MONITOR PLAN ACT

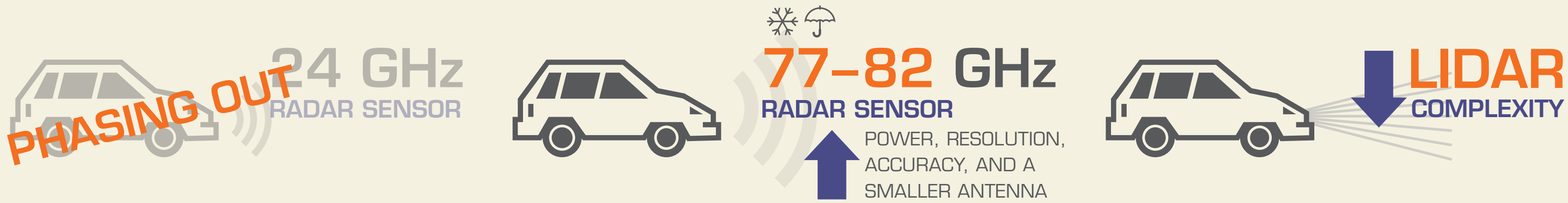
Testing Sensor Fusion for Autonomous Vehicles

- Fusing radar, lidar, and other sensors improves autonomous driving capabilities
- The unique timing for each sensor presents a synchronization challenge for test
- Rapidly evolving technology demands test system flexibility

Autonomous vehicles, once seen only in science fiction, are now a certainty within a matter of years. In June 2017, Honda announced it would join the ranks of many other major car manufacturers and produce an autonomous vehicle capable of driving city streets by 2025. A key enabling technology for this will be sensor fusion, the combining of data from an array of sensors to make decisions. Dating back to the Apollo Lunar Module, sensor fusion today lives in our pockets where smartphones combine GPS with accelerometers and gyros. This fusion allows manufacturers to use cheaper, less powerful sensors and save battery life while offering consumers more comprehensive functionality. What makes this concept novel in vehicles is the pairing of active, smart algorithms with a new mix of sensors. The full potential of sensor fusion technology is not yet known, but as we put this concept into practice for autonomous vehicles, test engineers must overcome two major challenges: evolving sensor technology and difficult synchronization.

Evolving Sensor Technology

From GPS to cameras and radar to accelerometers and gyros, test systems must be ready to handle a wide spectrum of I/O such as video, CAN, and RF. Further complicating this challenge, the sensors themselves are constantly changing. Radar sensors, valued for weather-agnostic obstacle detection, are migrating from 24 GHz to 77–82 GHz allowing for smaller antennas, wider bandwidth, and the ability to transmit higher power. This leads to greater accuracy and object resolution. Lidar, a simpler alternative to radar, has traditionally been expensive and unreliable in suboptimal weather conditions. Today, however, the rise of solid-state lidars is helping to decrease costs. In addition, Ford has released research that uses lidar sensors to differentiate rain from snow, making lidar a compelling option.



The evolution of radar and lidar technology is indicative of the constant change testers must be ready to address across sensor types.

Difficult Synchronization

If data isn't properly synchronized, the vehicle cannot formulate an accurate picture of the environment, and safety becomes a major concern. Synchronization challenges originate with the sensors themselves. Because sensor data is not inherently timestamped, engineers use sensor specifications such as camera frame rate to deduce timing with software, which decreases accuracy. To make matters worse, test engineers using hardware-in-the-loop (HIL) testing must establish a synchronized connection between a mathematical model running in real time and sensors like a camera that may be running on a different GPU-based processing platform where the camera is viewing a simulated scenario.

To properly test self-driving algorithms, the tester must ensure that the camera is seeing images that are synchronous with the model and any other sensors. Ideal test systems provide a common sense of time to all components, which makes synchronizing sensor and test data easier.

Preparing for a Certain Future

At this point, we can count down the days to the arrival of the autonomous car. Sensor fusion is key to the success or failure of these smart machines. Already challenging, the complexity of sensor fusion technology is still evolving. To adapt to future changes, test systems must be modular and flexible enough to incorporate new I/O when necessary while providing a common timebase for synchronization. Some technologies have already forced test engineers to take new approaches, like incorporating realistic over-the-air test for automotive radar instead of cabled solutions. In the future, thanks to rapidly developing machine learning techniques applied to verification, test engineers will determine the most efficient test scenarios based on smart algorithms that can quickly detect failure-triggering patterns. This will allow them to achieve maximum test coverage in less time.

A flexible test solution that expands with new technologies and addresses complex timing and simulation is essential. By using a test system that keeps pace with your cutting-edge technology, you'll be on the road to producing safe, smart vehicles that are ready on time.

Watch our **five-part webinar series** to learn more about autonomous vehicle test.