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Simcenter 3D Motion Modeling

Geometry-based pre- and post-processing for multibody dynamics

Benefits

- Reduce costly physical prototypes by using motion simulation to understand mechanism performance
- Quickly convert CAD geometry and assemblies into fully functional motion models
- Iterate with design teams through an associative model that delivers rapid design-analysis iterations
- Gain insight into the kinematic and dynamic performance of a mechanism by animating, graphing, generating motion envelopes and validating product clearance
- Seamlessly transfer motion results to other Simcenter 3D applications for structural analysis, durability, acoustics and more

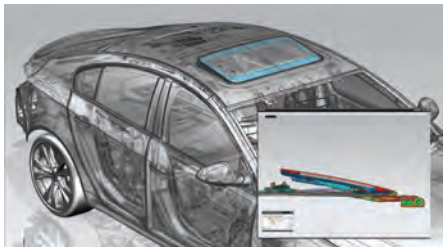
Summary
Simcenter 3D Motion Modeling software provides multibody pre- and postprocessing capabilities that engineers need to understand, evaluate and optimize mechanical and mechatronic systems. Simcenter 3D Motion Modeling delivers a complete yet simple-to-use set of capabilities to study the complex aspects of kinematics and rigid body dynamics during product development in industries such as aerospace, automotive, industrial machinery, electronics and others.

Geometry-based motion modeling
Unlike traditional multibody dynamics tools that use primitive stick models that require you to manually enter centers of gravity, moments of inertia, and the like, Simcenter 3D Motion Modeling uses real geometry data from the start. Simcenter 3D Motion Modeling allows you to quickly convert a complete CAD assembly into a motion model in seconds. Simcenter 3D Motion Modeling converts the geometry bodies into the mechanism links while inheriting all of the physical properties of that body (such as mass, center of gravity and moments of inertia).

Secondly, Simcenter 3D Motion Modeling will convert assembly constraints into the most appropriate mechanism joint types. After the mechanism is created, you can then add other motion objects such as springs, dampers, forces, torques, drivers and more.

The motion models you build in Simcenter 3D Motion Modeling are associated to the base design data. This means if the original CAD geometry changes in the assembly, you can rapidly update the corresponding motion model to incorporate the new geometry. The associativity then allows engineers and designers to collaborate more closely and achieve faster design-analysis iterations that help you achieve a better, more robust product.

Part of the Simcenter 3D platform
Simcenter 3D Motion Modeling is part of the broader Simcenter 3D platform for 3D simulation. For certain types of structural, acoustics, vibration and durability analysis, it is critical to understand the loading conditions for the part or



Simcenter 3D Motion Modeling helps you to build complex motion models such as sunroof mechanisms.

Simcenter 3D Motion Modeling

assembly being analyzed. Simcenter 3D Motion Modeling and the Simcenter 3D Motion Solver can help you determine these loads and seamlessly transfer the loading conditions to the Simcenter 3D Engineering Desktop for use in other simulation applications. This can help greatly improve productivity for you or your extended simulation team.

Motion pre- and postprocessing capabilities
The following lists details for the pre- and postprocessing capabilities in Simcenter 3D Motion Modeling. To learn more about the solver and motion solutions that you can use in Simcenter 3D, please refer to the fact sheet for the Simcenter 3D Motion Solver.

Model creation

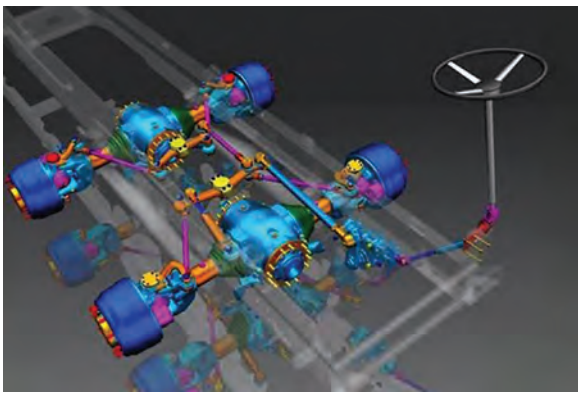
Rigid bodies and CAD integration
- Moving objects or links are defined from the master model (CAD data) or generated from within Simcenter 3D Motion itself. Links remain associative with the geometric objects and the user can override the mass properties as needed.
- Positions, mass properties and orientation of all motion data are in sync with any geometric model modifications. The solution also automates the mapping from an assembly with constraints to links and joints.
- The positions and orientations of the CAD assembly and components can be defined directly from the animation results.
- Efficiently assemble and manage modular mechanisms by including submechanisms within a larger mechanism assembly.

Joints
- Standard joints: revolute, cylindrical, spherical, translational, screw, gear, planar, universal
- Constraint or primitive: in line, in plane, parallel, perpendicular, orientation
- Curve and surface joints: point-curve, point-surface, curve-curve
- Friction definitions

Force elements
- Loading force and torque
- Standard force elements: spring and damper (translational, rotational)
- Bushing forces: including stiffness, damping, pre-load for standard Cartesian bushing and cylindrical bushing
- Forces can be linear or nonlinear

3D contact
- 3D contact based on tessellation of the geometry surface. Tessellation can be controlled by sag, length and angle.
- Analytical contact using formulations based on basic shapes without need for solid CAD geometry.

Results specifics
- Sensors help you to explicitly define quantities and specific locations of interest to report reaction, position, velocity and acceleration.
- Result measure: capture the time-dependent result quantity as an expression; for example, to extract the maximum torque reaction and automatically compare with a requirement.

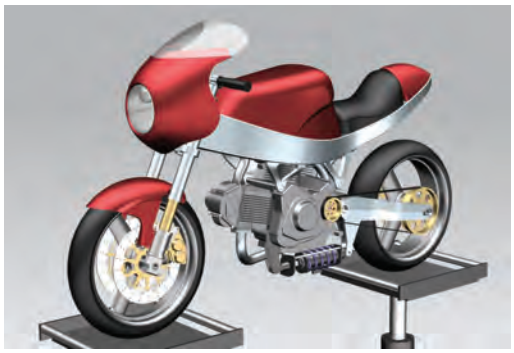


Quickly convert CAD assemblies into fully functional motion models.

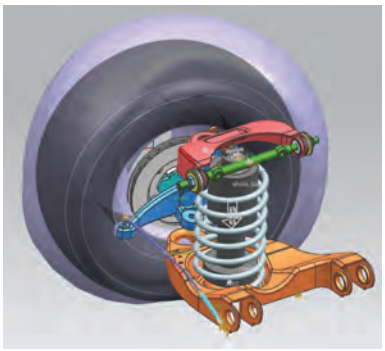
Mathematical formulas and functions
- Useful for drivers and force elements
- Simplified formulation by predefined variables: derived, and solver runtime function

Input curves
- Import of ASCII .CSV files
- Time data in the following file formats can directly be imported/exported: MATLAB®, MTS RPC® III, nCode DAC, Universal, LMS Samtech Samcef™

Parametrization/automation
- All model expressions (input parameters) can be parameterized. They can be synchronized with Microsoft® Excel®



Perform multibody dynamics on real CAD geometry.



Create motion envelopes to design for package space and check for interference.

- Journal recording and replay to automate all user interactions : Visual Basic, Python, Java, C++, C#
- Mathematical formulas for and between expressions
- Built-in knowledgeware: corporate know-how can be embedded through formulas, rules and checks
- Motion simulation built on a product can expose results and facilitate design decisions for any user via Product Template Studio
- Feature browser allows fast visualization and editing of any motion element

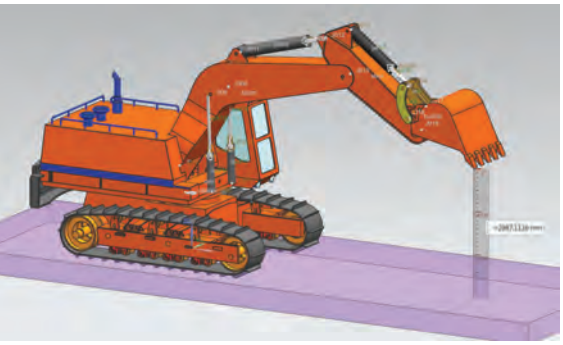
Solution types

- Normal run – kinematics, dynamics, static, time and step
- Articulation – quasi-static or kinematics, interactively driven
- Spreadsheet – quasi-static or kinematics, driven via a live Excel table

Visualization and exploration of results

Animation

- Control the animation, view, rendering mode and display of all the moving objects
- Synchronize graph animation with visual mechanism animation
- Tools for package study and clearance: trace geometries and envelope, interference and clearance, dynamic measurements



Measure distances between geometry to understand clearances.

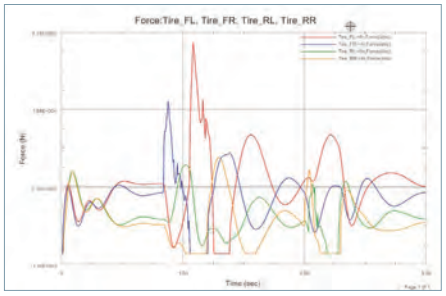
- Identify and capture the timesteps and geometry positions of interest.
- Movie creation

Graphing

- Directly plot from motion feature tree
- Graph results in global or local reference frames
- Save plot templates to quickly recreate often-used plots and graphs
- Curve export to auxiliary data files for functions (AFU) format or Excel format
- Complete toolset for XY curve graphing:
  - Mathematical operations on results such as scaling, multiplying curves, differentiating, integrating, taking fast Fourier transform (FFT), and more
  - XY plot display control as line type, color, unit, legend, probing, and zooming

PLM integration

- Out-of-the-box integration with Teamcenter® software
- The motion model is a specific object attached to the CAD master model item revision. The motion data remains in synch with the design revision and assembly BOM.
- All files from the motion solver are attached to the motion model for tracking and later review of results.
- Directly export JT format files from Simcenter 3D Motion Modeling to share a lightweight representation of the geometry and the animation within Teamcenter for others to view and make decisions.



Powerful XY graphing capabilities help you interpret motion simulation results.

Supported hardware and operating systems

Simcenter 3D Motion Modeling is a module in the suite of Simcenter 3D applications. In order to solve a motion model, you must also have a license of Simcenter 3D Motion Solver. Unequal numbers of licenses of the solver and Simcenter 3D Motion Modeling products are permitted. It is available on all Simcenter 3D supported hardware/OS platforms (Windows and Linux).

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