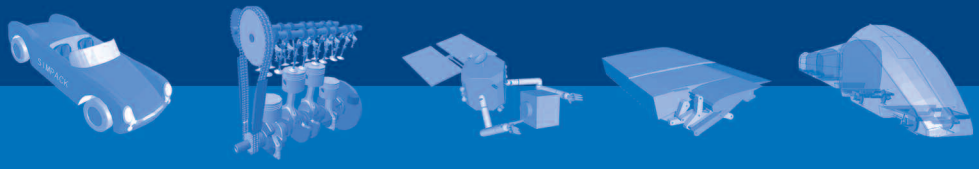
General Info for Experts



What Are You Intending To Do?

Content

Page

02 SIMPACK – What is SIMPACK?

04 SIMPACK Kinematics and Dynamics
05 SIMPACK Pre-Processing
06 SIMPACK Solver
07 SIMPACK Post-Processing

08 SIMPACK Modules:
applications and functionalities
09 SIMPACK Interfaces

10 INTEC GmbH
11 Consulting and Engineering
12 Training

What is SIMPACK?

SIMPACK is a multi-body simulation software tool used to simulate mechanical systems. The SIMPACK software is able to analyse vibrational behaviour, calculate forces and accelerations and describe and predict the motion of any complex multi-body system.

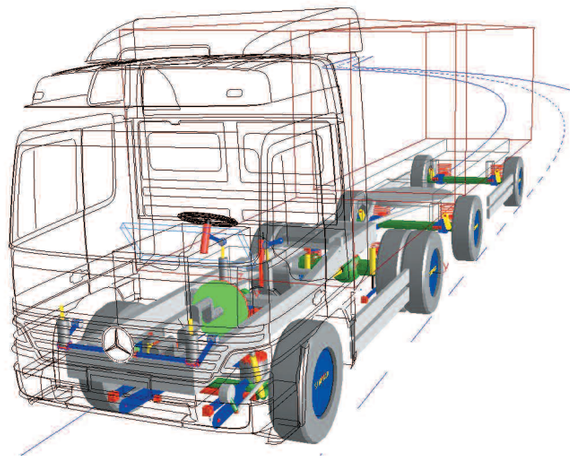
The basic concept of SIMPACK is to create the equations of motion for mechanical and mechatronic systems simply by building up a CAD style model (including joints, force elements, etc.) and then applying various calculation techniques, such as a time integration, to obtain a solution for the systems dynamic behaviour.

SIMPACK has been specifically developed to be able to simulate virtually any mechanical and mechatronic systems. From simple systems with few degrees of freedom to entire train configurations, SIMPACK may be employed at any stage of the design, development and optimisation process.

SIMPACK's fully integrated functionality for the creation and export of models in FORTRAN or C code enables a high connectivity to other simulation tools. Additionally, together with the respective specialised modelling components, the exported code allows SIMPACK models to run on many HIL platforms.

BOMBARDIER TRANSPORTATION

Courtesy of Bombardier Transportation (Switzerland) AG – Intercity Trains



DAIMLERCHRYSLER

Courtesy of DaimlerChrysler AG

SIMPACK is a multi-body system software used to simulate mechanical and mechatronic systems.

SIMPACK´s main areas of application are

- Automotive (manufacturers and component suppliers)
- Railway (manufacturers, suppliers, permanent way and operators)
- Aerospace
- General mechanical engineering
- Engine design

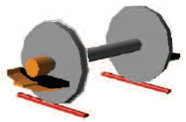
SIMPACK is faster than its closest rival and utilises the latest mathematical techniques to provide the highest degree of accuracy and reliability whilst still retaining its user-friendly qualities.

These qualities have helped in gaining a large customer base including BMW, DaimlerChrysler, Bombardier and Siemens, who have all been working with SIMPACK for a number of years.

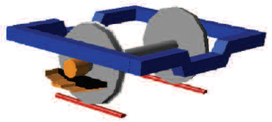
SIMPACK Kinematics and Dynamics

Step 01

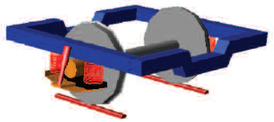
Step 02



Step 03



Step 04



SIMPACK Kinematics and Dynamics is the basic foundation of SIMPACK, with the heart of the software being SIMPACK's outstanding solver. All other modules and interfaces can be added on to SIMPACK Kinematics and Dynamics.

The General Features of SIMPACK Kinematics and Dynamics

- Basic module of SIMPACK
- Visual 3D model set-up
- SIMPACK time domain solver
- Eigenmode Analysis
- Quasi Static Solver
- Animation and plot tools
- Extensive libraries for joints, springs, dampers, friction, etc.
- Integrated data management features

SIMPACK Kinematics and Dynamics comprises the functionalities of Model Set-up, Solver and Animation/Plots.

Once a model has been created within the SIMPACK model set-up, the solver can then be used to carry out different analyses, the results of which can be animated and plotted.

SIMPACK Kinematics and Dynamics is the basic module and includes the heart of **SIMPACK** – the outstanding solver.

The Pre Processing – Model Set-up

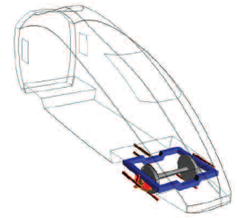
The model set-up is an easy starting point for those new to SIMPACK and, at the same time, offers complete control to advanced users.

Extensive modelling libraries are available, supporting the fast and efficient creation of a model. Any type of joint, marker or force element (standard or user-defined), can be easily incorporated within the model. Use of the mouse enables the user to work interactively with the 3D representation. This not only saves time in setting up and modifying models but also reduces modelling errors.

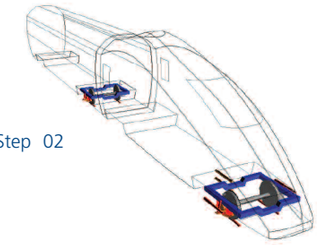
The 3D components may, as well as completely set up within SIMPACK, be created within a CAD package and then imported into SIMPACK.

Any multi-body model, once created within SIMPACK, can be exported to external environments using the add-on module CODE EXPORT. This makes SIMPACK ideal for designing actively controlled systems and for HIL and real-time applications.

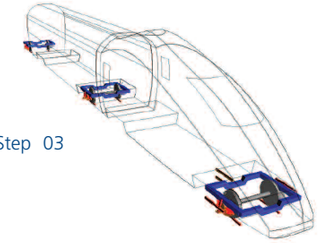
Step 01



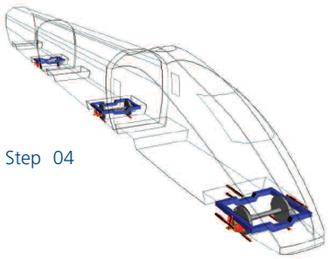
Step 02



Step 03



Step 04



SIMPACK allows a fast and efficient model set-up, helping safeguard against modelling errors.

The Solver

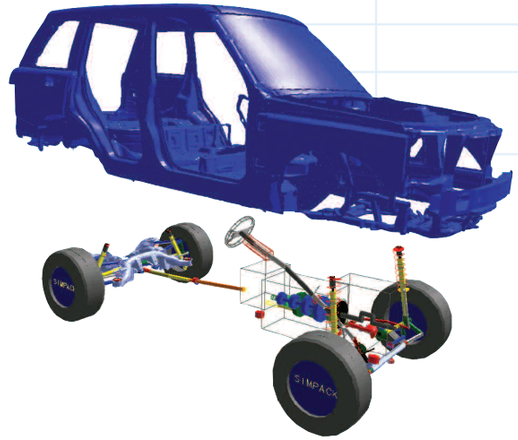
Once a multi-body model has been set-up, the solver automatically creates the equations of motion.

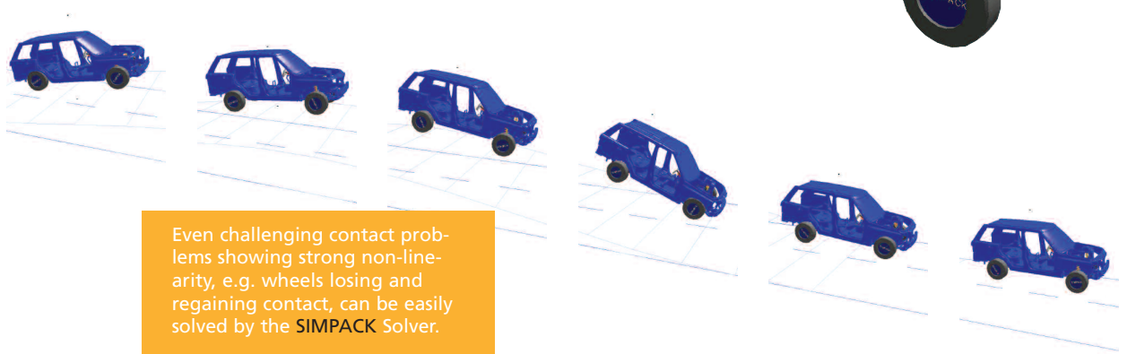
Unique algorithms are used by SIMPACK in order to generate the equations of motion. Within SIMPACK the required calculation effort is proportional to the degrees of freedom, whereas in other software this is a quadratic or even cubic relationship.

This and the high performance integration methods enable SIMPACK to minimise calculation times, whilst also being reliable and stable. This has been demonstrated in countless benchmarks and tests.

Additionally SIMPACK gives access to a large number of parameters allowing experienced users to tune the solver for complex systems.

Apart from the time integration, the SIMPACK solver also comprises of calculation methods for static equilibria, used to automatically determine pre-load forces for a given model state. The standard solver can also be used to perform an eigen-value analysis. Additional frequency domain calculation methods can be found in the SIMPACK NVH module.





Even challenging contact problems showing strong non-linearity, e.g. wheels losing and regaining contact, can be easily solved by the SIMPACK Solver.

Post-Processing: Animation/Plots

The 3D model may be easily animated within SIMPACK by using the results of an eigen-value analysis or an integration run. Specific aspects of the animation may be readily investigated using fixed and moved cameras. Furthermore SIMPACK can generate films of the animations, which are often necessary for presentations.

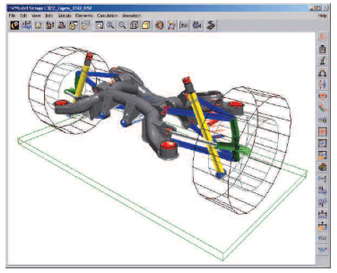
In addition to using animations for investigating dynamic or kinematic behaviour, a user may also plot or export all corresponding numerical data (e.g. ascii to excel).

Whether working within the time domain or frequency domain, SIMPACK's plot templates, along with the curve import and overlay capability, enable fast and comprehensive data comparisons.

Plot data may be further analysed by using SIMPACK's extensive library of filters and curve superposition features.

Re-running integrations are not necessary in SIMPACK when adding additional sensors to a model.

Add-on Modules



Kinematics and Dynamics is the basic module of SIMPACK.

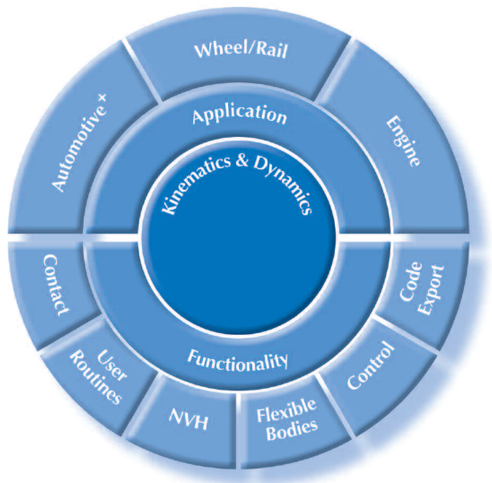
Many add-on modules are also available for special applications and functionalities.

The SIMPACK add-on modules for specific applications

- SIMPACK Automotive+
- SIMPACK Wheel/Rail
- SIMPACK Engine

The add-on modules for different functionalities

- CONTACT mechanics – enables the user to define arbitrary shaped contact surfaces and carry out a contact simulation
- USER ROUTINES – enables the user to define their own modelling elements (e.g. force elements)
- NVH (noise-vibration-harshness) – supports better simulation of high frequency vibratory systems
- SIMBEAM (flexible bodies) – enables the user to interactively create spatial, flexible beam structures directly in SIMPACK
- CONTROL – enables the user to build up mechatronic systems
- CODE EXPORT – enables the user to export SIMPACK models as FORTRAN or C code (e.g. for use in HIL systems)



SIMPACK's functionality may be easily extended with add-on modules.

SIMPACK Interfaces

SIMPACK fits perfectly into the CAE environments of CAD, FEA and CACE systems.

FEA interfaces

With the powerful FEA interface FEMBS, SIMPACK has the reputation for being the technological leader for the integration of flexible bodies into a multi-body software.

SIMPACK's FEA interfaces can import flexible parts from any of the leading FEA tools. Unique features are offered to adapt the flexible body to its mounting conditions in the multi-body system and to guarantee extremely time efficient simulation, even for large structures such as car and railway vehicle bodies.

CAD interfaces

Once created, CAD data can be easily incorporated into a SIMPACK model.

With its CAD interfaces, SIMPACK is linked to the main data source of today's industry and likewise makes SIMPACK's outstanding solver available to CAD designers.

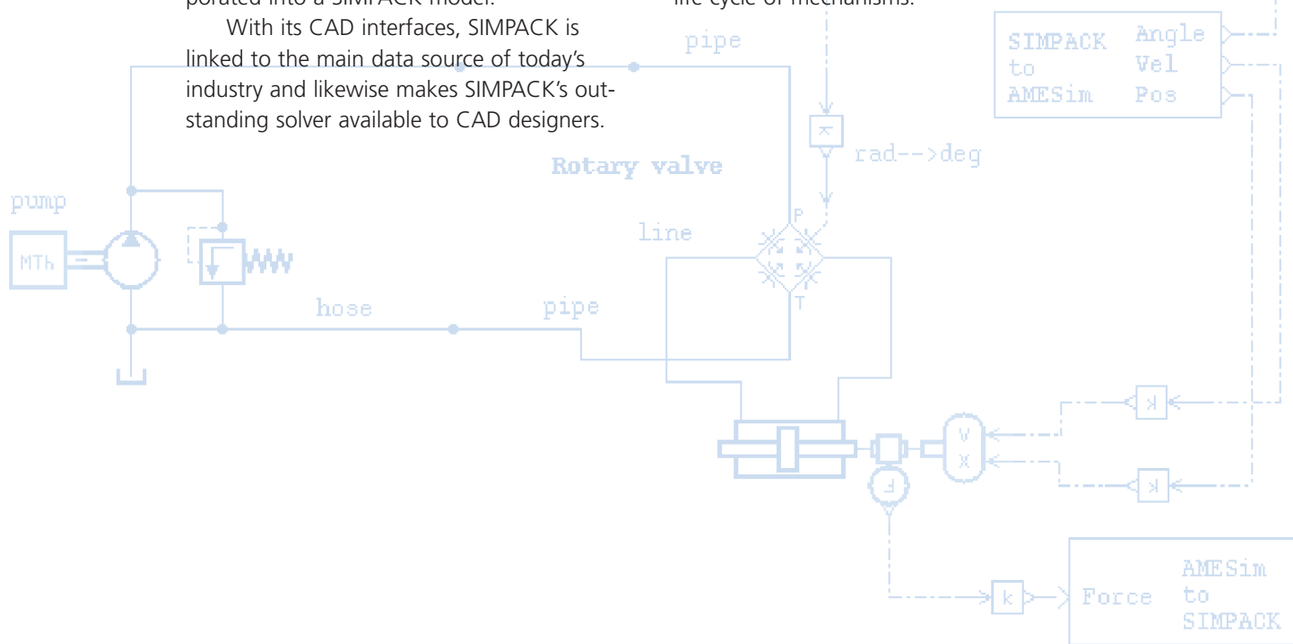
CACE interfaces (Matlab Simulink)

With SIMAT and MATSIM suitable interface technology is offered for any mechatronic simulation task. SIMPACK models may be exported to MATLAB or MATLAB models may be exported to SIMPACK (using the Realtime Workshop). Additionally the benefits of both solvers may be used in conjunction via co-simulation.

The previous missing link between Simulink and FEA/CAD data may now be realised by SIMPACK.

Interface to durability programs

For durability simulation using multi-body, FEA and fatigue simulation, SIMPACK offers leading edge interface technology that supports the challenging task of predicting the life cycle of mechanisms.



INTEC GmbH

INTEC GmbH is the company which develops and markets SIMPACK.

Along with the SIMPACK software suite and software training courses, consulting and engineering is also offered.

INTEC GmbH provides maintenance services, comprising of SIMPACK upgrades as well as dedicated hotline and support services.

One of INTEC's key priorities is to give SIMPACK users the best support possible. The hotline team prides itself in assisting SIMPACK users.

There is even a project room available at INTEC GmbH, which can be used by customers who would like comprehensive support from the INTEC staff.

INTEC (as spin-off from the DLR) was founded in 1993 by Dr. Alex Eichberger to offer software and engineering services to meet the industry demands on multi-body simulation.

1996 Dr. Lutz Mauer, a respected expert in railway engineering, joined the executive board and the company changed its legal status to a limited liability company, a GmbH. SIMPACK WHEEL/RAIL and AUTOMOTIVE^{+} opened the door for INTEC to the rail and automotive industry.

1998 SIMPACK went on the international market with licences being sold in Korea, England, Japan and USA.

INTEC has now become the market leader in the field of railway simulation.

Consulting and Engineering

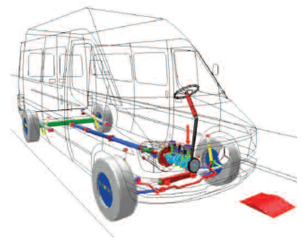
INTEC's Consulting Services Group provides a wide range of engineering services to help you implement multi-body simulation for developing better products. Typical project areas are

- Customisation of SIMPACK
- Creating SIMPACK models according to customer specification
- Problem solving
- Complete engineering projects
- Basic research in the field of multi-body simulation

The prices for engineering or consulting tasks are based on the complexity of the project and are evaluated on a project-by-project basis.

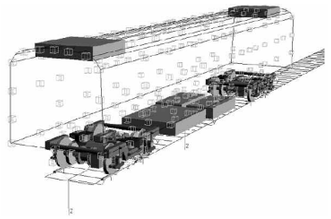
INTEC prides itself in offering the best possible consulting and support.

Creation of a complete vehicle model with flexible components



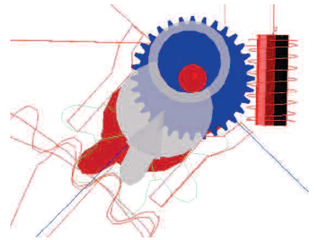
Courtesy of DaimlerChrysler

Model Databases for railway systems



Courtesy of Siemens AG

Planar Kinematic Mechanisms



Training Courses

INTEC GmbH offers various training courses ranging from SIMPACK beginner courses to expert user courses concentrating on specific functionalities.

SIMPACK Basics training is the first step in getting to grips with the functionality of SIMPACK and is a prerequisite for further training courses.

Application Training Courses
- SIMPACK Automotive+ Training Course
- SIMPACK Wheel/Rail Training Course
- SIMPACK Engine Training Course

Specialist Training Courses
- User Routines Training Course
- Contact Mechanics Training Course
- NVH Training Course
- Code Export Training Course

Training Courses for the Use of Interfaces
- Simulink Interfaces Training Course (SIMAT, MATSIM)
- FEMBS Training Course

INTEC GmbH, Wessling

If you would like additional information or brochures please contact us or visit our website at **www.simpack.com**.

INTEC Dynamics Ltd.
Cambridge Road Industrial Estate
Whetstone, Leicester LE8 6LH
United Kingdom
Tel.: +44 116 275 13-13
Fax: +44 116 275 13-33
info@intecdynamics.co.uk
www.simpack.com