TSAP
TRANSPORTATION SAFETY & POLICY

NC Transportation Center of Excellence in Advanced Technology Safety and Policy

Led by the UNC Highway Safety Research Center, the NC Transportation Center of Excellence in Advanced Technology Safety and Policy, or TSAP (“tee-sap”) for short, is a three-year research program focused on building knowledge on the role of Connected and Autonomous Vehicles (CAV) and improving existing infrastructure to advance road safety, mobility, and accessibility.

Advanced transportation technologies, while disruptive, offer both opportunities and challenges. As the presence of CAV and other new mobility modes increase in North Carolina, TSAP will play an important role in ensuring that the state has a safe, efficient transportation future.

TSAP was one of three university research programs to receive a $1 million NC Department of Transportation grant in February 2020 through the Transportation Center of Excellence Initiative to study future transportation challenges in North Carolina.

TSAP, a partner in ensuring that North Carolina has a safe, efficient transportation future.

Our Team

Comprised of members from Appalachian State University, NC A&T University, NC Central University, UNC Charlotte, UNC-Chapel Hill, and the UNC Highway Safety Research Center, TSAP is a consortium of partners encompassing diversity in disciplines and representation. The TASP team includes a multidisciplinary group of traffic safety research professionals, human factors experts, planners, public administrators, educators, computer scientists/systems engineers, and civil and electrical engineers who share a collaborative mindset.

TSAP RESEARCH

TSAP's five research projects include two key themes:

- Using and improving existing infrastructure to advance safety and mobility and to help North Carolina communities, particularly vulnerable road users; and
- Using connected and automated vehicles (CAV) to advance mobility, with a focus on economic impact and data.

PROJECT 1

Impacts of CAV-ready infrastructure on Vulnerable Road Users: Guidance for North Carolina's Local and State Transportation Agencies

Focus: Guidance for implementation of CAV infrastructure with a focus on safe interactions with VRUs

PIs: Dr. Tabitha Combs, UNC-Chapel Hill; Dr. Elizabeth Shay, Appalachian State University

Project Description: Connected and Automated Vehicles offer potential gains in safety, efficiency, and mobility, but also raise policy-relevant questions of impacts on vulnerable road users (VRU) such as pedestrians and cyclists. Local and state governments will be challenged with providing transportation infrastructure that supports and maximizes the safety and efficiency potential of CAV, yet also enhances travel conditions for VRU. As yet, however, there is little empirically based guidance on the likely impacts of CAV-adapted infrastructure on VRU safety or mobility.

This research addresses this gap by identifying CAV-readiness strategies targeting intersection design and empirically evaluating their likely impacts on safety, mobility, and accessibility for North Carolina residents.

This mixed-methods research will identify, catalog, visualize, and evaluate CAV-readiness strategies with implications for the physical design and operation of intersections. Findings from the analysis will be used to identify the most promising sorts of intervention from the VRU safety and mobility perspective across a variety of contexts.

Research Impact: This project will guide NCDOT in identifying CAV-readiness strategies to promote safety and mobility across modes, advance best practices in public participation in the design and deployment of safety countermeasures, and position NCDOT as an international leader in multimodal, future-adapted infrastructure innovation. The project will culminate in a decision guide for local and state policy makers that describes the VRU implications of the most likely forms of infrastructure adaptation.

PROJECT 2

IOT Solutions for Near Horizon Challenges in Smart City Pedestrian Travel

Focus: Dynamic traffic control tools and information technology to facilitate CAV deployment at intersections, while promoting safety and accessibility for other roadway users

PI: Dr. Sean Tikkun, NC Central University

Project Description: The use of Internet of Things (IoT) and Vehicle to Everything (V2E) communication in the automobile AI market reveals a continued need for analytics and communication at the pedestrian level as well. Pedestrian to Infrastructure (P2I) and Pedestrian to Vehicle (P2V) are two areas that could significantly improve safety and pedestrian travel in a dynamic and responsive environment. Three areas that can stimulate that development will be explored by this project. The first area will explore the analysis of pedestrian habits to improve safety. The second area will establish methods of communication between pedestrian smart devices with the traffic infrastructure. The third will establish a method of communicating intersection information to pedestrians. The areas of this project will be explored with researcher expertise in pedestrians who are blind and visually impaired in an effort to promote universal design in solutions.

Research Impact: The findings of this project will enable urban and traffic planning to ensure access and pedestrian level analytics. At this time, most consumer level solutions at the automobile level tend to ignore pedestrian analytics beyond collision avoidance. The products of this project will serve as a foundation for future deployment and development that can interface with existing infrastructure allowing for more fluid pedestrian traffic and a connected environment that includes pedestrians as a node of information.

PROJECT 3

Operational and Economic Impacts of Connected and Autonomous Vehicles

Focus: Long-range planning models for NCDOT and other public agencies to assess the safety and economic impacts of CAV infrastructure investment

PI: Dr. Srinivas Pulugurtha, UNC Charlotte

Project Description: The world is witnessing a revolution in vehicle technology research. CAV have recently drawn intense attention from researchers in the field of transportation engineering, particularly on investigating the potential benefits CAV will bring regarding mobility and safety. Predictions indicate that high-level CAV will not become ubiquitous in the marketplace for several decades. This increase in demand for CAV, over time, will have a varying impact on the operational performance and economy pertaining to the transportation network, based on CAV penetration rates. The impacts at various CAV penetration rates could be positive or negative when certain factors are considered at a micro-level. These factors include travel demand and an increase or a decrease in congestion costs, traffic safety, the unemployment rate in the transportation sector, the effect on the energy market, insurance costs, emissions (air quality), and more.

The objectives of this project are to model and evaluate the operational and safety performance of the transportation network at various penetration rates of CAV, and to research and assess the impact of CAV on the economy.

Research Impact: The potential outcomes from this project are microscopic simulation models to analyze heterogeneous traffic networks as well as a framework for assessing the operational and economic impacts of CAV, systematically. These outcomes will provide valuable insights for proactively planning, designing, and operating North Carolina's transportation network.

PROJECT 4

Intelligent Data Exploration & Analysis for New & Existing Transportation Technology (IDEANETT)

Focus: Integration of CAV fleet data with NCDOT data infrastructures to create a publicly beneficial travel time visualization and information system

PIs: Dr. Hyoshin (John) Park, NC A&T University; Dr. Venktesh Pandey, NC A&T University

Project Description: This project will develop data-driven vehicle routing algorithm with a particular class of problem dealing with 1) time-dependent transportation network, 2) spatial-temporal map dependencies, and 3) a priori time-varying least travel time.

The primary objective of this project is to reduce the travel time of the in-vehicle navigation system for the North Carolina highway in a simulation environment. This research will be used to inform more accurate travel information for travelers and a better navigation option with less uncertainty, to help NCDOT Traffic Management Unit and Traffic Systems Operations staff's ability to understand the data adaptability in North Carolina, and to provide a tool for use in handling existing and new sensor data. NCDOT will be capable of handling an unprecedented amount of data significantly enhancing reliability of travel time information.

The results of this research will be visualization system to estimate and predict short-term and long-term travel time by links and paths levels in North Carolina, through spatiotemporal correlation map.

Research Impact: The results of this project will provide benefits at multiple levels. At the local level, the CAV data will provide up-to-date information on the travel time that can be used by traffic operator and travelers. At the state level, CAV data-driven navigation algorithm directly and instantly benefits traveling citizens by reducing their travel time. A particular measurement of interest will be a travel time reduction by quantifying link and path travel time uncertainty in transportation network.

PROJECT 5

Plan for Advanced Technology Data Readiness

Focus: Identification of CAV data needed by public agencies and maps such data to agency use cases for an NCDOT-specific data readiness framework

PI: Dr. Srinivas Pulugurtha, UNC Charlotte

Project Description: Advanced transportation technologies offer many benefits to transportation customers; however, they can also complicate data-specific tasks such as crash analysis, vehicle registration, tracking and revenue. Moreover, because CAV may have different requirements on infrastructure, there may also be new data requirements on land use and the built environment. It is beneficial, therefore, to understand how the data requirements for CAVs differ from traditional vehicles prior to deployment.

The goal of this proposed effort is to develop an NCDOT-specific framework for data readiness by (1) identifying the CAV-specific data NC public agencies need and (2) mapping the data to public agency use cases. Because “data” is a broad term, the team will analyze CAV data according to four categories, including vehicle, infrastructure, crash and public impression data.

Research Impact: The products resulting from this effort include a draft model data readiness plan summarizing best practices for CAV data collection and tracking and a recommended framework for data readiness, developed in cooperation with NCDOT. The results of the analysis will be used to develop a framework for data readiness that can be used by NCDOT to set priorities for CAV deployment, which will be shared with the NC Fully Autonomous Vehicle Committee’s (FAVC) Operations Working Group.