A PLATFORM FOR CHANGE: TTI PROVIDES FHWA A NEW WAY TO TEST CV/AV TECHNOLOGIES

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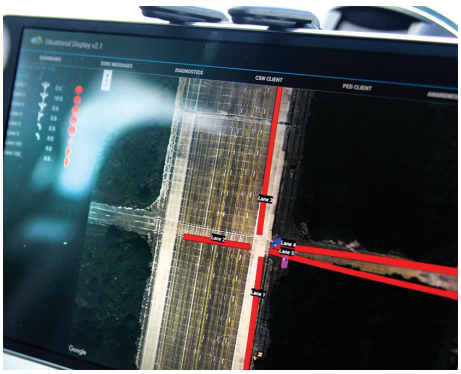
The connected vehicle/automated vehicle (CV/AV) revolution is happening now. But before it becomes a reality, the technologies that make it possible have to be vetted, validated and successfully implemented.

CONnected Vehicle Assessment Simulation (CONVAS)

The Texas A&M Transportation Institute (TTI) has developed an augmented-reality environment where real entities (vehicles and traffic signal operation) are combined with simulated traffic and displayed on a screen. The first-of-its-kind approach — called CONVAS (CONnected Vehicle Assessment Simulation) — marries the cost-effectiveness of computer simulation with actual roadway operations to produce an efficient yet dependable evaluation mechanism for the Federal Highway Administration (FHWA). TTI has been developing the platform since January 2014.



Leading the Revolution

Srinivasa Sunkari and his team developed an enhanced hardware-in-the-loop (HITL) simulation in this project by incorporating an actual CV on a roadway network into a simulation model and displaying simulated CVs inside the real vehicle at the same time. This enables development and testing of advanced CV applications or strategies by allowing assessments of how CVs respond to each other and other entities such as pedestrians, emergency vehicles and transit vehicles in a controlled environment. This is the first time HITL simulation has ever been applied in this way.

With the delivery of CONVAS, FHWA will have a way to test the performance of large-scale CV applications while minimizing evaluation costs. Through simulation, technologies can be fine-tuned, and engineers can use the results to design advanced algorithms that, in turn, will govern how vehicles drive tomorrow's roadways. In short, thanks to CONVAS, our future transportation system will be safer, more dependable and less expensive to build.

"The limitations of traditional simulation come from having to model every entity to be as realistic as possible. With CONVAS, operating agencies can assess CV applications using a simulation environment that can accurately represent a mix of real vehicles with simulated vehicles simultaneously in real time."

TTI Research Engineer Srinivasa Sunkari, Principal Investigator

One Solution to Multiple Challenges, Two Successful Demonstrations

A secondary purpose of the CONVAS project is to evaluate a disrupted wireless communications connection. To more accurately represent CV communications, TTI researchers integrated the commercial microscopic traffic simulator Vissim with the open-source wireless network simulator ns-3. Doing so enables simulated vehicles to adapt to variability in the communication environment, providing a more realistic assessment of CV applications in the simulation model. As Sunkari notes, "Connected vehicle technologies all rely on wireless communications. But what happens when the wireless connection is disrupted or blocked?" Similar to its application of HITL simulation, TTI's integration of the two simulators had also never been done before.

On June 22, 2016, Sunkari and his research team demonstrated CONVAS to visiting FHWA sponsors at The Texas A&M University System's RELLIS Campus. The field test confirmed the successful integration of the Vissim and ns-3 simulators, and showed the seamless data flow between the simulation model and the test vehicle's onboard unit.

On February 28, 2017, TTI validated its HITL simulation platform by again successfully demonstrating CONVAS to representatives of NASA, the U.S. Army, the California Department of Transportation and the Texas Department of Transportation as part of a Technology Readiness Level Assessment. As in the earlier demonstration, attendees were able to see, in real time, how a CV reacts to simulated vehicles or roadway conditions, as well as how simulated vehicles react to other CVs.

Sunkari and his team are waiting to hear if a second phase of the project will be initiated. Phase 2 could involve the testing of a specific CV application.

"Regardless, CONVAS will likely be used in other TTI connected vehicle research and, perhaps, connected vehicle technologies for The Texas A&M University System," Sunkari says.

> **"The technology used in developing this platform will bring benefits in CV research for many years to come as we work to improve our transportation network to become a more intelligent, more reliable and safer system."**
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> *FHWA Highway Research Engineer Peter Huang, who manages the Turner-Fairbank Intelligent Intersection Traffic Control Laboratory*

About TTI

The Texas A&M Transportation Institute, established in 1950, seeks solutions to the problems and challenges facing all modes of transportation — surface, air, pipeline, water and rail. The Institute works with nearly 200 sponsors in the United States and abroad at all levels of government and in the private sector and is recognized as one of the finest higher-education-affiliated transportation research agencies in the nation. TTI has saved the state and nation billions of dollars through strategies and products developed through its research program. TTI research has a proven impact — resulting in lives, time and resources saved.

TTI's Mission

To solve transportation problems through research, to transfer technology and to develop diverse human resources to meet the transportation challenges of tomorrow.

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