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Simcenter 3D Motion Standard Tire

Accurate prediction of tire-road interactions for CAE-based driving dynamics assessment

Benefits

- Accurately predict ride comfort and handling performance of a vehicle with a limited number of tire and road parameters
- Access multiple tire force models with scalable level of detail; suitable models for passenger cars, trucks and buses, agriculture and construction equipment vehicles, landing gear
- Perform high-frequency analyses, such as full-vehicle ride comfort behavior and durability analysis

Summary

Simcenter™ 3D Motion Standard Tire software enables you to model any force component generated by a pneumatic tire in contact with a road surface, including normal or vertical, longitudinal and lateral, as well as all resulting moments. Tire forces are calculated based on the relative motion between the road and the wheel. Various formulations allow scalable modeling of the tire, from non-inertial to inclusion of higher-order effects, making Simcenter 3D Motion Standard Tire the appropriate solution for a broad range of vehicle applications, such as handling, ride comfort, vibration analyses and more. Depending on the selected formulation, you specify a set of parameters, nonlinear characteristic curves and property files representing the physical and/or empirical

characteristics of the tire, and define a road profile, with different formats supported for both 2D curves and 3D surfaces.

Tire formulations

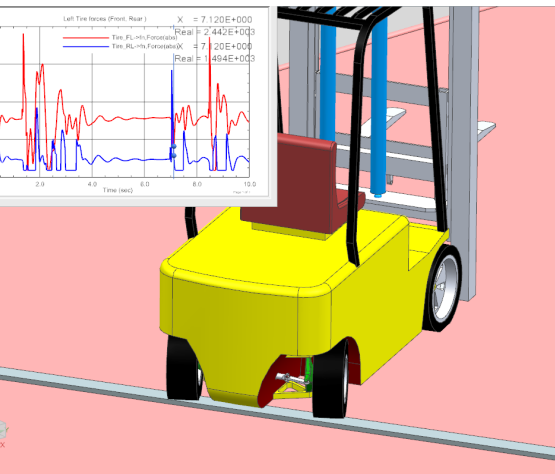
Simcenter 3D Motion Standard Tire includes three tire formulations: the non-inertial tire model, the basic tire model and the motorcycle tire model.

The non-inertial tire model provides the most concise description of the vehicle tire. This formulation ignores the rotational inertia of the wheel, so the body to which the tire is attached must be constrained to the chassis or master body to avoid rotation. Most typical tire properties such as the unloaded radius, road friction coefficient, radial stiffness (constant or nonlinear) and damping, rolling resistance, cornering stiffness and self-aligning moment arm must be defined. The model is valid for a limited range of applications only, such as agricultural tires.

The basic tire model enables you to improve the accuracy by increasing the complexity of the force formulation:

- All rotational degrees of freedom of the wheel are considered
- Longitudinal forces due to the rolling slip can be simulated
- Additional nonlinear properties can be specified, such as cornering stiffness based on tire vertical forces ("carpet plot" properties) and hysteresis on vertical loads

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- Higher-order dynamic effects can be taken into account such as time lags on lateral forces (tire relaxation length) and vibrations of the carcass of the tire

When applying the motorcycle tire model, most of the tire properties must be specified in an external file, and must be defined as coefficients of the industry-standard Pacejka Magic Formula for tire behavior. It is particularly suitable for those applications where the camber angle (the angle between the wheel spin axis and the road plane) can become very large, such as in motorcycle simulations.

Capabilities

Tire modeling

Simcenter 3D Motion Standard Tire includes the following tire simulation capabilities:

- Accurate prediction of radial, traction/braking and cornering loads (including a “carpet plot” look-up table formulation, with the lateral force expressed as function of tire lateral slip angle and the vertical load)

- Roll, self-aligning and overturning moments calculation from these three force components
- Scalable complexity of surface types for longitudinal slip force calculation
- Coupling between longitudinal and lateral loads is supported through the “friction ellipse” approach. This takes into account the mutual limits to force components calculated as a function of friction coefficients and tire vertical force
- Tire carcass effects can be included for high-frequency analyses
- Different resolutions of the tire patch can be considered for a distributed contact normal force model (required for higher accuracy when road profiles contain abrupt changes)
- Support of the third-party tire formulation COSIN FTire (requiring an additional license from COSIN) for accurate prediction of ride comfort behavior and durability loads in full vehicle maneuvers

Road modeling

Simcenter 3D Motion Standard Tire supports the following road modeling capabilities:

- Scalable complexity of road profile definition, from a simple 2D representation (vertical height in function of the longitudinal distance) to a full 3D complex surface
- Moving bodies are supported as road elements, and can be in contact with the tire, for moving road applications such as rotating drum test benches
- Separate road friction coefficients for each tire in the model can be specified to perform specific analyses, such as mu-split braking

Postprocessing

Predefined result sets are available as standard output, such as tire forces and moments, wheel position and orientation:

- Reaction force and torque components on tire from chassis, tire, ground reference frame
- Forces in the tire patch: vertical, longitudinal, lateral
- Tire vertical deflection
- Steer angle
- Steer slip angle
- Camber angle
- Rolling slip
- Rolling resistance
- Friction force
- Normal force unit vectors in road coordinate system
- Velocities at the tire patch: vertical, longitudinal, lateral
- User-defined values

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