



DYMOLA – Vehicle Dynamics Library Car Suspensions

Overview

- Suspensions modeling and analysis for passenger cars and light trucks

Key Features

- Multi-body suspension and steering models
- Template-based design for flexible reconfiguration
- Active components
- Automated analysis

Benefits

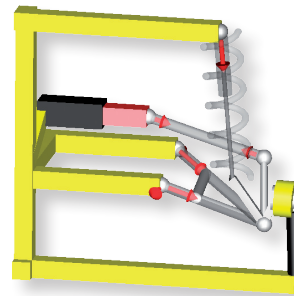
- Develop and evaluate suspension and steering geometry, compliances and control in a full vehicle simulation environment
- Integrate active suspension components for improved ride and handling.

The VDL Car Suspensions Library targets suspension and steering system development. It provides detailed suspension modeling and analysis capabilities, both on subsystem level and in chassis and vehicles. This includes both ready-to-use topologies, test rigs and experiments, templates and components. The suspension models are useful for studying the effects of mechanical re-design or to analyze or design actively controlled suspension with embedded actuators.

> Modular layout

All suspension and linkage models are designed with dedicated joint, link, and mechanism models. These components are special for the geometric suspension option and features hard point description, adapted animation, elastic properties, force visualization and more. This makes it easy to design configurations from scratch or modify existing ones. The library comes with a set of predefined geometric layouts adapted to passenger cars and light trucks, including McPherson, double-wishbone, trailing arm, five-link, live axle, and many more. As for any other Vehicle Dynamics Library subsystem, it is straightforward to customize suspensions and add active components for e.g. control design.

Additionally, experiments and test rigs for dedicated analysis are included. This facilitates evaluation already at subsystem level.



Animation screen shot from a suspension linkage test. The arrows indicate how the forces are transmitted through the linkage.

> Steering systems



Steering linkage with 3D representation of shaft and joints, including the resulting nonlinear steering wheel-to-rack ratio.

> K&C analysis

As kinematic and compliance (K&C) is a key analysis for suspension design, the library comes with predefined functionality for automation of the required simulations, including generation of the characteristics plots which makes comparison with measurements straightforward. Since the suspensions are built from dedicated components, it is convenient to study suspension load. By just turning on the animation, the force transfer through the suspension can be visualized.

> Automatic tabular conversion

Special joints have been developed to take tabular data as input. This makes it possible to entirely represent a kinematic linkage with tables. The Suspensions library provides a conversion from suspensions to tabular data, as well as experiment setups for verification simulations.

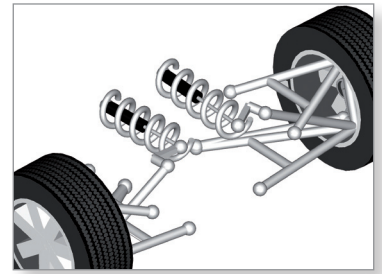
To capture the steering-wheel moment characteristics, accurate models of the kinematics, compliances and friction are included. The physical detail of the models makes it straightforward to add sensors and actuators to study new concepts in power assist, active front steering, steer-by-wire, and similar systems.

> Customization

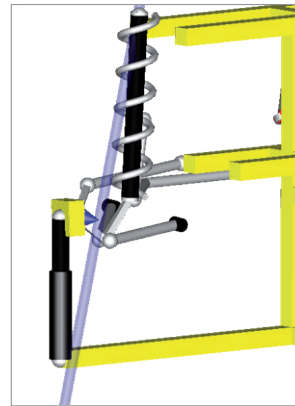
The openness of Vehicle Dynamics Libraries provides unrivalled possibilities for customization, both in component and experiment design. The illustration below shows a linkage design based on two linear actuators that replace the lower control arm and steer link. It allows for both steer and camber control, with built-in redundancy.

Based on the available test rigs and sensors, it is straightforward to define one's own analysis. This is illustrated by the king pin visualization seen below. The suspension is a McPherson strut with separate lower links, allowing for greater flexibility in positioning the king pin axis. Here, an instant rotation axis sensor is used to keep track of the king pin motion, with the resulting axis visualized as a blue line.

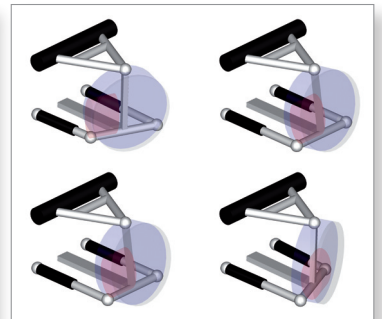
The Car Suspensions Library is developed, supported, and maintained by Modelon AB, a Dassault Systèmes technology partner.



Rear double wishbone suspension for a formula car with inboard mounted spring-damper packages.



Suspension linkage with two lower links replacing the A-arm mounted in a test rig. The resulting king pin axis is visualized as a blue bar.



A custom active suspension linkage with individual camber and steer control based on two linkage actuators (below).

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