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Simcenter Amesim Chassis Systems solution

Design and validation of the chassis, its subsystems and their controls

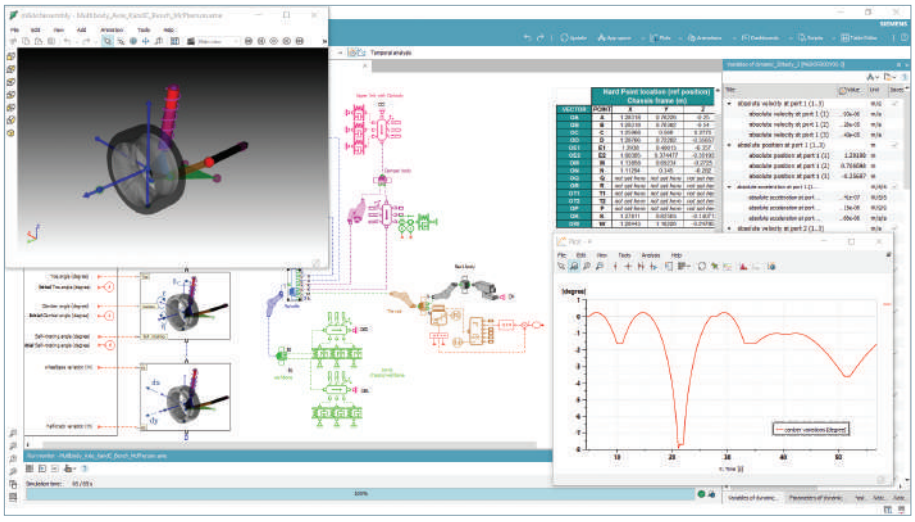
Benefits

- Evaluate global chassis behavior featuring complex subsystem interactions through nonlinear multi-domain physical effects
- Design and validate subsystems and their controls with easy-to-parameter submodels where possible and flexible detailed models (actuator inputs, sensor outputs) where necessary
- Use one software across the V-cycle and generate MiL-SiL-HiL and man-in-the-loop models by leveraging a comprehensive model reduction toolset
- Extend your analysis capabilities with a powerful and scalable physics core which can use a variety of data sources (measurements, simulation results, geometries) and integrates cleanly in your workflow
- Work with user-friendly tools covering the common use cases or leverage the flexibility of the underlying platform to accommodate your specific needs

Summary
Cars and ground vehicles are impacted by major technological shifts (electrification and hybridization), as subsystems interactions become more complex (ADAS, regenerative braking) and expectations grow higher (fuel economy, comfort) – all under the ever-present constraints of cost, safety and regulation.

The Simcenter™ Amesim™ Chassis Systems solution offers dedicated and flexible tools for the design and validation of these complex systems that require integrated multiphysics modeling.

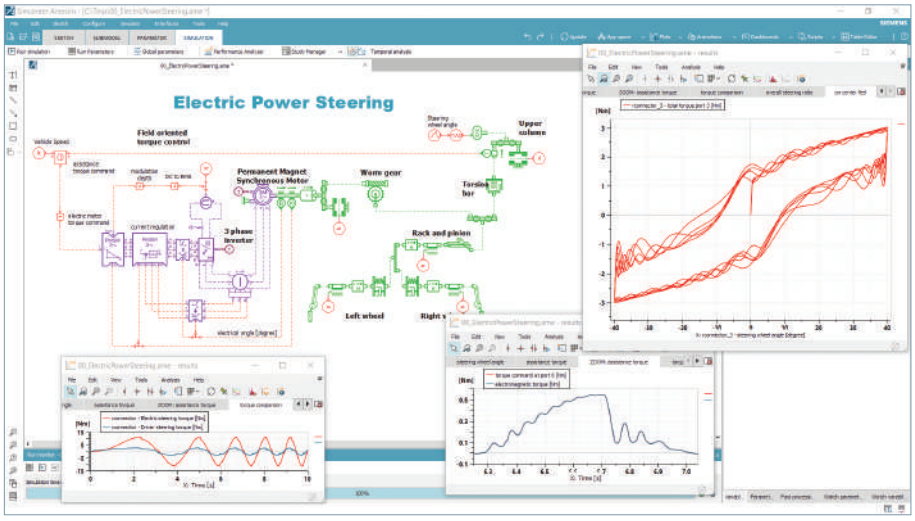
Chassis design
The kinematic and compliance (K&C)-based approach at the core of the chassis systems solution is ideally suited to chassis and subsystem design and evaluation at both ends of the V-cycle. It provides the proper abstraction level to work on chassis handling and comfort without being burdened by the details of the CAD and material properties of the suspension and bushings. This 3D solution relies on kinematic tables that can be created through a variety of workflows or imported from a wide range of sources (measurements, multibody system – MBS – software, geometric description and other K&C-based software).



Simcenter Amesim Chassis Systems solution

Features

- Natively connected with Simcenter Amesim's extensive multiphysics libraries for scalable subsystem modeling
- General and flexible Simulink® and FMI interfaces (connection to control logic, subsystem import, etc.)
- Range of chassis modeling options (simplified, 15 DoF K&C-based, 3D mechanism-based) with associated predefined templates and representative vehicles
- Four-wheel vehicles (with optional trailer), multiaxle and articulated chassis
- Native interfaces to advanced tire models (MF-Swift, FTire) and environment simulation tools (Simcenter™ Prescan™ software)
- iCAR dedicated chassis GUI, data import tools (K&C bench results, kinematic tables from suspension geometries, vehicle description files, GPS trajectories, OpenStreetMap – OSM, OpenCRG), standard maneuvers, 3D visualization and postprocessing (plots and 2D dashboard)



The solution provides you with many tools to simplify and automate the resulting workflows. The specific strength of Simcenter Amesim is its openness and extensive multiphysics libraries that enable you to seamlessly add relevant subsystems and their controls to the core chassis model.

The solution also includes an MBS library and finite element import tools which extend the applicability to higher frequencies and/or nonconventional chassis architectures (off-highway, handling equipment, mobile robotics, taxiing airplanes, and others).

Power steering system modeling

The solution leverages Simcenter Amesim's multiphysics libraries to model hydraulic power steering (HPS), electrohydraulic power steering (EHPS) and electric power steering (EPS). The damping of the physical system is properly represented by the advanced friction models of the mechanical library along with the physics of the hydraulic and/or electrical circuit. This is important when designing and evaluating controls (electronic control units – ECUs) as part of the global, closed-loop chassis system.

The main EPS types are available: belt or direct drive, rack assist, dual pinion, pinion assist, column assist.

For HPS and EHPS you can detail the rotary valve, pump and piping circuit (rigid pipe or flexible hose).

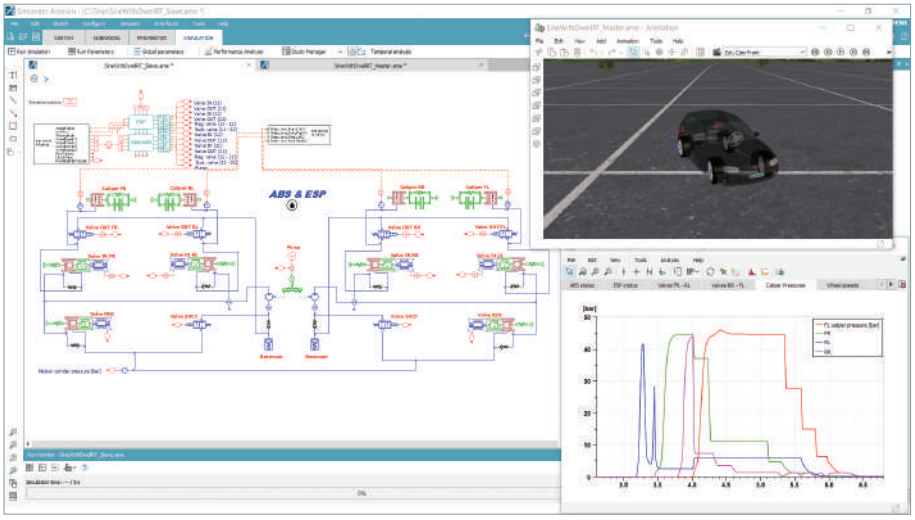
If necessary Simcenter Amesim can be coupled to multibody software such as Simcenter Motion or MSC Adams for advanced studies (shimmy phenomenon and others). The resulting high-fidelity physical models are accurate and enable early evaluation of steering behavior in highly dynamic maneuvers, stability in critical situations (parking) and/or when various ADAS are involved (lane-keeping assist, swerve assist and others).

Braking system modeling

The push towards ever-more intrusive ADAS systems, whether safety-oriented (anti-lock braking system – ABS, Electronic Stability Program – ESP, precharge, advanced emergency braking systems – AEBS) or not (anti-slip regulation – ASR, and off-road assists), and towards regenerative braking has a major impact on the braking system design and validation, as well as its control.

With Simcenter Amesim's unique multi-physics libraries the solution handles hydraulic and pneumatic braking systems and their interaction with regenerative braking (electric actuators, electric circuit and batteries) and allows you to create models featuring the inputs to actuators and outputs from sensors that are crucial to design and validate the system.

Whether you are designing an individual component, the complete hydraulic (or pneumatic) braking circuit or are testing control strategies (with software in the loop – SiL, or hardware in the loop – HiL), you will have the right level of detail. Applications include pressure valve stability of ABS/ESP systems, cavitation and noise in the master cylinder, vehicle stability with X, H and I hydraulic architectures, pedal-feel and regenerative braking.



Suspension and anti-roll
The solution covers passive, semi-active and active suspensions. Its applicability ranges from detailed design of components (inner valves of a damper) to the design and validation of an advanced system involving active pumps, air springs and hydraulic connections between wheels with a vehicle driving on a realistic road (in the OpenCRG standard format).

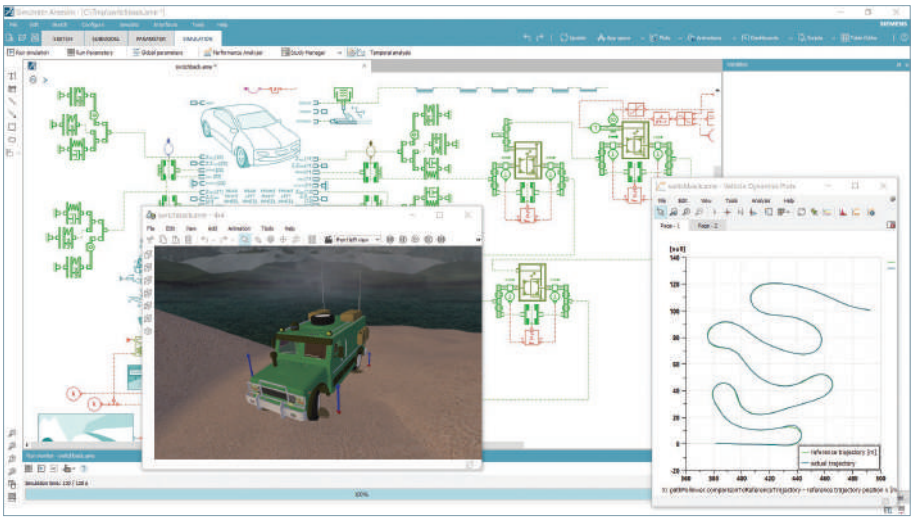
Compare the comfort and handling of various designs in simplified test cases or with a full chassis featuring advanced tire-ground models. Validate your controls via SiL and HiL simulations.

Driveline
A large part of the powertrain and driveline design occurs in a purely longitudinal world but there are times when you must consider a dissymmetric context.

Traction management: when traction is unevenly distributed, whether because of uneven grip or uneven vertical load (weigh transfer during cornering, in a slope, bumps), engineers seek to limit the power sent to the least grippy wheel. Coupling the driveline with a 3D chassis enables you to evaluate the performance of the vehicle in those common, but complex, situations (including limited slip differential – LSD, anti-slip regulation – ASR, and use of auxiliary electric/hydraulic motors).

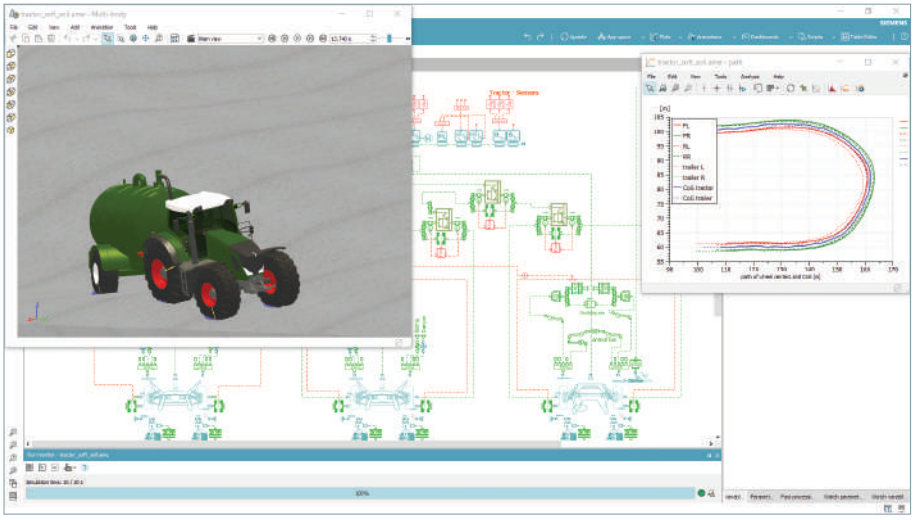
Torque vectoring: vehicle lateral stability is critically influenced by motor and braking torque. To ensure optimal behavior in all use cases with today's complex drivelines (4-wheel drives, hybrids and others), engineers need a multiphysics, full-vehicle model.

Vibrations and abuse load: vehicle electrification completely changes the dynamics of the driveline, and with it the intensity and frequencies of loads encountered on half shafts and engine rubber mounts, for example in wide open throttle (WoT) mu-split situations. The flexibility of the chassis system solution and robust multiphysics solver enable you to predict and design for those critical load cases within a single coherent package.



Control and ADAS
Simcenter Amesim offers a solution for both ends of the V-cycle, allowing for global simulation of the vehicle system as well as detailed multiphysics modeling of the actuators and sensors (proprioceptive in Simcenter Amesim or exteroceptive when coupled with Simcenter Prescan or other environment simulation tools). From early control architecture choices to SiL, MiL, HiL or driver-in-the-loop based validations, Simcenter Amesim's unique multiphysics and chassis package enables you to model the complex interactions occurring across the vehicle physical system, its controls and the environment.

The numerous subsystem assembly possibilities (Simulink, FMI, encrypted components) enable you to connect the plant model and its subsystems to the control layers while respecting the confidentiality and IP requirements of the multiple stakeholders involved.



Some applications may require additional libraries such as Powertrain, Electric storage or Pneumatic. They are included in the auto package. Real-time export requires the corresponding option.

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