SAE100 Future look

In celebration of SAE's Centennial in 2005, industry executives discuss the future of mobility technology.

The emerging role of physical test in product development

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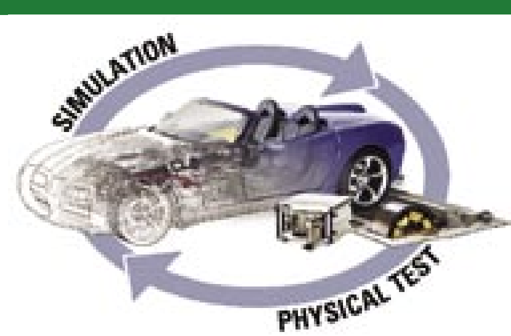

Simulation—physical test integration

In **SAE**'s 100 years, the process of building automotive vehicles has undergone major transformations. In the early days, we used a "build and ship" approach. Then, as we began to scale volumes and realized the importance of quality, we added testing to the process, leading to a "build-test-ship" approach.

For most of the 100 years, this was physical test's traditional role, with a special focus placed on quality and testing since the 1980s. However, in the past decade, we have seen a significant emphasis on reducing automotive product-development cycles from 4-5 years down to 12-18 months. The notion of "zero prototyping"—the goal of which is to produce acceptable, working models in the first attempt—was recently introduced. Both these trends caused simulation to be added formally into the design cycle, resulting in a "simulate-build-test-ship" approach. Simulations created the strong need to calibrate mathematical models with test data earlier in the product-development cycle.

Another recent trend is the increasing complexity of vehicles led by the progressive replacement of mechanical structures with electronic components. As vehicles' electronic content increases, most of the testing, which was primarily mechanical, now incorporates an overlay of electronics. We now see a strong need for a common test platform that scales seamlessly between mechanical and electronics test environments.

Physical test integration with simulation

In the current product-development process, testing appears in two areas: once upstream as a means for validating designs and simulations, and later downstream as a pass/fail monitor on product attributes prior to their release for production. Even though the types of measurements taken in both instances are similar, the tests' purposes and who and how an organization uses the results are substantially different.

The integration of simulation with physical test will significantly accelerate the product-development process. The bi-directional flow of information between these two functions is critical for success. For instance, engineers can compare test data from previous models or components against simulation results and calibrate them to increase confidence in their simulation predictions for current designs. They also can use test data as inputs into their simulations to improve the fidelity of their results. In return, simulation can provide engineers insight to minimizing and optimizing their tests, such as determining the optimum location of sensors, actuators, and exciters. Even prior to testing, simulations can help engineers identify the best designs to prototype.

One implication of this integration is the need for the test platform to deliver connectivity to design and simulation tools. Simulation (CAE) software vendors should focus on building tighter connectivity with test platforms moving forward, as they have done with CAD over the past decade. Furthermore, there is a growing need to provide an integrated environment to better visualize and compare test and simulation data together with video.

Convergence of multi-domain testing

The multi-domain and multi-physics complexity of automotive system designs and testing is another growing trend. Consider, for example, the automotive radio, which has been transformed into the automotive media center. Testing now involves examining the performance of a TV display, DVD and CD players, GPS navigation systems, PC e-mail access, electronic games, remote diagnostics, satellite car alarm and radio, and of course, the original AM/FM stereo functions. The testing of these requires multi-domain measurement and excitation capabilities in a modular and expandable test platform that are executed in a coordinated and time-critical manner.

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Large-scale examples of mechanical and electronic functions converging are in the areas of mechatronics and X-by-wire. Designing mechatronics structures such as antilock braking systems and active chassis systems involves seamless connectivity between the controller design and the hardware-in-the-loop test functions and added real-time capabilities. With the requirement of taking the control design to an embedded target, the process requires a unified, open platform that spans the entire embedded control design "V" development cycle. The separation between design and test blurs in this environment where engineers need to switch between mathematical models of plants and physical plants seamlessly.

Next-generation physical test platform

As we look at significant changes occurring in the automotive test environment, it is unlikely that past fragmented approaches to testing will scale appropriately. There is a strong need for an easy-to-use, modular, customizable but open COTS (commercial off-the-shelf) test software platform with a plug-and-play architecture, akin to the CAD of testing. Additionally, it must abstract the user from low-level hardware connectivity issues, thereby making the hardware transparent. It should provide seamless connectivity to the environment surrounding the test, using standards wherever possible—through communication buses such as CAN (controller area network), sensors and actuators with TEDS (Transducer Electronic Data Sheet), design and simulation PLM (product life-cycle management) software, ERP (enterprise resource planning) and manufacturing execution systems, and so on. The **National Instruments** (NI) LabVIEW graphical test software platform serves as an example that integrates seamlessly with hardware and provides built-in connectivity to third-party devices and the environment.

For test hardware, we are moving toward software-enabled reconfigurable devices driven by advances in embedded hardware technology, such as FPGA (field-programmable gate array) and DSP (digital signal processing) chips. This technology provides breakthrough performance that is easily customizable for each application, but still available as a COTS product.

Test as a platform-level initiative

As test moves into the upstream product-development process, it becomes a pacing element of lean product development, a leading characteristic of which is efficient and appropriate use and reuse of resources. Design/CAD, simulation/CAE, manufacture/CAM, and physical test are critical functions in product development, and product developers should seamlessly draw upon the extent of each depending on their needs. The seamless connectivity between the platforms for each of these functions must be guaranteed.

We need to think of "physical test" as more than a collection of individually efficient test systems. Given the amount of resources, both capital and people, needed in the physical test process, it is important that we think of test as a platform-level initiative, reuse the building blocks of test across applications, and support global and supply chain transferability. Decisions on selecting a company-wide, broad-based COTS primary test platform are as important as selecting CAD/CAM platforms in the 1990s, and more recently, CAE platforms. This will ensure that CAD/CAM/CAE and physical test platforms, the basic elements of lean product development, are ready to provide leading companies with the efficiencies and accelerations in product development that they are currently seeking. ***aei***

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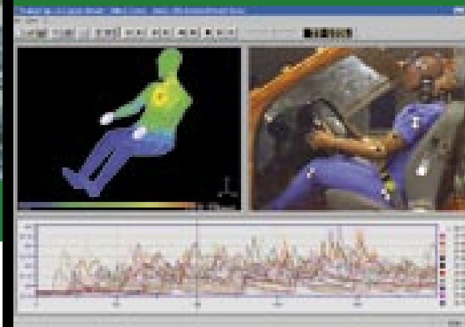

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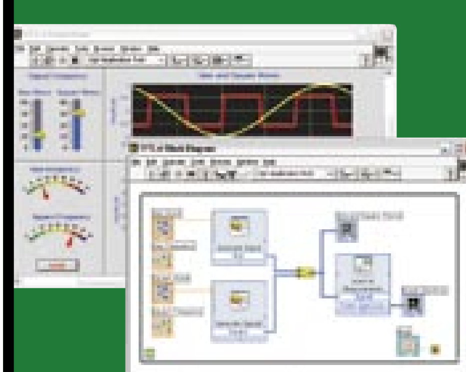

LabVIEW graphical test development environment