Editor's Note: If you're in the automotive industry, you can't use test capabilities designed looking in the "rearview mirror." As a test equipment manufacturer and a Tesla owner, I've had a front-row seat to the promise and challenge of autonomous vehicles, from the thrill of receiving new features via over-the-air software updates to discussions with automotive engineers on the challenges of meeting safety regulations. If you're affected by technology convergence, you'll find the NI platform and ecosystem uniquely capable of addressing these unsolved problems.

—Dr. James Truchard

Driven by Necessity

In the aerospace and defense industry, reducing release cycles and preventing program delays have become increasingly difficult. In automotive, consumer demands are driving up test complexity and introducing new costs in areas like infotainment. In response, test managers must find affordable ways to incorporate RF testing for wireless signals and machine vision testing for assisted parking to meet the widening I/O spread of test coverage.

Though industry regulations provide a guide to ensure safety in embedded electronics, compliance with these regulations requires the thorough testing of embedded software across an exhaustive range of real-world scenarios. Developing and testing embedded software with an emphasis on quality can strain the balance of business needs such as short time to market, low test cost, and the ability to meet the technical requirements driven by customer demand for new features and product differentiation. All embedded system manufacturers face similar demands, but they cannot sacrifice quality when it comes to safety-critical applications. Organizations that can evolve their development strategies to incorporate advanced hardware-in-the-loop (HIL) testing can reduce spending on quality-related problems, improve their market perception, and, most importantly, ensure customer safety.

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HIL Test Helps Meet Safety and Business Needs

Complying with safety standards requires an understanding of all potential health risks and hazards as well as the capability to rigorously test those scenarios. HIL testing meets many of these growing test needs at a lower cost and in a shorter time frame than physical tests and field tests. With this method, companies dynamically simulate real-world environments using mathematical models to provide closed-loop feedback to the controller being tested. HIL test becomes even more valuable as the need to offload test time in the field or the test cell intensifies with the addition of functionalities to controllers and the increase in test cases. Hybrid electric vehicle motor controllers are establishing new levels of functionality by managing safe power control between an internal combustion engine and

an electric motor. While designing Subaru's first hybrid electric vehicle, the Subaru XV Crosstrek, engineers at Fuji Heavy Industries needed to deliver complete test coverage of their innovative powertrain technology.

Subaru Uses FPGAs for Greater Safety and Reliability

Testing the hybrid motor controller required advanced test tools and new methodologies to provide high-quality software within the engineers' timeline. Subaru chose to use FPGA technology to meet its high-performance needs and verify a wide range of tests. For instance, when the vehicle slipped on ice, the controller had to recognize the loss of traction and provide the appropriate response to the hybrid powertrain. Re-creating these conditions on the proving grounds inconsistently yielded accurate data, and traditional processors for HIL could not accurately simulate the fidelity and speed required of an electric motor model.

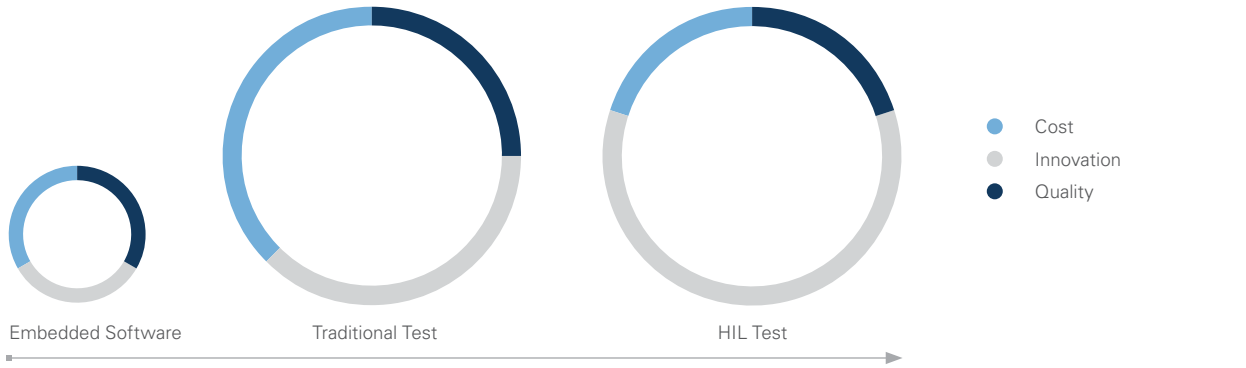
Using open and flexible FPGA modules, which significantly reduced communication time by collocating the processing node and I/O node, Subaru engineers offloaded taxing calculations and performed HIL tests on their system for corner cases such as traction loss on ice to provide greater safety and reliability. With the open architecture, they programmed their system to use a high-fidelity JMAG-RT model and achieve the 1.2 µs simulation rate required to accurately simulate the safety handling of an electric motor. The ability to move more field tests into the lab resulted in a 20X reduction in test time, so the engineers did not have to compromise innovative technology, shorter time to market, and lower test cost to achieve high-quality software. Subaru's HIL testing platform provided cheaper, more comprehensive, and faster testing than physical testing.

Scalable Test Platforms Offer Affordability While Ensuring Safety

Embedded software design and test teams must continue to find new ways to use this practice to ensure quality and make consumer safety a priority without sacrificing release schedules. HIL testing is mostly entrusted to only a specific test team, but developers have also been performing manual stimulus testing known as knob-box testing for quick functionality checks. This restricted form of testing allows them to spoof the controller by manually changing a limited number of channels. However, many functionality defects are still found in the later stages of HIL testing, or even in the field, which cost developers more resolution time. With higher levels of automation and easily repeatable test scenarios, developers can discover more of these functionality defects so that test engineers can focus on identifying performance and integration-based defects. Full-rack HIL test systems are not necessary for this application. Instead organizations must build scalable test platforms to provide an affordable solution across varying capabilities.

As increasing embedded controller capability drives further innovation, safety regulations will be honed to ensure even greater user safety. To keep up with feature demand while preserving the quality of the overall system, test capabilities will need to grow accordingly. Simply adding more test bandwidth will not scale with overhead; test managers need to adopt advanced HIL test technology and new techniques. This ensures that as industry regulations help guide system engineering teams toward higher levels of safety for more advanced products, test platforms can still meet critical cost and time requirements.

NEXT-GENERATION DEVELOPMENT



HIL solutions help drive down test costs without sacrificing the growing quality requirements inherent with new innovations.