

# Global HIL Strategy at General Motors

➤ dSPACE selected as the global HIL supplier for GM since early 2005

➤ GM uses dSPACE Simulators in 10 countries spanning 4 continents

➤ HIL testing for hybrid propulsion systems

In a thorough evaluation process for hardware-in-the-loop (HIL) solutions two years ago, dSPACE Simulator was chosen as the global HIL solution for General Motors. Currently, GM employs dSPACE Simulators in over ten countries, in various applications such as electrical, chassis, and hybrid propulsion systems. The simulators support a varying range of ECUs in a given category, which is a key requirement of GM's Combo HIL concept.

## Looking Back

About two years ago GM completed a complex evaluation of HIL test solutions from a number of potential suppliers. One of their aims was to find the best test equipment to meet the requirements of GM's global HIL strategy. Open- and closed-loop operation, an optional failure insertion unit, and easy duplication of benches were major criteria. Additionally, business aspects such as openness and worldwide supply chain were very important for a global company like GM.

Upon completion of the evaluation, dSPACE was selected as GM's global supplier for new HIL systems (see dSPACE NEWS 1/2006). "dSPACE HIL technology emerged on top after a thorough selection process", says Mike Barrera, HIL Tools Leader, GM US. The evaluation led to a multi-year contract defining important components of the cooperation.

▼ As of May 2007 dSPACE Simulators are used in technical centers spanning ten countries in four continents.



**Worldwide Deployment**

As of May 2007, General Motors will employ numerous dSPACE HIL systems in its worldwide technical centers, spanning ten countries in four continents: Australia, Brazil, Canada, China, Germany, India, Italy, South Korea, Sweden, and US. Most of GM’s major technical centers around the world are equipped with dSPACE Simulators. This impressive growth within the first two years has led to a situation where at any time, day or night, somewhere in the world a GM employee is working with dSPACE equipment – and dSPACE is working hard to ensure that more GM employees will be involved in the future. “dSPACE is a globally operating company, which suits the global structures of GM very well. The dSPACE HIL systems are flexible, robust, and expandable and therefore well accepted in all application areas”, comments Mina Khoee-Fard, Engineering Group Manager, GM US.

**The Combo HIL Concept**

For powertrains especially, GM relies on a combo HIL strategy that allows the systems to be used flexibly and provides a solid basis for global operation with distributed test activities around the world. The idea is that each HIL system is to a certain extent universal, so that multiple ECUs of a defined category can all be tested on it. The advantage is that multiple teams share the same simulator, resulting in a high level of utilization and improved return on investment. The combo concept allows stand-alone systems to be integrated into other benches; for instance, a transmission HIL integrates into a hybrid bench. All the dSPACE HIL systems at GM can be upgraded to meet new requirements. “The flexibility and expandability of the combo HIL concept extends the lifetime of assets,” is how Mike Barrera sums up the advantages of GM’s HIL strategy.

**Applications and Utilization**

A breakdown according to application shows that 40% of the systems are used for testing powertrain ECUs, 40% for electrical systems, and 20% for chassis controls/vehicle dynamics. Several HIL systems are in use in new hybrid propulsion projects. “My experience has shown that dSPACE is the leading provider for integrated real-time test systems,” says Dr. Hamid Oral, The Lead Controls Test Engineer from GM Hybrid Powertrain, “ and my team looks forward to using the dSPACE systems for the upcoming projects,” he added.

David Colbin, Engineering Group Manager, GMPT Sweden, explains, “It is vital for us to know how components will behave during failsofting or other stressing conditions. The HIL systems from dSPACE make it easier to discover serious problems.”

“We have several flexfuel engine controllers being tested with the dSPACE HIL system in Brazil. It gives us an easy and reliable way to find any ECU misbehaviors prior to the launching”, comments Vanessa Aiello, Product Engineer, GM Brazil, on her experience.

**Looking Forward**

The reliable operations of the HIL systems during the past two years are the basis for good future prospects. “dSPACE keeps pace with GM’s ongoing development, providing suitable tools for new projects,” says Mike Barrera. “Our close contact with dSPACE is an exciting opportunity to jointly prepare the way for new technologies.”

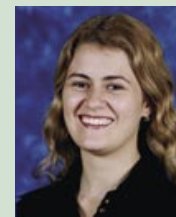
“GM requires a huge number of specialized test solutions in all application areas resulting in numerous custom developments. dSPACE’s ability to respond quickly to GM needs is a win-win situation for both companies,” summarizes Mina Khoee-Fard.



*Mina Khoee-Fard,  
Engineering Group  
Manager, GM US*



*Mike Barrera,  
HIL Tools Leader,  
GM US*



*Vanessa Aiello,  
Product Engineer,  
GM Brazil*



*Dr. Hamid Oral,  
Lead Controls  
Test Engineer,  
GM Hybrid  
Powertrain US*



*David Colbin,  
Engineering  
Group Manager,  
GMPT Sweden*