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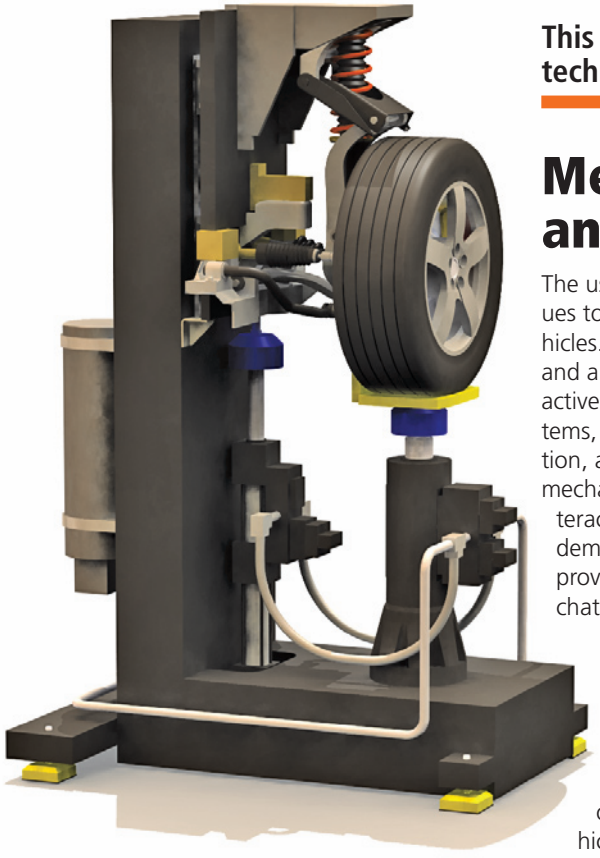
Special Report

Testing and engineering services

This special edition of Testing & Simulation focuses on the latest technology for vehicle development and validation.



The mechatronics development and validation test bench developed by MTS Systems is designed to create realistic and repeatable maneuvers for the purpose of direct characterization and measurement of vehicle dynamic events.

Mechatronics development and validation move indoors

The use of mechatronic systems continues to increase in all types of ground vehicles. From electronic stability control and automated manual transmissions to active dampers and active steering systems, the growing complexity, integration, and need to directly characterize the mechanical, software, and electronic interactions of such systems is creating demand for physical test systems that provide a more efficient means of mechatronics development and validation.

By providing engineers with the tools to move mechatronics testing from the proving ground to the test lab, OEMs and suppliers will have a much more precise, safe, affordable, and repeatable means of evaluating component and vehicle performance.

Mechatronic systems and components continue to be incorporated at a growing rate into ground vehicles to improve the performance, safety, and, ultimately, competitiveness of those vehicles.

The vehicle dynamics engineer may choose a mechatronic component, such as an active damper, because it permits the engineer to deliver better performance on customer attributes across a range of driving events. Many of the benefits of active components relates to their ability to manage transient and dynamic events. An immediate challenge is that engineering sciences have a relatively limited understanding of the nature of such events. Even traditional test systems deal mostly with steady-state characterization. As OEMs and suppliers raise the performance bar, integration of various mechatronic systems is required.

The current mechatronics development process relies heavily on prototypes and track testing. Prototypes would be a better development tool if they were available early in the development process, plentiful, repeatable, stable, and safe for even extreme maneuvers. Of course, these are not the typical attributes of prototypes. The current process

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relies too heavily on tools weighted toward the end of the development process when the cost of change is too high.

OEMs have reported up to 25% of their warranty exposure being related to electronics. Hardware-in-the-loop (HIL) simulation is a significant tool to improve the overall quality of electronics. While HIL permits simulation of events to validate fault handling and performance, it is confined in most cases to only assess electronic and software performance, leaving system integration and physical effect for track testing. A better solution would permit simulation-based validation of the entire mechatronic system.

New mechatronics test rig systems are emerging that bring the test track into the test lab, providing a more controlled and repeatable environment for mechatronics development and validation (MDV). These lab-based MDV simulation systems integrate virtual modeling technologies with mechanical testing equipment, enabling precise, efficient validation of how active physical vehicle components perform under specific forces and motions.

An example of one of these test systems is the proof-of-concept MDV bench **MTS Systems** recently demonstrated with its model-based simulation partner, **dSPACE**, at Automotive Testing Expo Europe 2006 in Stuttgart, Germany. The test bench, which integrates an active real quarter suspension with a real-time vehicle dynamics model, is designed to create realistic and repeatable maneuvers for the purpose of direct characterization and measurement of vehicle dynamic events.

In the demonstration, MTS uses modeled and mechanical simulation (MMS) technology. MMS technology integrates the HIL simulation technique for electronic control units (ECUs) with physical simulation and advanced control techniques to permit a real-time, integrated physical and electronic development and validation platform. This technology addresses the need for simulation to drive the test rig and ECU, as well as the need for the test rig to respond appropriately with an active unit under test. A key to its flexibility is the ability to effectively "drive" the active component in the test lab. No recorded events are required, and the system does not rely on synthetic inputs such as sine waves that are difficult to relate to real vehicle performance. With MMS technology, OEMs and suppliers can develop and validate the response of an active physical vehicle component under realistic forces and motions.

Such a test system offers repeatable and realistic event simulation at any stage of the development process to facilitate the development or validation tests required to deliver the desired mechatronic system performance attributes on time. Sample use cases include algorithm optimization, ECU calibration, and control strategy development.

For the first time, OEMs and suppliers will have an accurate, repeatable, and highly efficient means of evaluating active component performance by using MDV testing techniques, at both the subsystem and full-vehicle levels. Mechatronics testing systems can increase safety and decrease prototype limitations by permitting analysis of faults and extreme maneuvers in the safety of the virtual and laboratory environments. Mechatronics development and validation systems also offer process improvement benefits, such as the ability to validate the performance of a common component across a number of vehicles, such as a transmission.

By relying less on the proving ground and more on the test lab, mechatronic system engineers will achieve the time and cost savings necessary to support a greater volume and variety of mechatronics-related test scenarios. They will be better equipped to address the need to improve performance, reduce development cycle time, and reduce warranty exposure.

This article was written for *AEI* by ***Dan Barsness***, Senior Market Development Manager, MTS Systems.

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