

Open Simulation Models

- **dSPACE Simulator and models from a single source**
- **Perfect HIL integration**
- **Graphical parameterization in ModelDesk**

Automotive Simulation Models (ASMs) are a new product line from dSPACE, providing simulation models for developing and testing automotive electronic control units (ECUs). The models are designed for engine and vehicle dynamics simulation and have their own graphical user interface, ModelDesk. They are ideal for both online and offline simulation. We focus on hardware-in-the-loop (HIL) simulation here.

dSPACE is the world's most successful provider of HIL solutions and was recently recognized as the "Leading Manufacturing Test Company of the Year" by Frost & Sullivan for its pioneering achievements. These lay mainly in developing simulator hardware and the necessary operating and control software (ControlDesk, Real-Time Interface, etc.). The models of the controlled systems that were used in simulation came from other manufacturers or were developed by customers themselves. However, a simulator and the model running on it need to be regarded as a single unit, and an increasing number of customers were asking their system supplier, in other words dSPACE, to meet special requirements. To respond to customers' requests faster and better, we decided to develop our own models.

Integrating HIL Models

In the real world, even the best simulator cannot reach its full potential if it cannot be adapted properly to project requirements. So flexibility in commissioning and modification is a vital requirement for any HIL system. We have therefore given our new Automotive Simulation Models the features they need for better integration into customer projects and for faster modification processes.

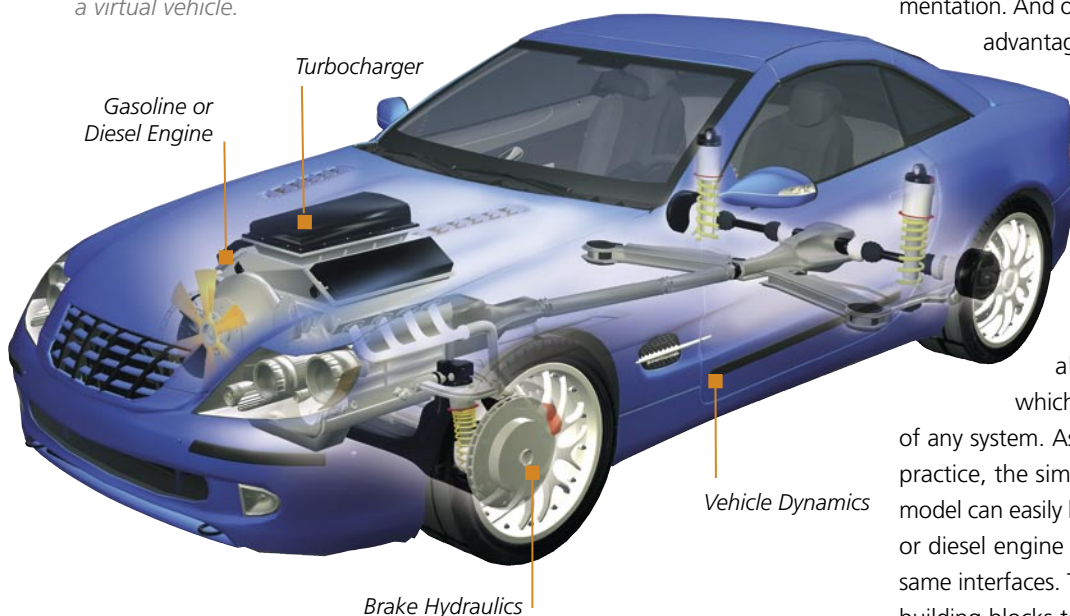
Open Simulink Models

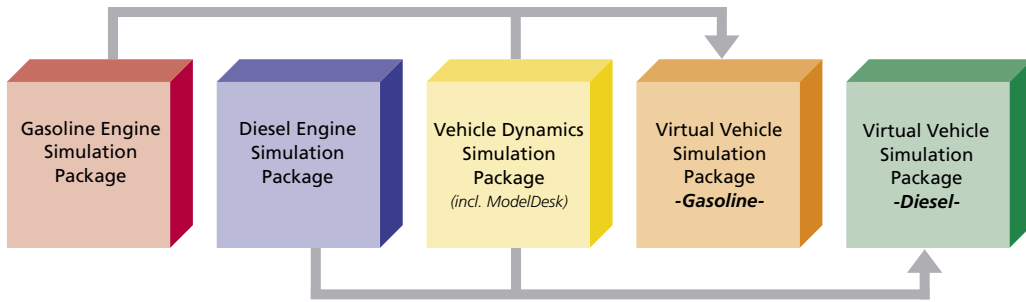
The ASMs are implemented completely in Simulink®, and a major feature is that they are visible to users right down to the level of standard Simulink blocks. This means that users can view the models and modify them, with the assistance of comprehensive documentation. And open models have another invaluable advantage: they provide direct access to vital parameters during simulation.

Seamless Interfaces for Interoperability

The engine, drivetrain, and vehicle dynamics systems all share the same interface concept. This is based on two variables, engine speed and torque, which form the input and output signals of any system. As an example of what this means in practice, the simple engine in the vehicle dynamics model can easily be replaced by the complex gasoline or diesel engine model, as all the systems have the same interfaces. The models can be put together like building blocks to construct more complex systems, right up to a virtual vehicle.

▼ Use ASMs to build a virtual vehicle.





◀ Overview of simulation packages.

User-Friendly

Combinations of simulators and models from different manufacturers typically require a certain amount of adaptation work. The ASModels and dSPACE Simulator are ideally adapted to one another. This is immediately apparent when the I/O models and the controlled system models in a simulator are initialized: their start-up procedures interact perfectly.

The model signals are available in a hierarchical bus, the ASMSignalBus, implemented with the Simulink Bus Selector. As an example: to find the pressure in the common rail system of a diesel engine, the path through the bus is Engine – Fuel System – Rail – p_Rail. With the ASMSignalBus it is easy to connect the Simulator's I/O hardware to the associated signals.

ModelDesk currently supports the vehicle dynamics and brake hydraulics models, and can provide parameter sets for offline and online simulation.

ASM Packaging

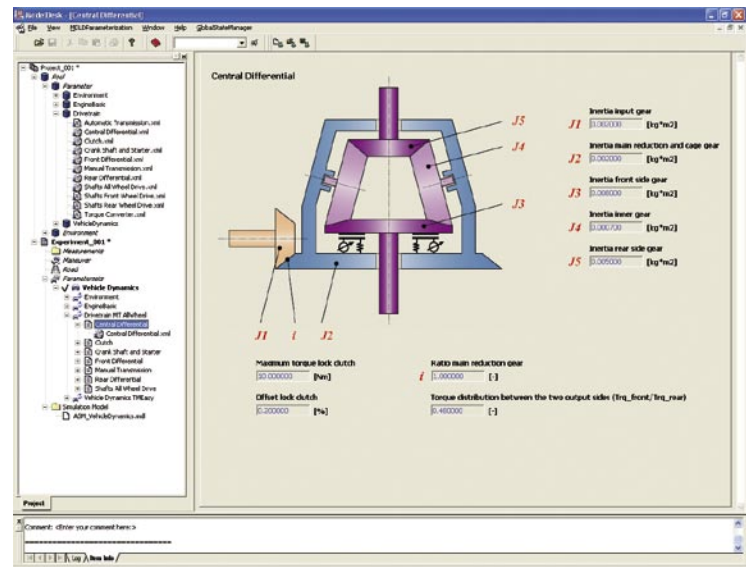
The following simulation packages will be available at launch:

- Gasoline Engine Simulation Package
- Diesel Engine Simulation Package
- Vehicle Dynamics Simulation Package

▼ Parameterizing a differential in ModelDesk.

ModelDesk

ModelDesk is a graphical user interface for parameterizing and managing parameter sets. It contains graphical tools for creating roads and planning maneuvers. ModelDesk finds the automotive components of a model and displays them in graphical form. If brake hydraulics are added to the vehicle model, ModelDesk displays the appropriate graphical parameter pages. The intuitive user guidance is also graphical: clicking a differential in the drivetrain displays the parameterization page for that differential, for example.



Engine Models in Brief

The engine properties are represented by a mean-value model with crankshaft-angle-based torque generation, dynamic simulation of the air path, and several injection models. To simulate the engine in a vehicle system in a closed control loop, the engine model has a drivetrain with longitudinal dynamics and either manual or automatic transmission, and models for the driver and the soft ECUs.

Vehicle Dynamics Model in Brief

The physical vehicle properties are modeled as a multibody system with 32 degrees of freedom. The model contains a drivetrain with elastic shafts, a table-based engine, two semiempirical tire models, a nonlinear vehicle multibody system with table-based axle kinematics/elastokinematics and aerodynamics, and a steering system model. It also includes an environment model consisting of a road, driving maneuvers, and a driver.

☰ ASM flyer