

# VEHICLE SYSTEMS MODELING AND ANALYSIS (VeSyMA) SUSPENSION LIBRARY

Develop suspension systems for vehicle dynamics including road, driver and stability control models

## VEHICLE DYNAMICS AS A BUSINESS EXPERIENCE

More and more vehicle dynamics is focusing on active suspensions, where actuation, torque vectoring and control models are part of the equation to provide the best experience and safety to the occupants.

The VeSyMA Suspensions library offers an extensive solution for active suspension development, by providing a complete set of suspension, rig, experiment models and templates within a unique multi-discipline approach.

Focused on the optimization and analysis of automotive and on-road vehicles, where the basic vehicle layout is that of a pair of independent linkages connected by an anti-roll bar, the Suspensions library provides the user with a turn-key solution to detailed vehicle dynamic analysis.

## VESYMA LIBRARY

The core of the Suspensions library is multiple multibody steered/non-steered independent linkage models of various layouts and configurations, built to be easily parameterized and integrated into a vehicle model. Further detail can be provided by lumped compliance blocks and mounting bushes, enabling kinematic and compliance (K&C) effects to be captured and included in a full vehicle model. The same principle extends to anti-roll bar models, with an array of options available to model various mounting scenarios. Common steering mechanisms rack, pinion and pitman arm are available with various power assistance and manual options.

Moving beyond linkages, a full vehicle dynamic analysis suite is provided by detailed road models, encompassing both high-frequency/low-amplitude road roughness and low-frequency/high-amplitude curbs. Undulations and camber are also included. Flat/smooth road models are utilized for rig tests with wheel patched, whilst specifically designed actuators can be employed to simulate a full vehicle K&C experiment. Tire models available include Pacejka MF 6.1/6.2 models, with F-Tire supported as well as the option for multi-threading available. Closed and open-loop driver models complete the library, enabling the user to understand vehicle dynamics and handling performance in a repeatable virtual test environment.

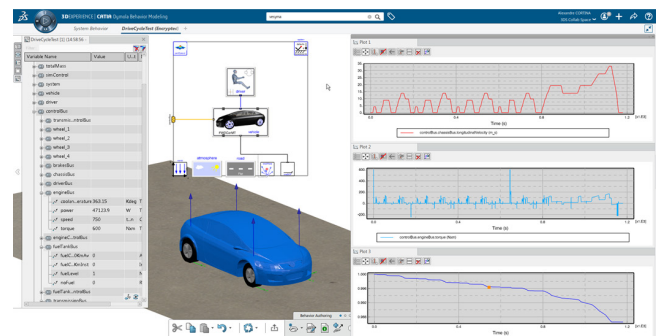
## HIGHLIGHTS

- Top-level and sub-system templates and interfaces for diverse vehicle models using the open standard Modelica language
- CAN-bus style control bus for vehicle data signal distribution
- Multibody ideal manual, automatic or automated manual dual clutch transmission models

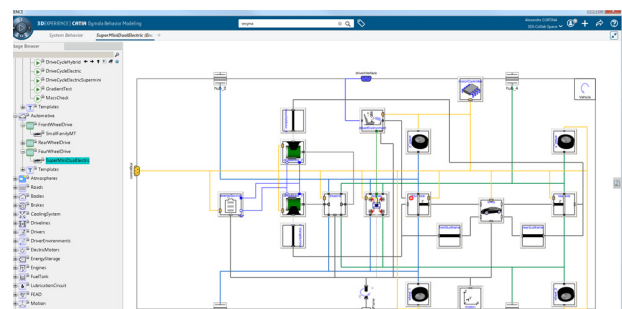
- Mapped petrol and diesel engine models including multibody and frictional effects
- Variable fuel tank mass with dynamic center-of-gravity position and inertia
- 1D independent brake models, from idealized to hybrid compatible, brake-by-wire and single/twin cylinder pseudo-hydraulic models
- Table based DC motor with static and dynamic state-of-charge (SOC) battery models
- 1D drivetrain, including FWD, RWD and 4WD layouts

## BENEFITS

- Accelerate vehicle performance investigation through an intuitive open and modular approach
- Predict fuel economy for standard and specific drive cycles, based on multi-domain simulation
- Simplifies the understanding of vehicle sub-system interactions and behaviors
- Streamlines the processes for further specialized investigation such as vehicle dynamics, or electrified powertrain development
- Open to other disciplines system-level investigation and energy usage, such as occupant thermal comfort



Drive cycle test for torque and energy assessment



Electric Vehicle Architecture

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