Fuel Cell Systems

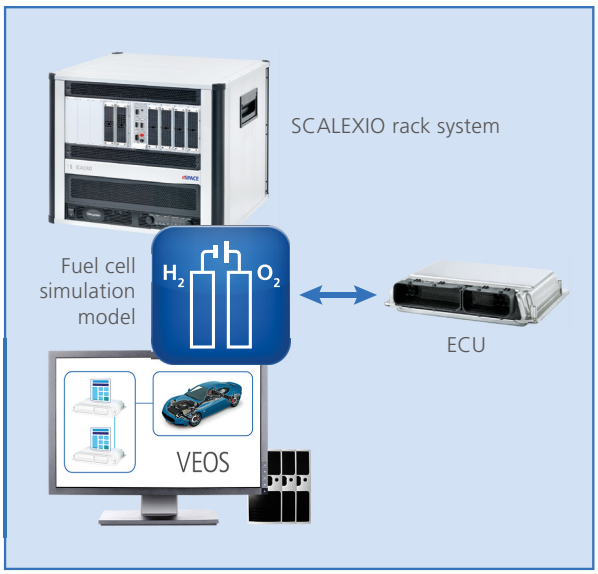
Developing and testing state-of-the-art fuel cell control systems

Highlights

- Scalable solutions for testing from SIL to HIL, including VEOS and our SCALEXIO off-the-shelf systems
- Open Simulink® fuel cell system models for in-the-loop systems
- Simulation model that includes cell-internal electro-chemical reactions as well as the air and the hydrogen supply path

Application Areas

When it comes to commercial vehicle propulsion, fuel cells are becoming increasingly important. A typical fuel cell system consists of an air supply path (cathode), a hydrogen supply path (anode), and a cooling circuit. Fuel cell vehicles therefore require an electronic control unit (ECU) to control the operation of the fuel cell system and its individual subsystems. As with any other application, these ECUs have to pass extensive tests before being introduced to the market. dSPACE has the right tools to support you in developing and testing state-of-the-art fuel cell technologies.



Key Benefits

The fuel cell ECU uses various control algorithms to actuate the components related to the fuel cell system, including hydrogen injection, valves, pumps, and compressors. During ECU tests, the test system must appropriately process the actuation controls. At the same time, the sensor values from the fuel cell system, such as pressure and temperature, must be provided continuously to the ECU.

dSPACE offers industry-proven hardware-in-the-loop (HIL) test systems in which a simulator performs all relevant functions required for the operation of the ECU, e.g., SCALEXIO systems.

In addition to the hardware components, the tests require mathematical descriptions of the fuel cell system, called plant models, and optionally of the system's environment. Plant models of fuel cells have to fulfill various requirements, including strong computation performance (real-time capability), scalability, and model accuracy. dSPACE will support you in meeting these requirements by providing suitable models for the fuel cell system and test environments (e.g., full truck simulation) in the Automotive Simulation Models (ASM) portfolio. For more information on our standard fuel cell simulation model, see the next page.

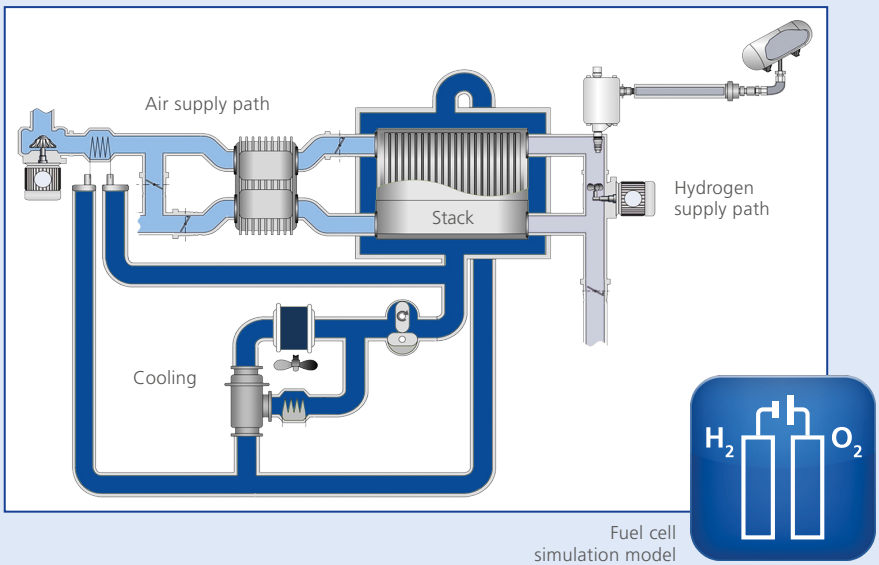
The fuel cell simulation model is calculated on the dSPACE test system suitable for your application, e.g., a SCALEXIO rack system for HIL testing or VEOS for PC-based simulation.

dSPACE

Fuel Cell Simulation Model – Components and Characteristics

Model Structure

Our standard fuel cell simulation model is provided as a ready-to-use model and includes different model components. To make the model intuitive and easy to handle, it is set up in the same way as the real fuel cell system, which consists of four subsystems: the cathode and the anode supply systems, the stack itself, and the cooling system. The performance of the fuel cell system is evaluated on the basis of the existing loss phenomena, including activation, ohmic, and concentration losses. The transport phenomena and the reaction mechanisms of the different gas types as well as the water management are considered as well. Our fuel cell simulation model can be adapted to any customer application and parameterized accordingly.



Model Components

- Fuel cell stack
- Cathode
  - Compressor
  - Air cooler
  - External humidifier
  - Throttle valves
- Anode
  - Tank and rail system
  - Injection valve
  - Drain valve
  - Recirculation pump
- Cooling circuit
- Soft ECU

Full Integration into the ASM Tool Suite

The fuel cell simulation model is fully integrated into our Automotive Simulation Models (ASM) tool suite and follows the same modular approach. This makes the model scalable for any application area – from component tests to full-vehicle tests and from passenger cars to truck trailers.

ASM is a tool suite which consists of simulation models for automotive applications that can be combined as needed. The open Simulink® models are used for model-based function development and in ECU tests on a software-in-the-loop (SIL) or hardware-in-the-loop (HIL) simulator.

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