

## DYMOLA – Vehicle Dynamics Library Drivelines

### Overview

- Modeling, simulation, and analysis of vehicle driveline and powertrain

### Key features

- 3D effects
- Animation
- Reusable templates
- Conventional and hybrid modeling
- Simulation performance
- Seamless integration of detailed powertrain models with chassis and brakes

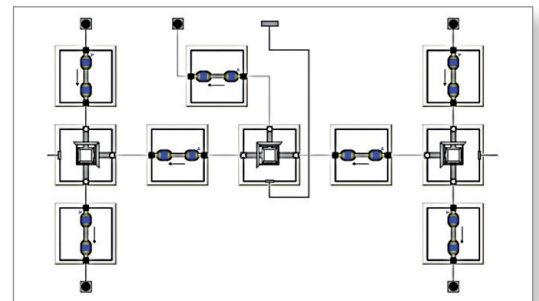
### Benefits

- Simulate drivelines at a fraction of the time necessary for standard multi-body representations
- Time and cost savings
- Improved collaboration between departments
- Concurrent engineering

The VDL Drivelines Library is intended for the development of vehicle drivelines, especially 3D effects of shafts, joints and gears. This library contains a template structure that enables convenient design of different topologies, both hybrid and conventional.

### > Faster simulation

The driveline models are based on Modelon's Rotational3D library which allow for a much more efficient simulation of 3D effects compared to standard multi-body representation. This means that effects such as the torque ripple due to universal joints are captured even in complete vehicle system simulation.



Template-based 4WD driveline with replaceable differentials and shafts.

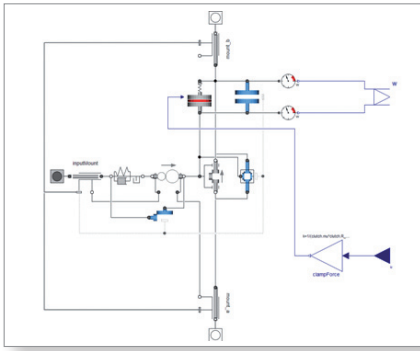


Diagram view of differential model with clutch.

### > Flexible design

The VDL Drivelines Library extended with a template-based infrastructure where each component, such as a differential or a shaft, is easily replaceable. This makes it convenient to configure drivelines with and without active components. Users can define own templates by drag-and-drop modeling, which makes it easy to implement custom designs, and to do concept evaluations. Custom components can be created easily using basic components from the Rotational3D library.

### > Hybrids

Modeling of hybrid and electric drivelines is straightforward. Detailed electrical machine models from libraries such as Smart Electric Drives or Spot may be used in conjunction with mechanical driveline components to produce models with high fidelity in both electrical and mechanical domains. Simplified models of electrical components will soon be available in the Drivelines option to allow even simpler modeling of hybrid and electric configurations.

### > Testing

Driveline analysis benefits from the wide range of predefined test possibilities in VDL. VDL features a full 3D road description which makes it convenient to study effects of up- and downhill driving. Time-based studies such as drive cycle experiments are convenient to do in VDL; there are drive-cycle following drivers that can be used directly. Additionally, roads

can have inclination which makes it convenient to study effects of up- and downhill driving. The plots to the right show the speed and battery state of charge for a drive cycle experiment.

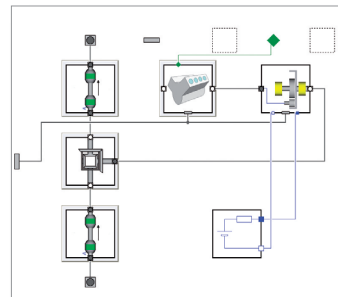
### > Driveline control

With VDL it is convenient to expand an analysis from a pure longitudinal study. This can for example be in terms of more transient behavior and load transfer effects for traction slip control. Furthermore, it is convenient to add lateral effect to the analysis when required, for example to study vehicle stability at regenerative braking or performance enhancements by torque vectoring or direct yaw control. Driveline control design can easily be extended and combined with the systems from the Active Safety add-on, the detailed gearboxes and differentials from the Power Train Library, as well as integrated with hybrid components.

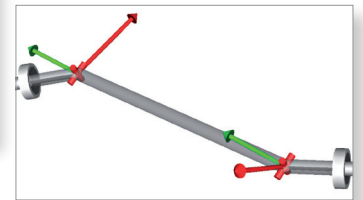
### > Reaction forces and torques

The shaft models describes the 3D torque and force balance which means they can be used to calculate reaction torques generated by shaft bending in combination with drive or brake torque.

*The VDL Drivelines Library is developed, supported, and maintained by Modelon AB, a Dassault Systèmes technology partner.*



Template-based Prius-type hybrid driveline with detailed electric machine models from the Smart Electric Drives Library.



Animation snap shot from a driven shaft, showing how the drive torque (green) generates reaction forces in the joints (red).

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