ETAS GmbH

Borsigstraße 14
70469 Stuttgart, Germany
Phone +49 711 3423-2240

Press and Public Relations:
Anja Krahl

anja.krahl@etas.com
www.etas.com

Press Release

Fast, scalable simulation of fuel cell systems

- ETAS transfers simulation know-how from IC engine powertrain technology to fuel cell drives
- Scalable, real-time capable models of complete fuel cell systems support efficient function tests for ECUs
- Realistic simulation of temperature and current behavior in the fuel cell stack

Stuttgart, June 1, 2016 – Hydrogen mobility is off the blocks. By 2023, it is estimated that hydrogen fuel will be available at 400 filling stations around Germany. Toyota, Honda, and Hyundai have already included their first production vehicle models with fuel cell drives in their ranges. Mercedes has announced that it will enter the market in 2017. In addition, a growing number of preproduction vehicle studies featuring the new powertrain technology are appearing at trade fairs. An important key to success is the safe functioning of the system. This requires comprehensive tests using simulations in order to achieve cost and quality objectives.

Every step closer to series production increases cost pressures. If fuel cell drives are to survive direct comparisons with IC engines, the vehicle's acquisition costs play an important role. Furthermore, fuel cell drives must work safely, reliably, and above all efficiently. To help the new technology break through, there is a need to minimize costs for the fuel cell and its electronic control while maximizing the efficiency of the system.

New fuel cell model for efficient development processes

Simulation methods have become established tools for optimizing IC engine powertrains. This is not surprising, when function tests of ECU software can be carried out quickly and cost-effectively in Hardware-in-the-Loop (HiL) or Software-in-the-Loop (SiL) processes. What is more, they are reproducible and able to safely cover critical limit ranges. With its new LABCAR-MODEL-FC (Fuel Cell) simulation model, ETAS has extended these advantages to fuel cell drives.

Using this new scalable and real-time-capable fuel cell model, developers can quickly, precisely, and realistically test powertrain control functions. This makes the whole development process more efficient. Another major advantage of the model is that critical operating states can also be tested virtually without having to use real vehicle or powertrain components. Consequently, there is no risk of damage to expensive test benches, and elaborate safety precautions for failure scenarios can be dispensed with.

The new simulation model has a modular design. Fuel cell systems can be modeled in their various configurations, including stack and peripherals. Developers have a component library at their disposal for the implementation of customer-specific simulation model variants. Even complex cell behavior can be simulated in this way – for example, through the use of predefined membrane models. The membrane models simulate the exact electrochemical processes that are decisive for current generation and temperature behavior in the stack. Cold-start effects are also taken into account in the model.

To allow developers to approach the complex behavior of a stack made of polymer electrolyte fuel cells step by step, the degree of detail can be changed at any time. To this end, ETAS offers stack models with two different levels of detail. Whereas LABCAR-MODEL-FC provides a basic model, LABCAR-MODEL-FCCAL (Fuel Cell Calibration) is also capable of displaying spatially resolved behavior in stacks. This makes it possible for users to observe various humidification profiles or non-linear current distribution.

Easy to handle and to integrate into existing model landscapes

The new fuel cell model integrates seamlessly into ETAS' existing LABCAR-MODEL landscape. For example, the model can be incorporated into complete vehicle models or combined with battery and electric motor models. It is also compatible with MATLAB/Simulink®, so that OEMs and suppliers can integrate the model quickly and without any problems into their established tool chains. Thanks to its open simulation architecture, the model can also be used with solutions from third-party providers such as IPG, TESIS, and Modelon. In this way, developers can simulate a wide range of vehicle architectures, adapt the model granularity to the project stage, and adjust the complexity up or down according to specific needs.

ETAS has transferred its many years of HiL system and model know-how from the development of conventional powertrains to hydrogen mobility: the user-friendly model offers the flexibility required for comprehensive virtualized tests of ECU functions in precisely the variety of operating states, management strategies, and system configurations that are needed for the effective development of efficient drive solutions. This enables developers of fuel cell drives to iteratively optimize operating strategies as well as water and temperature management. The success of these tasks will determine how well fuel cell powertrains perform against their IC engine competitors.

Combined know-how from research and industry

ETAS laid the foundations for the fuel cell model in a research collaboration with Esslingen University of Applied Sciences, the University of Stuttgart, and Robert Bosch GmbH and pressed swiftly ahead toward market launch. "Our LABCAR-MODEL-FC and -FCCAL simulation models and our LABCAR HiL test system are important steps toward making a success of hydrogen mobility," explains Jürgen Häring, who is responsible for development of the LABCAR-MODEL simulation models at ETAS. "They increase efficiency in development processes, which is vital for ensuring that the precious hydrogen is used as efficiently as possible in fuel cells." To help this innovative powertrain technology to break through, continues Häring, it is important to leverage all cost optimization potential from the very start of development. "The key to this is virtualization, and at ETAS we are actively engaged in making progress in this area."

ETAS GmbH
ETAS provides innovative solutions for the development of embedded systems for the automotive industry and other sectors of the embedded industry.
As a systems provider, ETAS supplies a multifaceted portfolio that covers the range from integrated tools and tool solutions to engineering services, consulting, training, and support. Security solutions in the area of embedded systems are offered by the ETAS subsidiary ESCRYPT. Established in 1994, ETAS GmbH is a 100-percent subsidiary of the Bosch Group, with international subsidiaries and sales offices in Europe, North and South America, and Asia.

For more information, please visit **www.etas.com**