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Siemens Digital Industries Software

Simcenter 3D for motion simulation

Increasing design confidence and reducing risks

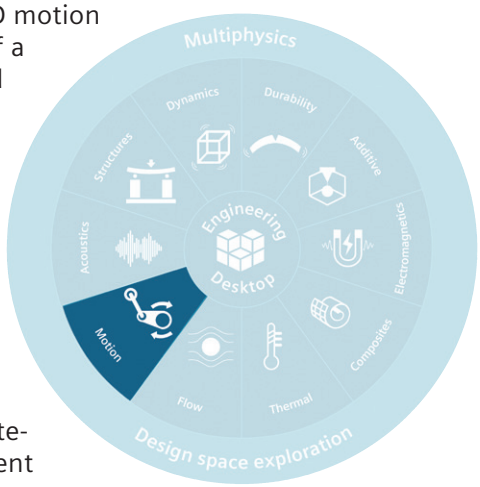
Solution benefits

- Accurately predict complex mechanism behavior
- Quickly build and maintain motion models using an integrated CAE environment
- Integrate systems and controls to simulate mechatronic systems
- Use add-on modules to simulate specific applications like tires, drivetrains or flexible pipes
- Seamlessly share and use motion simulation results across Simcenter 3D as input for use in other types of CAE applications

Simcenter™ 3D software offers modeling and simulation that helps engineers understand and predict the functional behavior of mechanisms. It delivers a complete and robust set of capabilities to support all aspects of advanced dynamic, static and kinematics motion simulation. The early use of motion simulation is key to evaluating mechanism performance to increase design confidence and reduce risks.

Providing a platform for multidiscipline simulation

The Simcenter 3D motion solution is part of a larger, integrated multidiscipline simulation environment with the Simcenter 3D Engineering Desktop at the core for centralized pre-/post-processing for all Simcenter 3D solutions. This integrated environment



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Simcenter 3D for motion simulation

helps you to achieve faster CAE processes and streamline multidiscipline simulations that integrate motion and other disciplines like finite element models for flexible body analysis as well as connections with acoustics for gear whine analysis.

A motion simulation solution for both analysts and designers

Designers and analysts typically approach motion simulation from two different perspectives, where CAD designers start with CAD data, and analysts often start with a blank slate. Simcenter 3D Motion solutions provide solutions that work with either user persona. Analysts can use Simcenter 3D Motion to create new mechanism models by hand using simple primitive geometry for linkages. This helps you understand how a new assembly mechanism might work before applying any detailed geometry. Designers working with computer-aided design (CAD) assembly models during the detailed design stage can quickly convert these assemblies into a working motion model in seconds by converting the geometry bodies into mechanism links and assembly constraints into corresponding motion joints. This can save designers critical modeling time, so they can begin realizing how geometry will impact the performance of their mechanism.

Accurately predict complex mechanism behavior

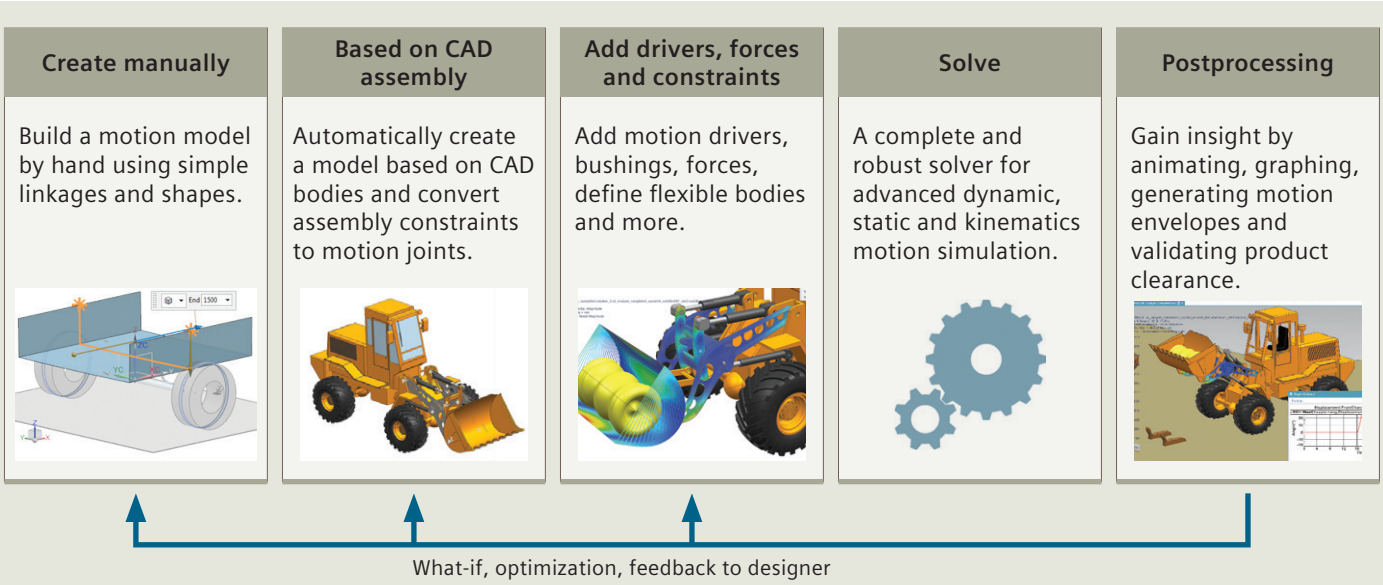
The Simcenter 3D Motion solver is built on more than 30 years of proven technology and uses the most advanced numerical multibody solving techniques to deliver fast, stable and robust simulation. Additionally, it provides accurate results for reaction forces, displacement, velocities and accelerations for rigid and flexible bodies. The loads obtained from the simulation can also be applied to structural analysis and durability, noise and vibration studies.

Integrate systems and controls to simulate mechatronic systems

Simcenter 3D can be integrated with leading control design tools and supports both model exchange and co-simulation methods to solve the mechanical system equations simultaneously with the controller or actuator system equations. This helps you understand how controls will impact the overall mechanism performance.

Seamlessly share results across Simcenter 3D

For certain types of structural, acoustics, vibration and durability analysis, it is critical to understand the loading conditions for the part or assembly being analyzed. You can seamlessly transfer loading conditions calculated with Simcenter 3D Motion solutions to the Simcenter 3D Engineering Desktop for use in other simulation applications. This will greatly improve productivity for you or your extended simulation team.



Industry applications

Understanding the operating environments for intricate mechanical systems – such as photocopiers, sliding sunroofs and wing flaps – can be challenging. Motion simulation calculates the reaction force, torque, velocity, acceleration and more for mechanical systems to allow you to study a broad range of product behaviors.

Automotive and transportation

Cars include a wide variety of mechanisms that impact vehicle performance and driver comfort. You can use Simcenter 3D to evaluate suspension and tire performance as well as sunroof, seat and automatic door mechanisms.

Aerospace and defense

Aerospace customers use Simcenter 3D Motion to evaluate landing-gear performance as well as wing-flap mechanisms.

Marine

Using Simcenter 3D can help engineers simulate how rudder systems perform in addition to other on-board mechanisms, like cranes on a cargo ship.

Industrial machinery

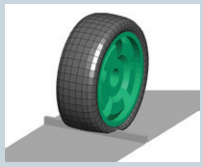
Industrial machines move constantly. From complex production machines and robots to conveyors, cranes and heavy equipment, machine developers can use Simcenter 3D to enable their machine to perform as expected.

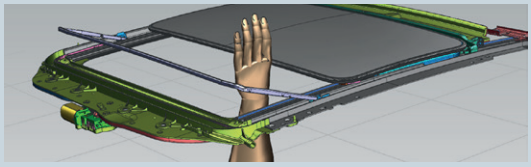
Electronics

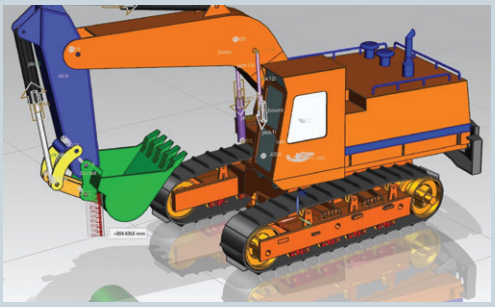
Electronics often have complex, well controlled moving mechanisms. Simcenter 3D can help you simulate the motion of photocopiers, scanners, disk drives and more.

Consumer products

Washing machines, dishwashers and toys all have mechanisms that end users rely on to meet their needs. Simcenter 3D can help you efficiently engineer these mechanisms.







Rigid body

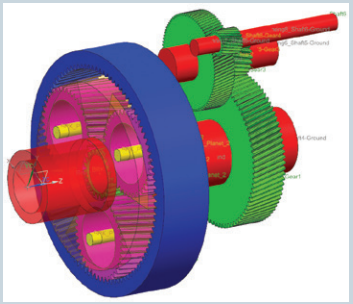
Flexible body

Tire models

Co-simulation with controls

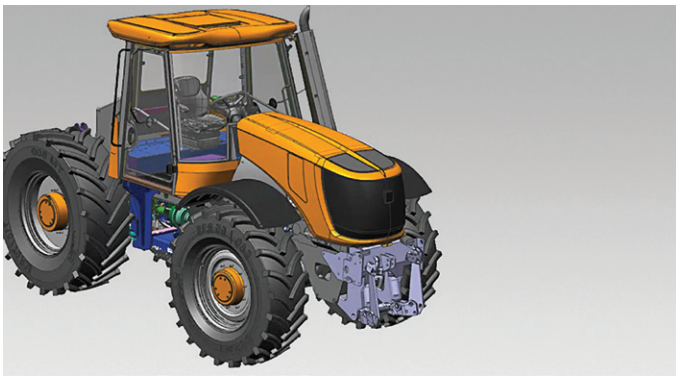
Interference checking

Drivetrain



Simcenter 3D Motion Modeling

Simcenter 3D Motion Modeling software provides multibody pre- and postprocessing capabilities to model, evaluate and optimize mechanisms. The module delivers a complete, yet simple-to-use set of capabilities to study the complex aspects of kinematics and dynamics during product development in industries such as aerospace, automotive, industrial machinery and electronics.

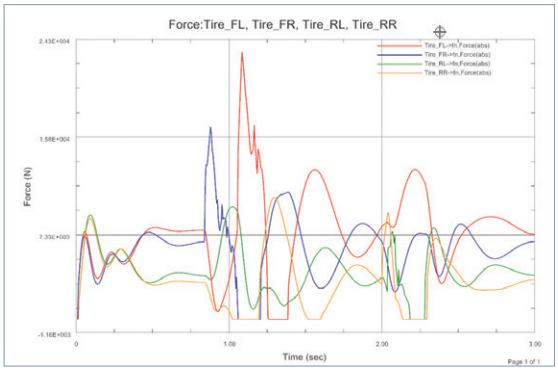


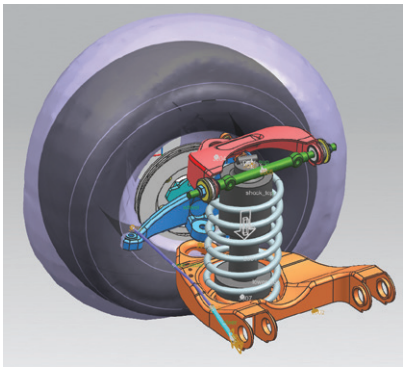
Module benefits

- Reduce expensive physical prototypes by using motion simulation to understand mechanism performance
- Gain insight into the kinematic and dynamic performance of a mechanism by animating, graphing and generating motion envelopes and validating product clearance

Key features

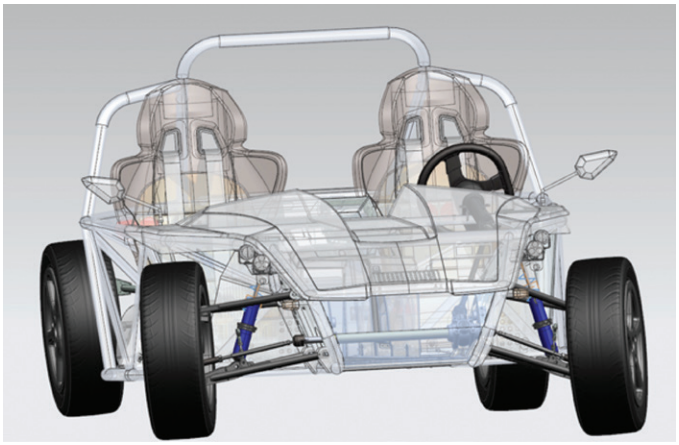
- Quickly convert CAD geometry and assemblies into fully functional motion models
- Seamlessly transfer motion results to other Simcenter 3D applications for structural analysis, durability, acoustics and more
- Includes a natural and direct interface to Simcenter Amesim™ software for accurate behavior of electronics, hydraulics and control components throughout the system

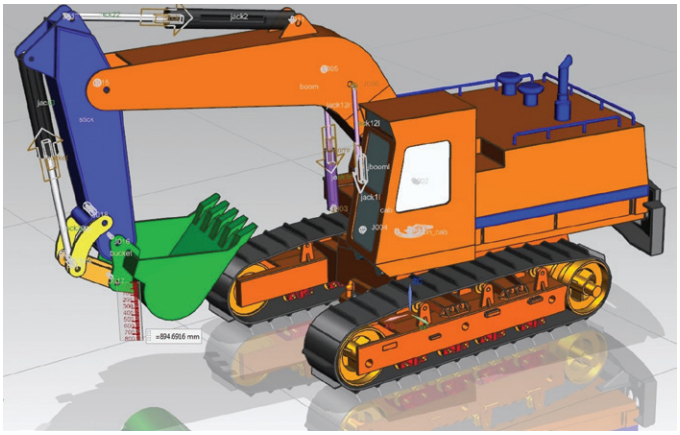




Simcenter 3D Motion solver

Simcenter 3D Motion solver helps engineers predict and understand the functional behavior of parts and assemblies. This multibody dynamic solver delivers a complete and robust set of capabilities to solve all aspects of advanced dynamic, static and kinematics motion simulation.





Module benefits

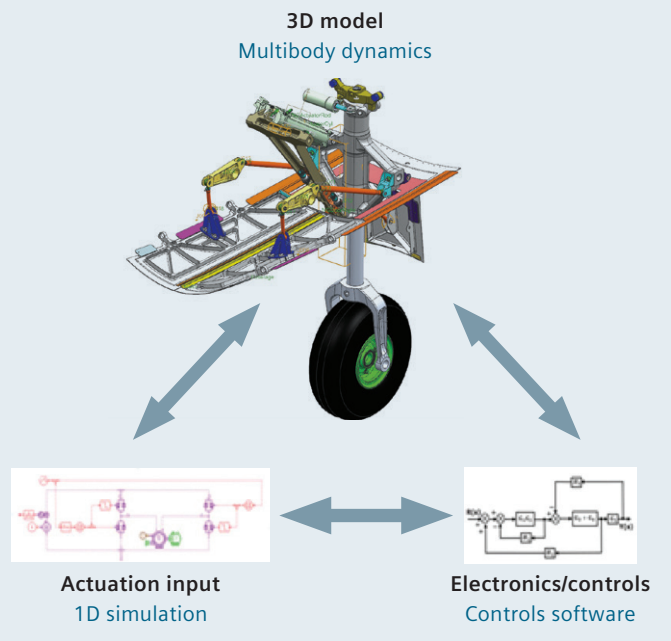
- Achieve highly accurate calculations (displacements, velocities, acceleration, reaction forces, flexible body results) using advanced multibody dynamics solving techniques
- Reduce costly physical prototypes by using motion simulation to understand mechanism performance

Key features

- Analysis types include kinematic, dynamic, static, quasi-static, time and step, articulation (interactively driven), spreadsheet (driven via a live Excel spreadsheet software table)
- An efficient set of sparse matrix algorithms to solve the linear equations formed in each type of analysis
- Explicit and implicit numerical integrators
- Support for model exchange and co-simulation
- User-defined subroutines.
- The Simcenter 3D Motion solver four node allows customers to share solver licenses over multiple cores and machines. It provides the advantage of sharing licenses of some add-on modules across cores and machines

Simcenter 3D Motion Systems and Controls

Mechanical engineers can easily predict how control systems affect their mechanisms, and control engineers can optimize their system designs with Simcenter 3D Motion Systems and Controls. This module provides a library of control modeling elements for the dynamic simulation of mechatronic systems. Through an interface to the MATLAB® environment and the Simulink® environment, you can easily connect motion models directly with control system designs to co-simulate both the motion and control models simultaneously. Simcenter 3D Motion Systems and Controls also includes a generic cosimulation interface for interfacing with other 3rd party or inhouse codes.

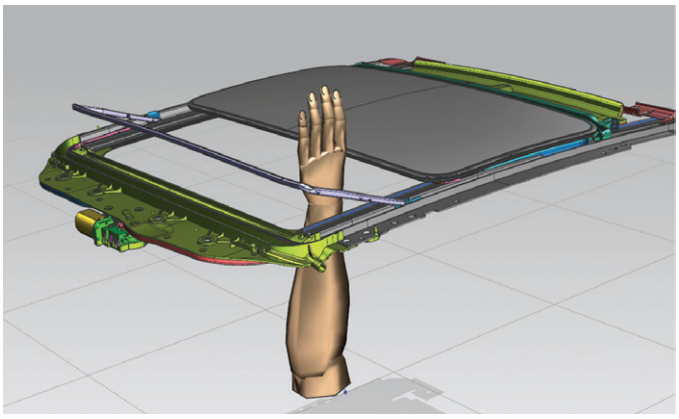


Module benefits

- Reduce risks from early design phases and gain engineering insight by correctly simulating the combined mechatronic system
- Design accurate and robust actuators and controllers

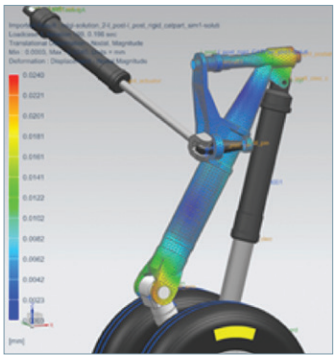
Key features

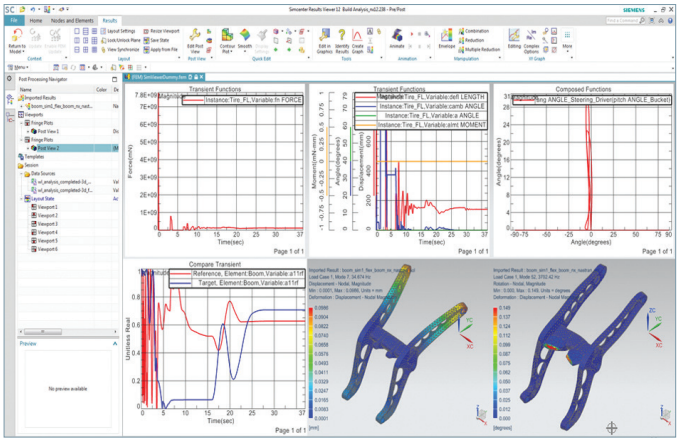
- Embedded library of control modeling elements
- Interface to MATLAB/Simulink for simulation of full nonlinear mechanical systems, including complex controls and actuators
- Support for Functional Mock-up Interface (FMI) standards



Simcenter 3D Motion Flexible Body

Using Simcenter 3D Motion Flexible Body helps increase the accuracy of multibody models by considering component deformations when simulating the motion of mechanisms. This approach allows you to combine the standard multibody simulation technology with a representation of body flexibility using a set of deformation modes.





Module benefits

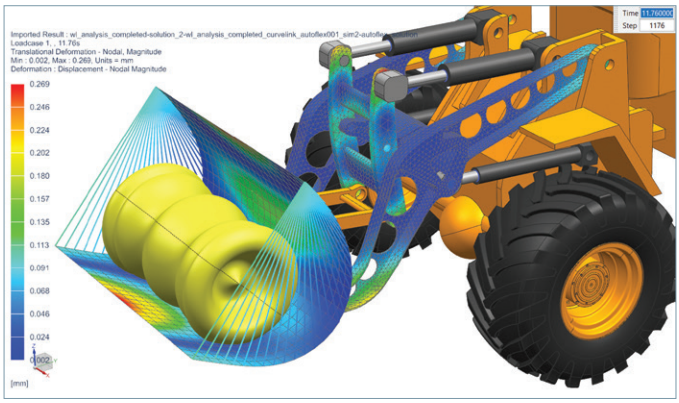
- Increase the accuracy of the predicted motion of mechanisms with flexible components
- Accurately predict the structural behavior of a body based on exact loads from connections in a mechanism

Key features

- Component mode synthesis methods available with multiple FE solvers such as Simcenter Nastran® software, MSC Nastran, ANSYS and Abaqus
- Editing of flexible body properties: mass and moments of inertia, modal damping

Simcenter 3D Motion Flexible Body Advanced

Simcenter 3D Motion Flexible Body Advanced extends modeling by using an automated process to turn existing geometry into a flexible body for motion analysis. It also allows you to model constraints and contact forces applied to flexible bodies.



Module benefits

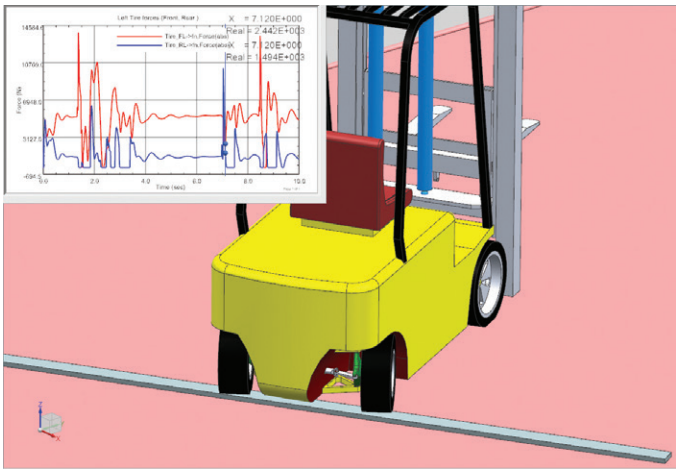
- Simplify the flexible body modeling process with time-saving guided procedures
- Facilitate simulation of distributed loads on flexible bodies due to contacts

Key features

- Automatic flex tool: It takes only a few mouse clicks to go from existing CAD geometry to a complete flexible body with associative finite element (FE) mesh representation and proper boundary conditions based on the connections to the mechanism
- Contact forces on flexible bodies: rigid-to-flex, flex-to-flex
- Point-on-curve constraints extended to flexible curves defined on FE nodes

Simcenter 3D Motion Standard Tire

Using Simcenter 3D Motion Standard Tire enables you to model any force component generated by a pneumatic tire in contact with a road surface, including normal and vertical, longitudinal and lateral, as well as all resulting moments.



Module benefits

- Accurate prediction of tire-road interactions for computer-aided engineering (CAE) based driving dynamics assessment
- Predict ride comfort and handling performance of a vehicle with a limited number of tire and road parameters

Key features

- Access multiple tire force models with a scalable level of detail; suitable models for passenger cars, trucks and buses, agriculture and construction equipment vehicles and landing gear
- Perform high-frequency analyses, such as full-vehicle ride comfort behavior and durability analysis
- Includes three tire formulation models: noninertial, basic and motorcycle
- Enables support for Flexible Structure Tire Model (FTire) from cosin scientific software

Simcenter 3D Motion CD Tire

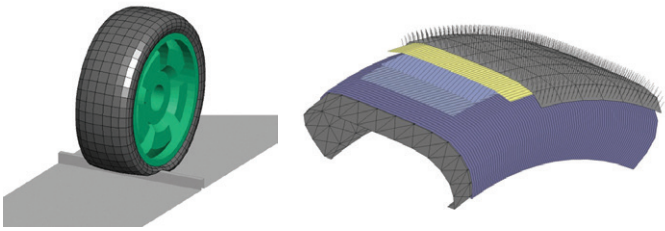
Simcenter 3D Motion CD Tire software delivers a family of tire models developed by ITWM Fraunhofer, available as third-party software in Simcenter 3D. These models are suitable for simulation of passenger cars, trucks and buses, off-highway vehicles, motorcycles and aircraft, and enable multibody analysts to accurately predict the tire behavior for full-vehicle handling, ride comfort and durability analyses.

Module benefits

- A dedicated family of tire models for vehicle ride comfort and durability assessment
- Accurately calculate tire forces for vehicles on arbitrary road surfaces
- Build scalable models with different levels of complexity and computational performance

Key features

- Covers a broad frequency range for durability, ride comfort and handling analyses of full vehicles and suspensions



Simcenter 3D Motion MF-Tyre

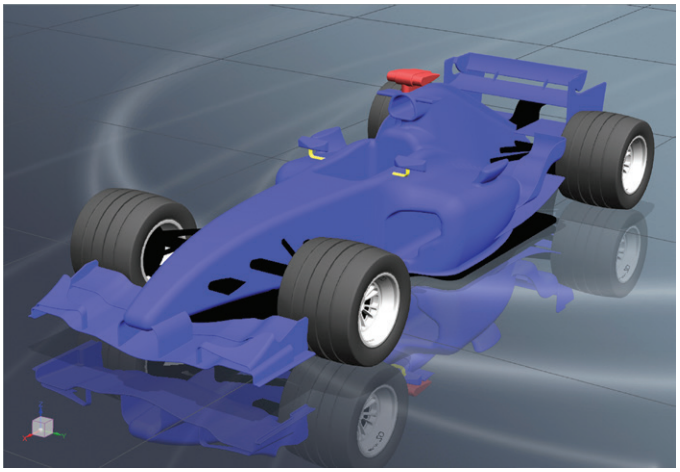
Simcenter 3D Motion MF-Tyre enables you to create a tire model that corresponds to the Delft-Tyre implementation (revision 6.1.2) of the global standard, the semi-empirical Pacejka Magic Formula from professor Hans Pacejka. These models can be used to accurately and efficiently simulate tire-road contact forces from steady-state to high-frequency analyses for vehicle types such as passenger cars, motorcycles, trucks and aircraft landing gear.

Module benefits

- Simulate tire forces for assessing vehicle handling and controlling prototyping analyses
- Accurately predict vehicle handling behavior, including steady-state cornering, power-off in a turn, lane change, J-turn and more

Key features

- Model the steady-state and dynamic behavior of the tire within a frequency band that covers vehicle-handling analyses, as well as control prototyping and rollover simulations
- Simulate vehicle control systems such as antilock braking system (ABS), electronic stability control (ESP), vehicle dynamic control (VDC) and traction control system (TCS)



Simcenter 3D Motion MF-Swift Tyre

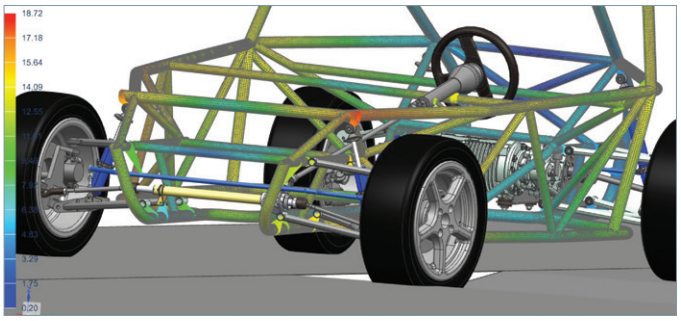
Using Simcenter 3D Motion MF-Tyre enables you to create a tire model that corresponds to the Delft-Tyre implementation (revision 6.2.0) of the global standard, the semi-empirical Pacejka Magic Formula from Pacejka. Simcenter 3D Motion MF-Swift is the higher-frequency extension, up to about 100 hertz (Hz) of the Magic Formula MF-Tyre model, enabling accurate full vehicle ride comfort, durability and vibration analyses. It can simulate vehicle control systems such as ABS, ESP, VSC, TCS and more over a wide range of operational conditions.

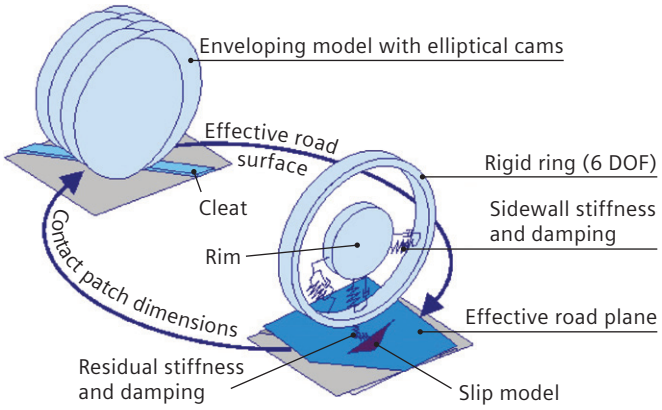
Module benefits

- Simulate tire forces for assessing vehicle handling and controlling prototyping analyses
- Accurately predict vehicle-handling behavior, including steady-state cornering, power-off in a turn, lane change, J-turn and more

Key features

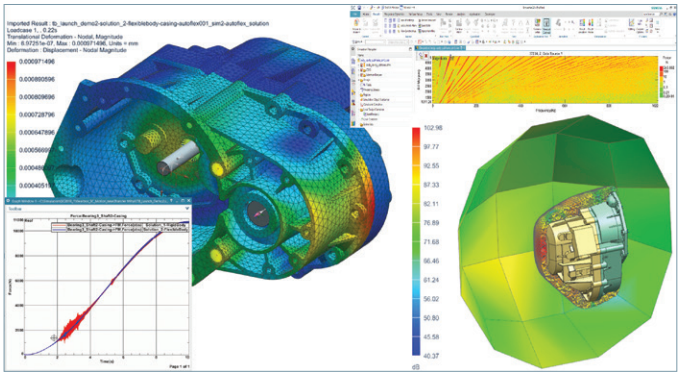
- Extend the industry-standard Pacejka Magic Formula to higher-frequency applications such as vehicle ride comfort, suspension and driveline vibration analyses

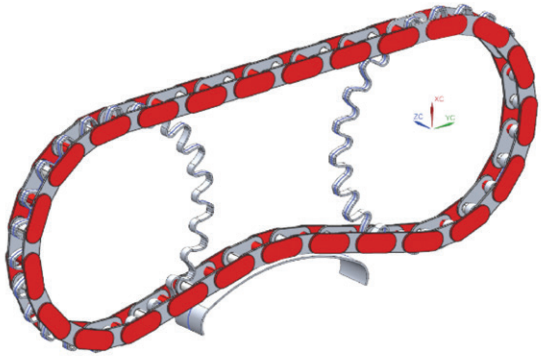




Simcenter 3D Motion Drivetrain

For the dynamic simulation of drivetrain elements, Simcenter 3D Motion Drivetrain groups several tools and features to facilitate creating detailed drivetrain models. The transmission builder brings in-depth, gearbox-specific ease of use into the multibody simulation process, so you can rapidly move from initial design specifications to accurate simulations. The discrete drivetrain capability also provides a convenient interface to simplify the modeling of complex chain, track and belt systems.



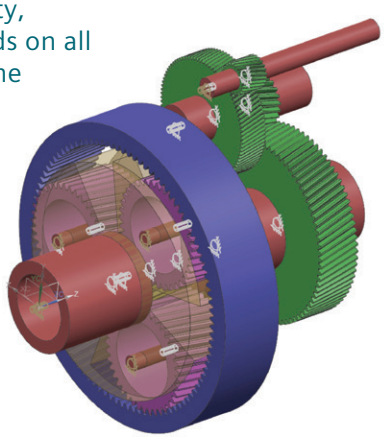


Module benefits

- Automatically create multibody transmission models based on industry standards, reducing time for creating models by up to 80 percent
- Perform end-to-end transmission simulation processes in a single environment
- Achieve reliable and fast multibody gear simulations with validated advanced solver methodologies
- Facilitate robust layout algorithm by using discrete drivetrain to simplify modeling of chain, belt and tracked systems, yet allow for creating custom geometry
- Get insight into complex dynamics of chain, belt and tracked systems to improve performance

Key features

- Automated multibody model creation for transmissions based on industry standards
- Manages single, multi-stage spur and helical assemblies for external or internal (such as in the planetary stage) gears
- Direct link to Simcenter 3D Acoustics to perform noise, vibration and harshness (NVH) assessment
- Define any pattern body with custom geometry such as chain links and track segments together with their connecting joints and forces
- Define layout components based on user-defined topology
- Predict the transient dynamic response – displacement, velocity, acceleration and loads on all pattern bodies and the related layout components



Simcenter 3D Motion TWR

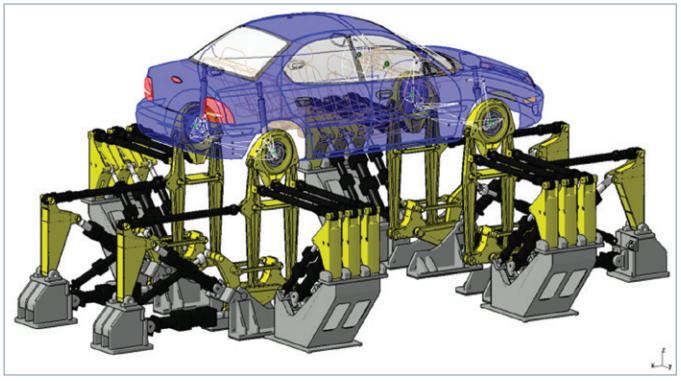
Simcenter 3D Motion TWR (time waveform replication) software is a vertical application that leverages the software's multibody dynamics capabilities. It allows you to build a virtual test rig, calculate the frequency response of a given system, specify target signals, filter and condition the signals and ultimately produce conditioned drive signals using an iterative solution process.

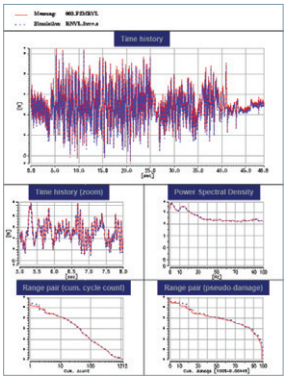
Module benefits

- Reduce cost, save time and mitigate unnecessary risks associated with handling physical specimens in the lab by building a virtual test rig to excite a model of the specimen
- Enables you to perform vehicle simulation without hard to characterize tires and roads

Key features

- Compute a set of inputs that guarantees the equilibrium of your numerical model during simulation and the replication of many physical quantities measured at the same location as the experimental test





Simcenter 3D Motion Real-Time solver

The Simcenter 3D Motion Real-Time solver and supporting licenses enhance the capabilities of Simcenter 3D Motion models. It enables the user to unlock new external model integration possibilities; add a model to a real-time (RT) platform, integrate with other multi-physics models and combine with RT simulators and hardware-in-loop (HiL). Re-use existing models or extend the accuracy of RT models by adding more degrees-of-freedom (DOF) than ever possible with previously reduced models.

Module benefits

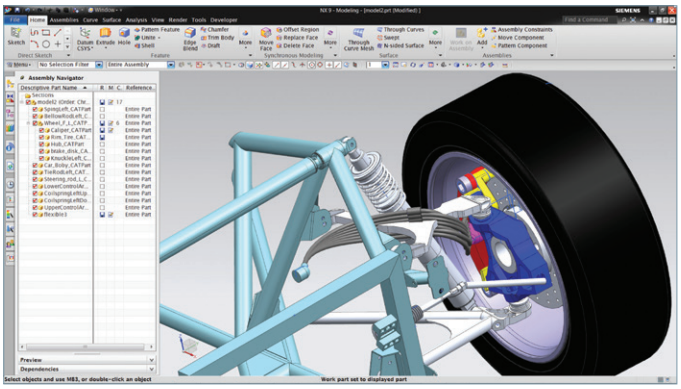
- Re-use Simcenter 3D Motion models in real time instead of recreating multiple models
- Avoid reducing models and maintain the original DOF
- Produce results faster for design-of-experiments (DOE)

Key features

- Available parallel solution for large industrial models
- Flexible body support
- Simcenter 3D Motion C-code export converts the model files into a format that can be used on third-party, real-time operating systems or in integration environments
- Simcenter 3D Motion Real-Time solver licenses are available to support the application and hardware that exist at the customer site

Simcenter 3D Flexible Pipe Standard Beam

Simcenter 3D Flexible Pipe Standard Beam software is an application dedicated to piping and tubing simulation. It allows designers and mechanical engineers to simulate mounting scenarios and calculate initial positions, operating positions and forces/moments within the pipe. In addition, it can be used to prevent a lack of fit between connectors and clips and check for excessive curvature or collision with other objects.



Module benefits

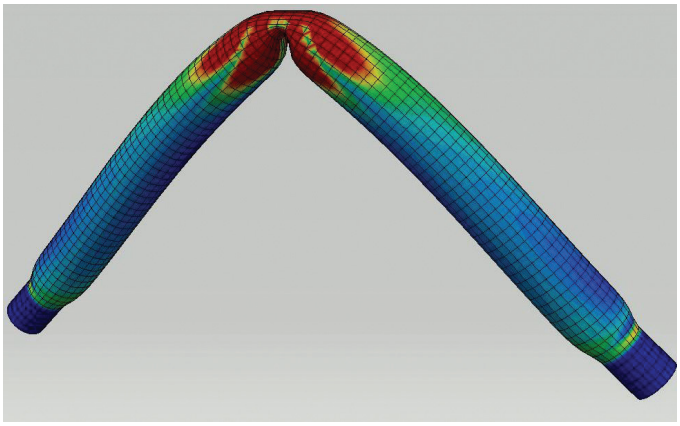
- Rapidly design flexible cables
- Avoid mounting/collision problems
- Provide accurate solutions by considering material properties
- Prevent fatigue problems by avoiding torsion in the mounting position
- Monitor reaction forces, torsion and bending radius

Key features

- Automatic zero-torsion analysis
- Compute positioning and kinematic movement of flexible cables (for example, brake cable, gearbox cable, fuel circuit), using the finite element method (FEM) beam calculation method
- Transient time/space temperature and pressure
- Compatible with motion kinematics results from Simcenter 3D

Simcenter 3D Flexible Pipe Standard Shell

Simcenter 3D Flexible Pipe Standard Shell software is an application dedicated to piping and tubing simulation. It allows designers and mechanical engineers to simulate mounting scenarios and calculate initial positions, operating positions and forces/moments within the pipe. In addition, it can be used to validate designs by checking crushing appearance and check for excessive curvature or collision with other objects.



Module benefits

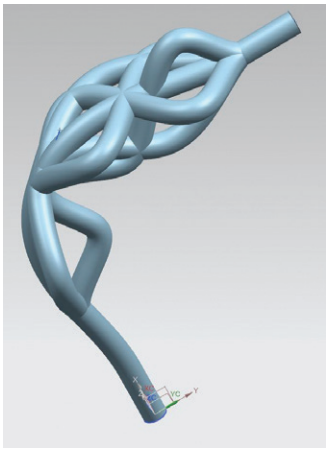
- Rapidly design flexible cables
- Detect crushing/buckling conditions prior to developing physical prototype
- Increase accuracy of results

Key features

- Avoid mounting/collision problems
- Allow definition of multilayer hoses

Simcenter 3D Flexible Pipe Linear Dynamic

Simcenter 3D Flexible Pipe Linear Dynamic is an extension that enables the computation of eigenmodes as well as the harmonic response of positioned pipes using either the FEM beam or the FEM shell calculation method.



Module benefits

- Rapidly design flexible cables
- Avoid mounting/collision problems
- Detect crushing/buckling conditions prior to developing a physical prototype
- Avoid loose connections and leakage by simulating dynamic (harmonic and transient) effects

Key features

- Compute the eigenmodes as well as the harmonic response of positioned pipes

Simcenter 3D Flexible Pipe Nonlinear Dynamic

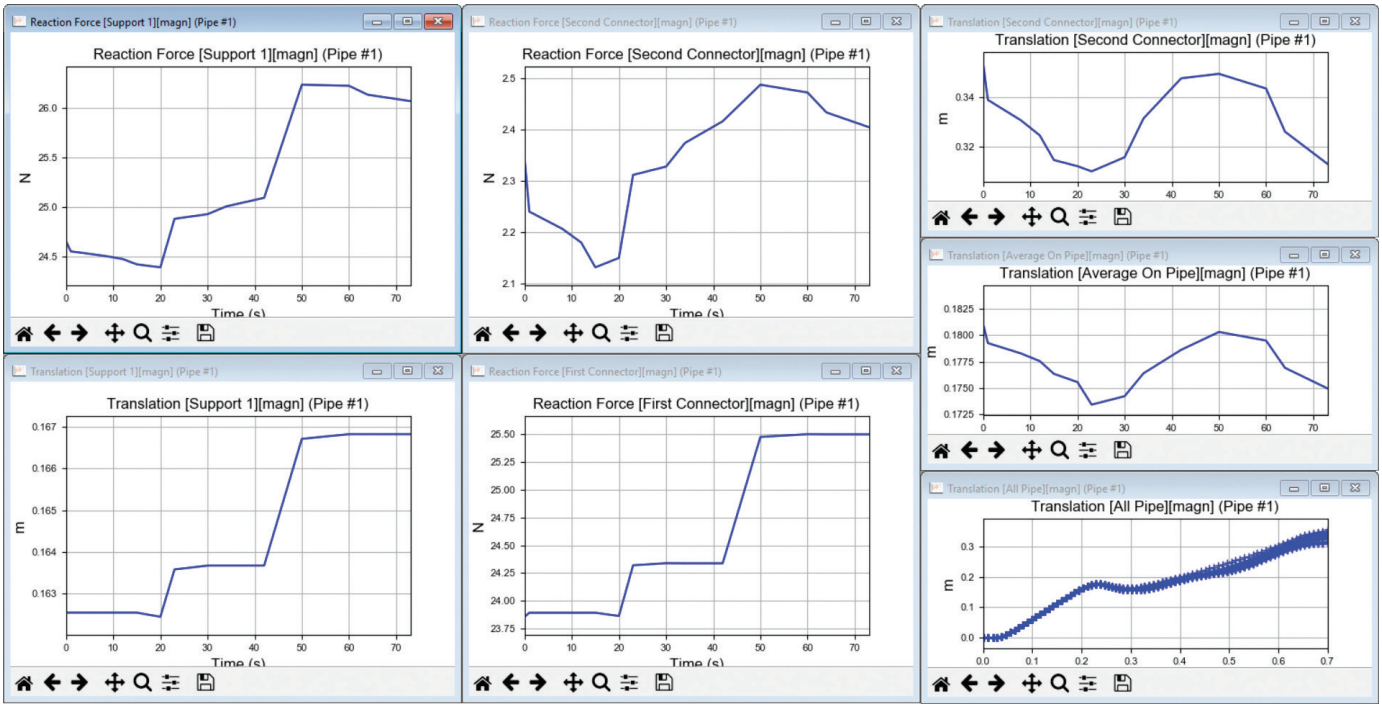
Simcenter 3D Flexible Pipe Nonlinear Dynamic is an extension that enables the computation of nonlinear movement analysis (transient response) using either the FEM beam or the FEM shell calculation method.

Module benefits

- Rapidly design flexible cables
- Avoid mounting/collision problems
- Detect crushing/buckling conditions prior to developing a physical prototype
- Avoid loose connections and leakage by simulating dynamic (harmonic and transient) effects

Key features

- Compute the nonlinear movement (transient response) of positioned pipes
- Compare with kinematic positioning
- Impose accelerations or displacements
- Compatible with motion kinematics results of Simcenter 3D
- Sensor monitoring (reaction forces, translation, acceleration)



Simcenter 3D Flexible Pipe Optimization

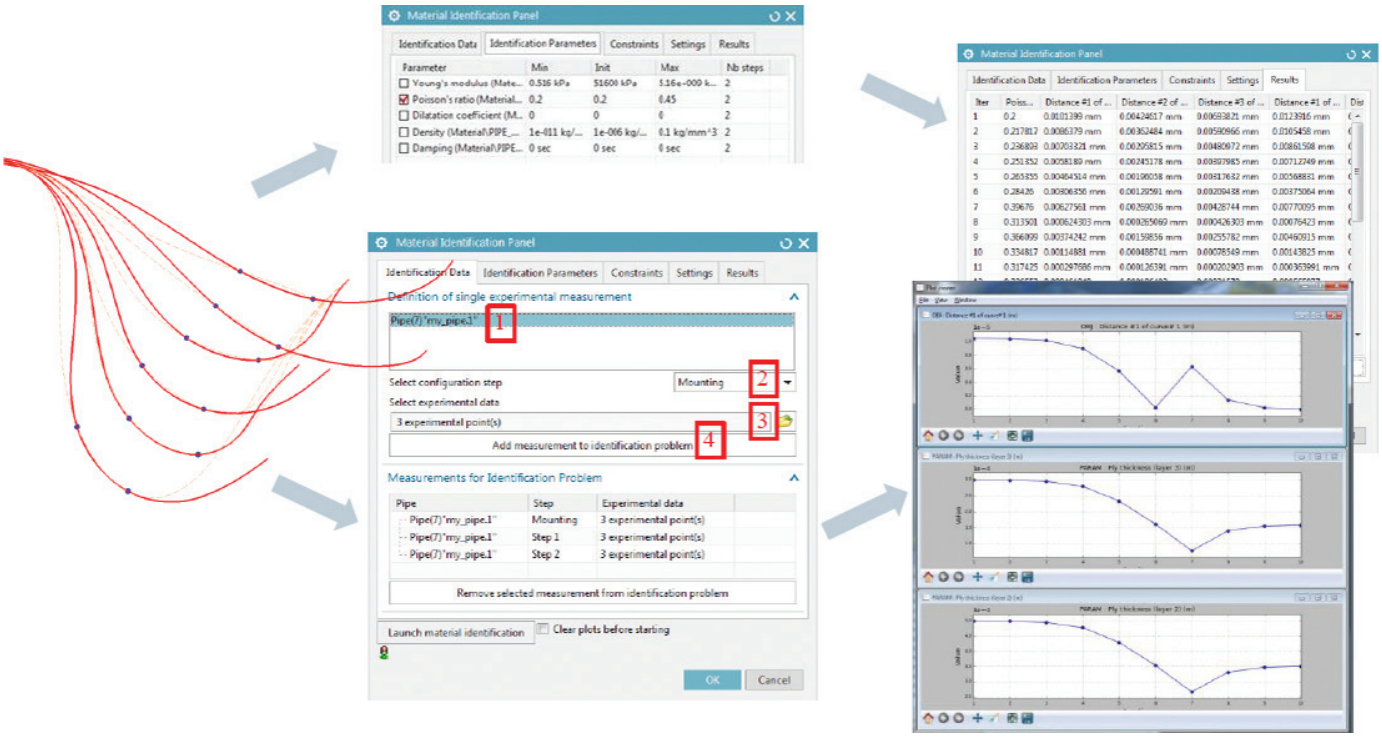
Simcenter 3D Flexible Optimization software is an extension that enables you to compute parametric studies and optimize the position and orientation of components. It also allows the customer to perform a material characterization based on physical measurements.

Module benefits

- Rapidly design flexible cables
- Avoid mounting/collision problems
- Use parametric study to evaluate sensitivity of the design
- Use DOE analysis to explore the design space
- Optimize reaction forces, length, clearance

Key features

- Create parametric studies and optimize the position and orientation of components
- Perform a material characterization based on physical measurements



Simcenter 3D Flexible Electric Cables and Wire Harness option

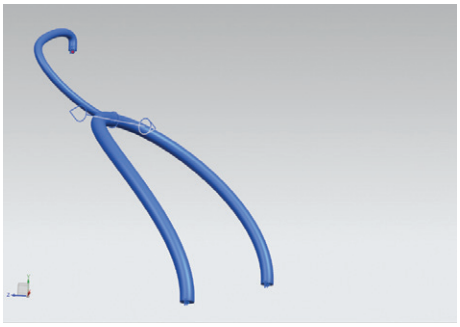
The Simcenter 3D Flexible Electric Cables and Wire Harness (EC&WH) option is an extension that enables you to compute EC&WH. It allows the customer to perform an accurate harness design thanks to a bi-directional link with the NX™ software routing solution and the use of nonlinear materials. This is mandatory in the case of electric cables.

Module benefits

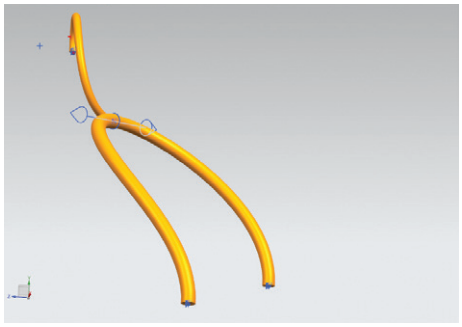
- Rapidly design electric cables and wire harness
- Direct import of existing NX electrical routing model
- Define bundle object (cables enclosed in an external protection layer)
- Accurate positioning and clearance checks of the harness
- Mounting and movements of electric flat cable

Key features

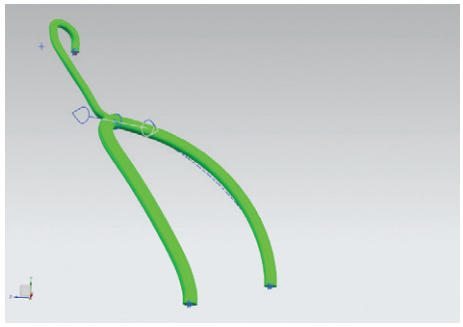
- Plasticity/hysteresis is captured for single cables and bundles
- Material characterization procedure for experimental load curves
- Material characterization procedure for virtual measurement of bundles
- Granularity/scalability of NX electrical routing solution for imported model (wire, cable, stock)
- Multiple cable contact
- Overstocks (taping) and clips (with relaxation) imported in a single click
- Optimal cross-section distribution



NX routing



Linear



Nonlinear

Capabilities chart

NX and Simcenter 3D Motion capabilities

General capabilities	Specific capabilities	NX Motion	Simcenter 3D Motion Modeling	Simcenter 3D Motion solver	Simcenter 3D Motion Systems and Controls	Simcenter 3D Motion Flexible Body	Simcenter 3D Motion Flexible Body Advanced	Simcenter 3D Motion Standard Tire	Simcenter 3D Motion CD Tire	Simcenter 3D Motion MF-Tyre	Simcenter 3D Motion MF-Swift Tyre	Simcenter Motion Drivetrain	Simcenter 3D Motion TWR	Simcenter 3D Motion Real-Time Desktop Solver	Ccode Exp	RT solver Node locked	Solver batch 4
Modeling	Import of animation designer, assembly constraint and Tecnomatix® portfolio process simulate kinematics models	•	•														
	Association to part and assembly geometry	•	•														
	Quick creation of primitive graphics	•	•														
	Joints, couplers, constraints	•	•														
	Motion drivers	•	•														
	Spring/damper and bushings	•	•														
	Applied forces	•	•														
	Joint friction	•	•														
	Initial conditions	•	•														
	3D body contact and analytical contact	•	•														
	Submechanisms	•	•														
	Text based elements		•														
	Integration with Simcenter Amesim™ software		•														
	Time waveform replication		+	+	+								•				
Postprocessing	Animation	•	•														
	XY graphing	•	•														
	Motion envelope, interference check, point trace, animation camera, load vectors	•	•														
	Capture assembly arrangements during animation	•	•														
	Multiple load case support	•	•														
	Load transfer to Simcenter 3D Engineering Desktop	•	•														
	Multiple output formats (the JT™ data format, VRML, animation movies, etc.)	•	•														
Analysis types and solver capabilities	Static equilibrium	•	+	•													
	Kinematic simulation	•	+	•													
	Dynamic simulation	•	+	•													
	Driver control through articulation and spreadsheet	•	+	•													
	User defined forces and subroutines		+	•													
	Multi-processor batch solver		+	+													•
	Real time solver		+	+										•	+	•	

General capabilities	Specific capabilities	NX Motion	Simcenter 3D Motion Modeling	Simcenter 3D Motion solver	Simcenter 3D Motion Systems and Controls	Simcenter 3D Motion Flexible Body	Simcenter 3D Motion Flexible Body Advanced	Simcenter 3D Motion Standard Tire	Simcenter 3D Motion CD Tire	Simcenter 3D Motion MF-Tyre	Simcenter 3D Motion MF-Swift Tyre	Simcenter Motion Drivetrain	Simcenter 3D Motion TWR	Simcenter 3D Motion Real-Time Desktop Solver	Ccode Exp	RT solver Node locked	Solver batch 4
Controls	Integration with Matlab		+	+	•												
	Integration with FMI/FMU 1.0 and 2.0		+	+	•												
	Integration with generic co-simulation		+	+	•												
	Control operations		+	+	•												
Flexible bodies	Linear flexible bodies		+	+		•											
	Automatic flexible body creation		+	+		+	•										
	Flexible body contact		+	+		+	•										
	Flexible body point-line constraint		+	+		+	•										
Drivetrain	Powertrain (combustion, tachometer, HD bearings)		+	+								•					
	Chains and Belts – timing or accessory		+	+								•					
	Transmission builder vertical and gear contact		+	+								•					
Vehicles	Tire/road modeling		+	+				•	•	•	•						
	Track vehicles		+	+								•					

Simcenter 3D Flexible Pipe capabilities

General capabilities	Specific capabilities	Simcenter 3D Flexible Pipe Standard Beam	Simcenter 3D Flexible Pipe Standard Shell	Simcenter 3D Flexible Pipe Optimization	Simcenter 3D Flexible Pipe Linear Dynamic	Simcenter 3D Flexible Pipe Nonlinear Dynamic	Simcenter 3D Flexible Pipe EC&WH option	Simcenter 3D Flexible Pipe Advanced Beam	Simcenter 3D Flexible Pipe Standard Beam and Shell	Simcenter 3D Flexible Pipe Simulation for EC&WH
Modeling	FE hypothesis: long and small diameter pipe (brake hose, electric cable, HVAC, bowden cable)	•						•	•	•
	FE hypothesis: short and big diameter hoses (air/water hoses, FFC, FPC)		•						•	
	FE hypothesis: mostly for advanced thick pipes (electric cable)		•						•	
	Components: connectors, supports	•	•					•	•	•
	Components: separators, collectors (multi-pipes)	•	•					•	•	•
	Collision with external surfaces (check only)	•	•					•	•	•
	Collision with external surfaces (contact)	•	•					•	•	•
	Pipe-pipe contact	•	•					•	•	•
	Pipe-pipe contact using beam/beam contact	•						•	•	•
	Relaxation on connectors/supports/separators/collectors	•	•					•	•	•
	Variable diameter/reinforcements/spirals	•	•					•	•	•
	Advanced materials: elastic/plastic/visco/composite/harmonic	•	•					•	•	•
	Space-time dependent pressure and temperature	•	•					•	•	•
	Link with kinematics : NX Motion	•	•					•	•	•
	Link with kinematics : Neutral file, XMO, axis systems, XML (CATIA Replay), arrangements	•	•					•	•	•

General capabilities	Specific capabilities	Simcenter 3D Flexible Pipe Standard Beam	Simcenter 3D Flexible Pipe Standard Shell	Simcenter 3D Flexible Pipe Optimization	Simcenter 3D Flexible Pipe Linear Dynamic	Simcenter 3D Flexible Pipe Nonlinear Dynamic	Simcenter 3D Flexible Pipe EC&WH option	Simcenter 3D Flexible Pipe Advanced Beam	Simcenter 3D Flexible Pipe Standard Beam and Shell	Simcenter 3D Flexible Pipe Simulation for EC&WH
Modeling (continued)	Pipe bundle: with pipe-pipe contact						•			•
	Copy/paste: pipes and assemblies	•	•					•	•	•
	Corrugated pipe	•	•					•	•	•
	Corrugated pipe with slit		•						•	
	Bowden cable: cable sliding into an outer layer	•	•					•	•	•
Analysis types	Quasi-static	•	•					•	•	•
	Zero/free torsion mounting	•						•	•	•
	Linear dynamic (frequency domain)				•			•		
	Random analysis (frequency domain)				•			•		
	Nonlinear dynamic (time domain)					•		•		
	Parametric design and optimization			•						•
	Instant model update (Kineo)	•						•	•	•
Material identification	Rubber-like hoses			•						•
	Electric cables						•			•
	From load curves of 1D pipe			•			•			•
	Optimization: on assembly of pipes			•						•
Post-processing	CAD results and animations	•	•					•	•	•
	FE results/plots/HTML report	•	•					•	•	•
Integration with other products	Connection with NX routing (stock mode)	•					•	•	•	•
	Connection with NX routing (cable and wire mode)	•	•					•	•	•
	Compatibility with Teamcenter® software	•	•					•	•	•

Legend:
• = included in module
+ = prerequisite

Note: Simcenter 3D Engineering Desktop is a minimum prerequisite for all Simcenter 3D products. Other dependency or prerequisites may apply for individual products.

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