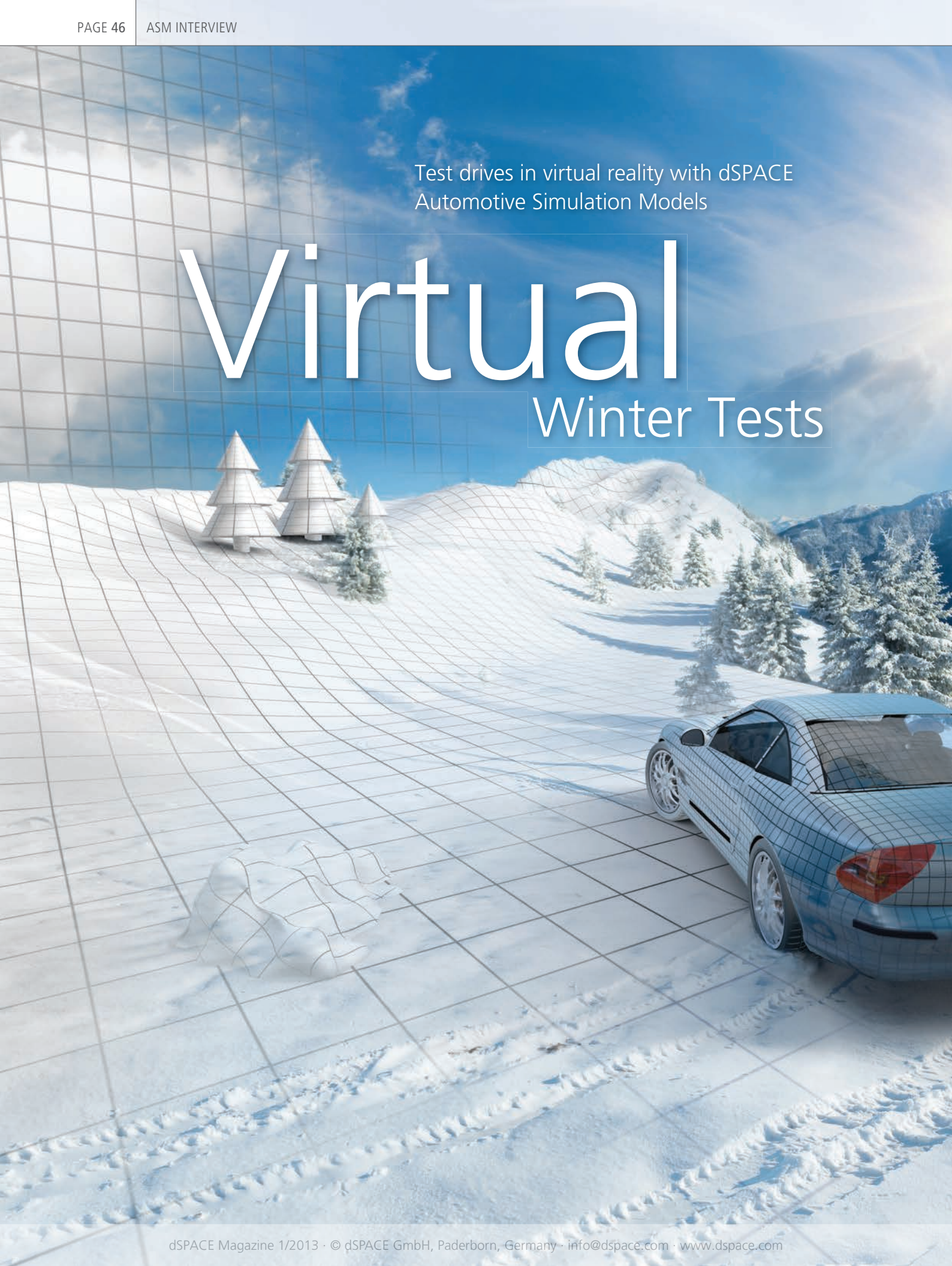


Test drives in virtual reality with dSPACE  
Automotive Simulation Models

# Virtual

## Winter Tests





No modern vehicle ever reaches the market without first undergoing exhaustive tests. And test vehicles alone are no longer enough to test the complex electronic control units. This job is performed by simulation models, which shift ECU development into the virtual reality of a virtual vehicle.

Dr. Hagen Haupt, head of dSPACE's Modeling Group, explains how the dSPACE simulation models are meeting this challenge.

*What are the Automotive Simulation Models (ASM)?*

The Automotive Simulation Models (ASM) are plant models, or in other words, they are a virtual, model-based substitute for a controlled system. They were created in MATLAB®/ Simulink® and support all the essential simulation tasks in the electronics/ electronics development process. dSPACE provides models for combustion engines, electric components, vehicle dynamics and driver assistance systems. We first launched them on the market in 2005, and have been extending them continuously ever since.

*What were the goals, and what has been achieved so far?*

From the beginning, we have had two main goals: One was to give our customers the option to obtain all the components needed for HIL simulation from a single vendor, since this provides enormous configuration, operation and maintenance benefits. And the other was to focus on making the simulation process more

seamless and efficient by allowing valuable know-how to be used across multiple teams and projects, from function development to HIL testing. We are now able to provide this seamless integration for developing and testing ECU functions in all currently relevant vehicle applications.

*What are the main advantages of the models?*

What our customers particularly appreciate is the openness of the models. Not only can they trace the implementation of modeled components right down to the level of individual Simulink blocks, they can also adapt the models themselves. The entire process is streamlined by using the same models and parameterizations from function development to HIL tests. Maximum convenience for handling simulations is provided by the graphical tool ModelDesk. This is the central location for configuring and parameterizing models, starting the simulation, and visualizing the simulation results – seamlessly from offline simulation to HIL simulation.

## ASM Model Portfolio

### Models for combustion engines:

- ASM Diesel/Gasoline Engine (mean-value models)
- ASM Diesel/Gasoline InCylinder (physical models)
- ASM Turbocharger (physical model)
- ASM Diesel Exhaust System (physical model)

### Vehicle dynamics models:

- ASM Vehicle Dynamics
- ASM Truck
- ASM Trailer
- ASM Brake Hydraulics
- ASM Pneumatics
- ASM KnC

### Environment model:

- ASM Traffic
- ASM Environment

ASM Video Channel



### *What special features do the models have?*

One strong point is that they have standardized interfaces that let users combine models like building blocks, to tailor them precisely to the scope and quality required for each specific application. For example, they can put together models that represent a hybrid drive with a specific battery cell characteristic.

ments at Daimler in Stuttgart, Nissan in Yokohama, and Scania in Sweden. Our models are also used by GM in America, Volkswagen in Europe, and Mazda in Asia, to name but a few. The heavy vehicle sector is represented by Caterpillar, Volvo, WABCO and others. These companies particularly appreciate our powerful variant management, which helps them parameterize and simulate vehicle variants.

## dSPACE plans to strategically extend the range of models provided for electromobility and driver assistance systems.

This is easy to do in the graphical tool ModelDesk, which is another boost to productivity. Another strong point is that the models match the dSPACE hardware very well. This supports the emulation of cell voltages, the simulation of electrical drives for process-based or FPGA-based calculations, etc. etc.

### *Why do so many companies rely on ASM?*

One reason is that the ASMs provide a complete portfolio from engines to traffic models, enabling entire virtual vehicles to be simulated together with their environment. dSPACE is currently the only vendor to offer such a comprehensive range of models. Another aspect is that many of our customers no longer want to do all the maintenance and development work involved in using their own in-house models. Changing to the ASMs saves them a lot of work. At the same time they remain flexible enough for customer-specific adaptations, thanks to the openness of the ASM. And whenever their

### *Which customers use the models?*

Even though the market launch of the models was only a few years ago, there are now 800 licenses at 250 customers all over the world. This especially includes major automobile manufacturers and suppliers, and also several universities. Recent newcomers are important depart-



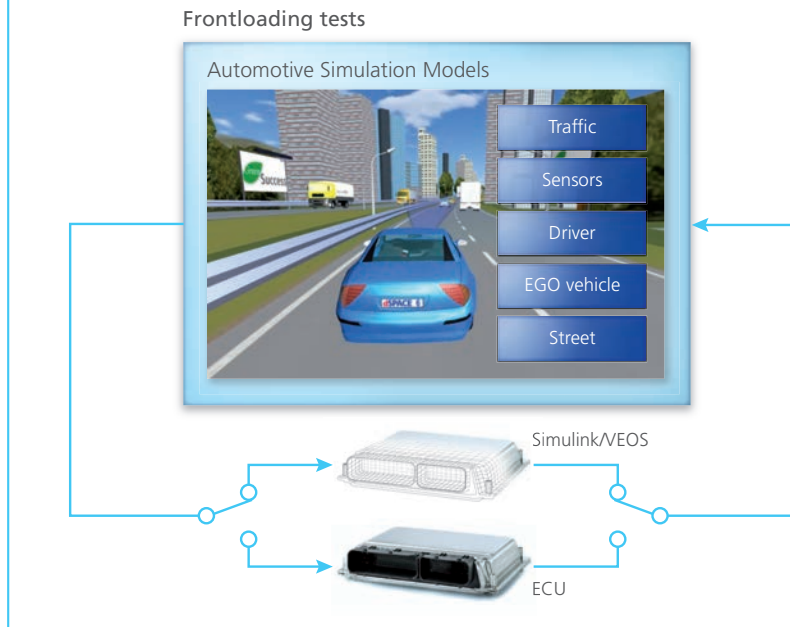
developers face new simulation tasks, they can either quickly find whatever they want from our well-established model portfolio, or further develop the models with our support.

#### *What application fields will the ASMs be tackling next?*

The main ones will be electromobility and driver assistance systems. Our customers are very active in these fields, and we will support them with simulation models. The ASM Traffic Model is already facilitating the development of ACC, emergency braking, lane keeping and parking assistants. Car2x is also a very exciting development field, and we will be launching simulation tools for this some time this year. Simulating traffic at junctions, map-based systems, and object recognition are just a few examples. The key to all of this is a flexible, convenient environment simulation – this is where ModelDesk comes in. In the field of electric drives, we will be adding more precise component models to our portfolio, including FPGA-based ones. We are also advancing classic application fields like combustion engines and vehicle dynamics simulation, for example, by further developing high-resolution cylinder pressure simulation for combustion-based engine controls and enhancing ASM KnC as a virtual suspension test bench.

#### *How are you preparing for the development challenges of the future?*

Electrics/electronics systems are growing in functionality and also becoming more highly networked. As a result, larger and larger models have to be combined. This leads to new challenges regarding not only the contents but also the handling of the models. To facilitate handling, we will provide highly integrated data management. Connection to



*The ASMs enable early, integrated testing in the automotive E/E development process.*

dSPACE is the only model vendor who covers the entire scope of automotive simulation from engines to road traffic.

dSPACE's data management and collaboration software SYNECT® will play a major role here. Packages built from ASMs and dSPACE VEOS® will offer powerful solutions dedicated to offline simulation.

#### *How do you acquire the know-how for simulations?*

When developing the ASMs, we cooperate closely with our users, so whenever new requirements come up, we can include them in our development plan immediately. Some parts of models that were developed in customer projects go straight into the product. And for specific tasks, we work with partners who already have the relevant experience. In the important application fields of electromobility and driver assistance systems, we are actively involved in the Toolbox Speichersysteme, TRAFFIS and Vir-

tual Car2x research projects. Well-founded research results coupled with dSPACE's practical experience and modeling expertise are the ideal foundation for powerful simulation models to perform the simulation tasks of the future.

*Thank you for speaking with us, Dr. Haupt.*



*Dr. Hagen Haupt is in charge of simulation model development at dSPACE GmbH.*