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UC Berkeley Develops New User-Friendly Tool to Expedite the Evaluation of Connected Automated Vehicle Technologies

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Issue

Connected Automated Vehicles (CAVs) are similar to other automated vehicles with the distinguishing difference being that CAVs obtain information about road conditions directly from other vehicles and infrastructure (e.g., traffic signals, road sensors) rather than relying solely on onboard sensors. Different CAV technologies are currently being tested and evaluated to assess the prospects for future implementation. These tests involve moving CAV-equipped vehicles on a physical test track and recording how the vehicles operate under different traffic conditions (Figure 1). Since it is difficult and expensive to recreate multiple real-world driving conditions on a single test track, virtual environments are typically used to simulate different traffic conditions, such as traffic signal operation, actions by other vehicles on the road, and other scenarios. These virtual hardware-in-the-loop (HIL) tests can expedite CAV performance evaluation and inform future system implementation; however, existing HIL test systems often lack the ability to manage large amounts of test data, which limits the value and use of these tests.

Research Overview and Benefits

UC Berkeley researchers developed a prototype HIL tool which includes new relational database management functions to facilitate data collection, storage, and evaluation capabilities to make it easier to collect and analyze data from HIL tests. The new user-friendly test tool improves the ability of researchers to evaluate proposed strategies regarding CAVs even if researchers do not have detailed technical background on CAV development.

Figure 1. Top: Test CAVs operating on physical test track. Bottom: Layout of the test track.

The benefits of this improved tool are summarized as follows:

- Coordinates the execution of the test and manages the data flow from different test systems as well as storing raw data sets collected from the test systems

What is a HIL test?

The HIL test consists of a real-time traffic simulation tool, test CAVs, and a cooperative intersection controller. The test CAVs and signal controller operate in the real-world and interact with the virtual traffic generated by the real-time simulations. The three modules work together to facilitate the interaction between the physical and virtual environment. This provides a fast and cost-effective way of testing CAV applications.

and generating performance metrics based on the raw data, which allows researchers to use existing traffic simulation tools, traffic signal controllers, and CAV control algorithms in their HIL tests.

- Offers flexibility for research teams to evaluate stored historical data from real-world test systems and makes the historical data available in several common file types, which enables researchers to export their datasets to other analytical tools.
- Can be easily extended to other CAV test systems, which helps test centers develop and improve their own systems.

To make the upgraded tool available to other researchers, a user-friendly test tool setup guide and user guide was developed. These guides will allow researchers to concentrate on developing and evaluating different CAV technologies without having to create new HIL testbeds and databases.

Policy Implications for California

The updated HIL test tool with data management functions positions California as a leader in CAV technologies deployment. The tool will accelerate the testing and evaluation of CAV technologies by UC Berkeley researchers as well as other researchers in California and beyond. The tool may also be used to provide state-of-the-art quantitative analysis to inform current and future CAV related policies in California.

More Information

More information about the improved HIL tool as well as the guidance materials and examples of real CAV tests using the improved tool can be found in the report "Streamlining Connected Automated Vehicle Test Data Collection and Evaluation in the Hardware-in-the-Loop Environment" prepared by Zhe Fu, Hao Liu, and Xiao-Yun Lu from UC Berkeley. The report is available at www.ucits.org/research-project/2020-23.

For more information about findings presented in this brief, please contact Hao Liu at liuhao@berkeley.edu.

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