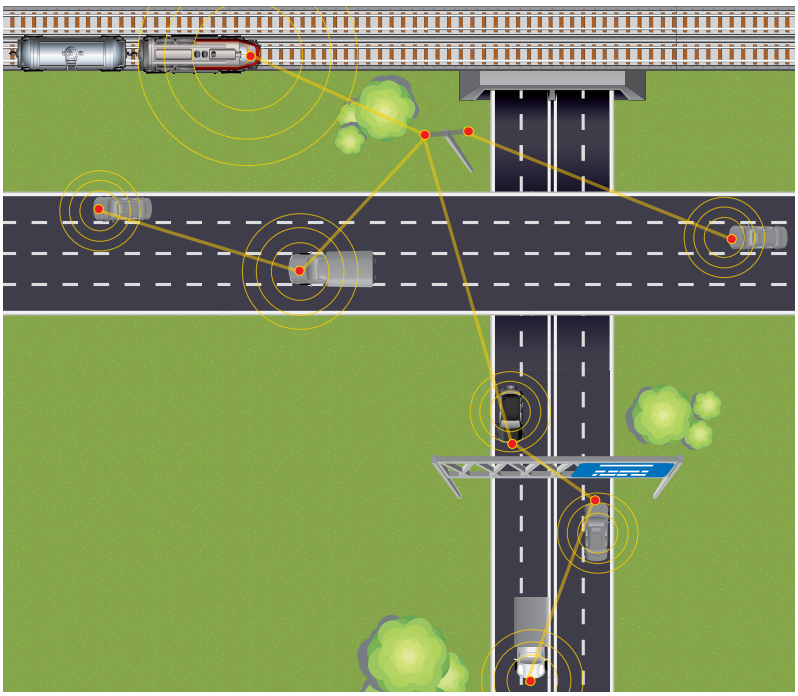
TTI's Capabilities in Connected Transportation



CV/AV TTI Vision

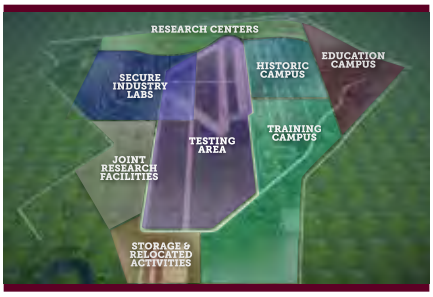
The Texas A&M Transportation Institute (TTI) shares an industry vision where no vehicles collide and people can use connected and automated transportation to transform how they live, work and interact with their environment. To achieve this vision, research, development and testing are needed on how vehicles, users and transportation infrastructure all work together.

While automated vehicles are emerging and connected vehicle research is progressing, TTI believes the most significant gains in safety and mobility will occur at the nexus of these areas. TTI is creating a world-class research environment on the Texas A&M University campus where researchers can collaborate, new transportation paradigms can be created, and future mobility and safety can be showcased.

RELLIS Campus

In December 2018, TTI is scheduled to move to the newly developed Texas A&M University System RELLIS Campus, a high-tech, multi-institutional research, testing and workforce development campus in close proximity to Texas A&M University. TTI already has several facilities located at the 2,000-acre campus, including a full-service safety proving grounds facility; an environmental and emissions facility; and a sediment and erosion control laboratory. In addition, the new Center for Infrastructure Renewal, a collaboration among TTI, the Texas A&M Engineering Experiment Station and the private sector, is being constructed next door to TTI's new State Headquarters Building. This research, testing and training facility is expected to reduce the cost and extend the life of infrastructure with new, better materials and construction methods.

CV/AV Test Beds



RELLIS Campus CV/AV Test Bed

TTI is developing a connected and automated transportation test bed at the Texas A&M University System RELLIS Campus in Bryan, Texas. The test bed will be used to develop and test connected and automated vehicle (CV/AV) applications and human-machine interfaces using vehicle-to-infrastructure (V2I) and infrastructure-to-vehicle communication in a controlled environment. The test bed will leverage other automated vehicle expertise across the University in ground, aerial and subterranean applications.

Connected Work Zone

TTI is deploying CV technology along the I-35 corridor to improve safety and mobility through work zones by providing in-vehicle devices to freight companies to receive work zone infrastructure data on lane closure location, capacity reduction, queue lengths and delay to assist in pre-trip and en-route planning for logistics.

Sponsor: Texas Department of Transportation and U.S. Department of Transportation

Transit, Bicycle and Pedestrian Safety

TTI developed a Concept of Operations Plan for designing, testing, piloting, demonstrating and deploying CV/AV technology hardware and applications to reduce and eliminate crashes involving transit, bicyclists and pedestrians. A pilot test was also conducted of the Mobileye Shield + collision avoidance system on a Texas A&M University bus in Phase I of the project. In Phase II, TTI is designing, developing and piloting a Smart Intersection/Smart Bus application with buses automatically communicating with smart traffic signals to provide visual and audio warnings to bicyclists and pedestrians. A smartphone app is also being designed, developed and piloted for bicyclists and pedestrians at the Smart Intersection.

Sponsor: Texas Department of Transportation

Physical Infrastructure

New Technologies and Approaches for Asset Management

Combining geo-coded machine vision technology with crowdsourcing strategies, TTI has developed and is prototyping a new method for highway agencies to obtain data on their assets and keep the data current with relatively minimal effort. TTI is installing custom-made machine vision systems in TxDOT fleet vehicles. The systems will require no input from the driver and collect the necessary data in an automated manner. Specific assets are automatically identified, geo-coded and provided a condition rating. These data are pushed to a cloud service where analytics are provided, and the data are returned to a dashboard where agencies can access real-time asset information to make more timely and cost-effective decisions with their limited maintenance budgets.

Sponsor: Texas Department of Transportation

Establishing Highway Infrastructure Criteria for Machine Vision

As vehicle technology continues to expand into new areas, a need is developing to synchronize vehicle technology capabilities with traditional physical highway infrastructure. One of the most heavily used elements of the physical infrastructure space on a highway is pavement markings. Many new vehicles use cameras and machine vision algorithms to detect and read pavement markings to provide features such as lane departure warning and lane-keeping assistance. TTI is leading a research project that is designed to develop pavement marking criteria that will provide reliable detection with in-vehicle camera systems. The results will be used by agencies interested in specifying and maintaining their highways to a level that will provide reliable machine vision detection.

Sponsor: National Cooperative Highway Research Program

Sensor-Enhanced Pavement Markings

TTI is developing and testing sensor-enhanced pavement markings to provide enhanced detection when machine vision begins to fail, such as in low sun positions or inclement weather, to provide a redundant detection alternative for vehicle technologies.

Sponsor: Virginia Department of Transportation

CV Applications

TTI researchers have developed the concept of operations and system requirements for the development of wrong way driving and mitigation applications for CVs. TTI researchers led the development of the Intelligent Network Flow Optimization bundle of CV applications, including the Q-WARN and Speed-Harm. A small-scale demonstration was conducted in Seattle to demonstrate the feasibility of using CV data to implement these applications. In addition, TTI is working with the Collision Avoidance Metrics Partnership (CAMP) to develop and test eco approach and departure applications to minimize fuel consumption and reduce vehicle emissions at signalized intersections.

Evaluation of CV Applications

TTI researchers have developed a platform to facilitate FHWA to evaluate CV applications and technologies in a realistic manner using advanced hardware-in-the-loop simulation techniques. The simulation model, VISSIM, was integrated with CV hardware and with ns-3, a communication simulation model.

CV Pilot Deployment and Program Evaluation

TTI was recently selected by FHWA to lead the national evaluation of the CV Pilot Deployments. Teaming with partners, such as Kittleson & Associates, Inc., Gannett Fleming, Rand Corporation, Cadmus and JMC Rota, TTI is leading the national evaluation of the three CV pilot sites (Tampa, New York City, and Wyoming). This evaluation could also be extended to include evaluations of the Smart City and AMTCD grants.

Signal Phase and Timing

TTI researchers led the development of an interface between traffic signal controllers and roadside equipment to enable communication of real-time traffic signal status and timing to CVs. Researchers then designed and developed an open source platform, Integrated Vehicle to Infrastructure Platform, to facilitate development and deployment of infrastructure-based CV applications. This platform is being improved to generate and broadcast conflict-free Infrastructure-to-Vehicle (I2V) required messages to improve intersection safety and mobility.

CV Standards

As part of the development of intersection and freeway operations-related CV applications, TTI researchers provided feedback to the standards committees working on updating the CV and traffic signal controller standards including SAE J2735, NTCIP 1202 and related standards. TTI researchers are also involved in a number of committees working on updating these standards.

Wrong-Way Driving Detection and Mitigation Research

Developed concept of operations and requirements for a CV test bed for wrong-way driving applications. Developing a proof-of-concept CV wrong-way driving detection and management system at the Texas A&M System's RELLIS Campus.

Sponsor: Texas Department of Transportation

Vehicle Automation

Commercial Truck Platooning

Created a first-of-its-kind comprehensive freight platooning demonstration in Texas to build upon past and current platooning development projects and demonstrate the safety and fuel savings benefits that can be achieved by applying vehicle automation to freight truck platoons.

Sponsor: Texas Department of Transportation

CV/AV Policy

Transportation Policy Research Center (PRC)

The emergence of CV/AV technology presents significant implications for policy makers. The TTI PRC is working to better understand those implications and inform the decision making that will influence how automated travel can come about in a way that best serves the public interest. The *Revolutionizing our Roadways* series outlines the PRC's work in the following specific areas.

Completed Research Reports

(tti.tamu.edu/policy/technology)

The Challenges and Benefits of Making Automated Vehicles a Reality

Policy Considerations for Automated Vehicle Testing in Texas

Cybersecurity Considerations for Connected and Automated Vehicle Policy

Data Privacy Considerations

Liability Issues

Travel Behavior Impacts of Automated Vehicles

Implications of Automated Vehicle Crash Scenarios

In Progress Research

Vehicle Telematics as a Platform for Road User Fees

Mobility Effects of Connected and Automated Vehicles

CV/AV Planning

Transportation Planning Implications of Automated Vehicles on Texas Highways
Assess how to effectively incorporate transformative CV/AV technologies in transportation planning to assist in the decision making process.

Sponsor: Texas Department of Transportation

Policy and Planning Actions to Internalize Societal Impacts of CV/AV Systems into Market Decisions
Generate information for state and local governments about policy/planning actions that can be taken to stimulate the development of markets for CV/AV systems for all modes, providing the ability to internalize societal costs and benefits in industry market decisions.

Sponsor: National Cooperative Highway Research Program

Providing Support to the Introduction of CV/AV Impacts into Regional Transportation Planning and Modeling Tools
Develop guidelines for the implementation of travel forecasting models that address travel behavior and system performance changes resulting from CV/AV technology.

Sponsor: National Cooperative Highway Research Program

Preparing for the Connected Airport and the Internet of Things
Develop an evidence-based primer for airport operators and stakeholders on the Internet of Things within the airport environment.

Sponsor: Airport Cooperative Research Program

Deploying CV/AV: Scenarios and Roadmap
Developed CV/AV deployment scenarios, use the scenarios to determine future roadway infrastructure requirements, and developed a strategic roadmap for addressing the implications of CV/AV futures.

Human Factors

Driver Cognitive Load and Distraction Due to Multimodal Infotainment System Interaction
Conducted a closed-course study to evaluate the extent to which popular multimodal infotainment systems requiring driver input may negatively impact behavior, cognitive load, and the subsequent impact on driving safety.

Sponsor: Honda Research Institute

Monitoring, Assessing and Acting on Driver and Vehicle States to Enhance Safety
Developed and evaluated a vehicle-based countermeasure that detects unsafe vehicle operational parameters and driver stress states and directly assists the driver and vehicle to improve overall safety.

Sponsor: Toyota Economic Loss Settlement

TTI's Mission

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

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