training has been tailored for anyone who is interested in simulating and analysing drivetrains. The training is suitable for all application areas, e.g. automotive, railway, wind turbines, general machinery, etc. Components and elements necessary for modelling all levels of drivetrain complexity, from simple torsional models to detailed 3D models including flexible bodies are covered. Also the various excitation mechanisms and analysis methods available within SIMPACK will be reviewed.

A prerequisite for attending the drivetrain training is a fundamental understanding of SIMPACK which can be obtained by attending the SIMPACK Basics training. Having previous experience with flexible bodies in SIMPACK is also recommended.



Schlossgut Gross Schwansee



La Villa

## CONTACT

### » WORLDWIDE HEADQUARTERS

INTEC GmbH  
Argelsrieder Feld 13  
82234 Wessling  
Germany  
Tel. +49 - 8153 - 9288 - 0  
Fax +49 - 8153 - 9288 - 11  
intec@simpack.de  
www.simpack.com

### » JAPAN

INTEC Japan K.K.  
5F Okubo Bldg.  
2-4-12 Yotsuya,  
Shinjuku-ku,  
Tokyo 160-0004, Japan  
Tel. +81 - 3 - 5360-6631  
Fax +81 - 3 - 5360-6632  
intec@simpack.jp  
www.simpack.jp

### » USA

INTEC USA  
5 Research Drive  
Greenville, SC 29607  
USA  
Tel. +1 - 888 - 899 - 8565  
Fax +1 - 864 - 283 - 7125  
robert.solomon@simpack.com  
www.simpack.com

### » GREAT BRITAIN

INTEC Dynamics Ltd.  
Cambridge Road Industrial Estate  
Whetstone  
Leicester LE8 6LH  
UK  
Tel. +44 116 275 1313  
Fax +44 116 275 1333  
suresh.gupta@intecdynamics.co.uk  
bjorn.vanuem@intecdynamics.co.uk  
www.simpack.com

### » FRANCE

INTEC France SAS  
1, Boulevard Vivier Merle  
69443 Lyon Cedex 03  
France  
Tel. +33 - 426 29 85 40  
Mobile +33 - 673 881 965  
francois.barral@simpack.fr  
www.simpack.com

### » BRAZIL

VirtualCAE  
Rua Tiradentes, 160 - Sala 22  
São Caetano do Sul - São Paulo  
CEP: 09541-220  
Brasil  
Tel. +55 11 4229-1349  
Mobile +55 11 9698-6930  
leandro@virtualcae.com.br  
www.virtualcae.com.br

### » INDIA

ProSIM R&D Center  
21/B, 1st Flr, 9th Main,  
Mahalaksmi Layout  
Bangalore 560096, India  
Tel. +91 80 233 - 79686  
Fax +91 80 235 - 78292  
shama@pro-sim.com  
www.pro-sim.com

### » CHINA

ESP  
Intelli-Center B Room 1709  
Zhongguancun East Road No.18  
Haidian District  
Beijing 100083  
P.R. China  
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82234 Wessling  
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