FY 2022 ANNUAL REPORT

CTI
Connecticut Transportation Institute

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MESSAGE FROM OUR EXECUTIVE DIRECTOR

The Connecticut Transportation Institute (CTI) has experienced dramatic growth and expansion over the last year, and we expect that trend to continue. CTI consists of three individual centers that work in harmony: The Connecticut Transportation Safety Research Center (CTSRC), the Connecticut Advanced Pavement Laboratory (CAPLab) and the CT Training and Technical Assistance Center (T2 Center) in collaboration with faculty members in civil and environmental engineering. All three centers added new staff over the last year and expanded our programs and services to the State of Connecticut and Department of Transportation. The T2 center expanded their Green Snow Pro education program to reduce the impacts of road salt on the environment and the CAP Lab kicked off a large-scale concrete sampling and analysis study to understand the scope and scale of the crumbling foundation problem plaguing not only Connecticut but areas across the globe. The CTSRC assisted the Connecticut Department of Transportation in the deployment of the Transportation Enterprise Database (TED) and open data portal.

We look forward to continued engagement with our current partners and creating new partnerships. We welcome you to explore the exciting opportunities that CTI is developing and collaborate with our institute to grow your leadership skills, enhance your research capabilities, and expand your understanding of how transportation impacts our daily life.

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WELCOME TO CTI

Who We Are

The Connecticut Transportation Institute (CTI) was founded in 1974 with the purpose of creating an education and training center for transportation technology. CTI operates within the UConn School of Engineering and serves as a focal point for transportation-related research at the university and training throughout the state. We conduct research on many transportation issues and work closely with the Connecticut Department of Transportation (CTDOT).

Our Mission

The Institute's core programs serve to advance the maintenance and enhancement of transportation systems and safety, with a particular focus on Connecticut's current and future needs. While each of CTI's programs has a unique mission, they work in tandem to promote innovative research, training, and technical assistance to provide state-of-the-art information on current trends and best practices.

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CAP LAB

During this past year the CAP Lab has participated with faculty from Civil and Environmental Engineering in a study funded by the National Institute of Standards and Technology looking at the crumbling concrete issues in houses plaguing parts of Connecticut and Massachusetts. We were fortunate to hire a dedicated technician this year to help us further this research.

The CAP Lab during the past year has also begun working with several high school programs to increase awareness amongst students about potential careers in the construction materials testing field. Our programs working with high school students have been very successful and interest in these programs continues to grow.

The CAP Lab has been, and continues to be, an important resource for the state of Connecticut as well as other states throughout the Northeast. As many transportation agencies continue to see significant retirements, the CAP Lab is able to provide technical guidance to help with the institutional knowledge loss that is occurring due to these retirements. The future of the CAP Lab is bright and the potential for growth is significant.

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About Us

In 1995, the Connecticut Advanced Pavement Laboratory (CAP Lab) was established by the Connecticut Department of Transportation (CTDOT) and the University of Connecticut (UConn). The CAP Lab is an Accredited Testing Facility that provides guidance on hot mix asphalt material design for the HMA industry, education and training services on HMA subjects for engineers, technicians and inspectors, technical assistance on paving mix acceptance and field construction, and research on HMA problems.

The CAP Lab conducts research on transportation construction materials with an emphasis on asphaltic materials. This research is conducted for the Connecticut Department of Transportation (CTDOT), regional transportation agencies and for the private industry. Researchers at the CAP Lab have contributed to the Long-Term Pavement Performance Project through the Federal Highway Administration, the Strategic Highway Research Program II, as well as Pavement Preservation initiatives. The CAP Lab fulfills an outreach function by conducting training courses for government employees, as well as technicians and consultants working with transportation construction materials. The Laboratory operates state-of-the-art equipment ranging from load frames performing low temperature/fracture energy testing to the newly implemented Asphalt Mixture Performance Tester.

Highlights

The Connecticut Advanced Pavement Lab (CAP Lab) was established in 1995 with the mission of assisting the successful implementation of Superpave in Connecticut. Superpave has been the standard paving material in Connecticut for close to 20 years.

The CAP Lab's work did not end with implementation of Superpave. The CAP Lab has an extremely strong relationship with the Connecticut Department of Transportation and has provided technical guidance to assist with the implementation of new materials, technologies, and construction methodologies. The CAP Lab over the years has worked with the paving industry as well to assist them with problems or issues they are facing. Two examples of this from this past year are the implementation of traffic-speed Ground-Penetrating RADAR to assist project-level forensics at the CTDOT Pavement Design Unit in which RADAR signals beamed into the pavement can be used by our research team to detect layer thicknesses and other structural anomalies. Additionally, this year was the first year CTDOT, with direct support from the CAP Lab, implemented intelligent construction pay factors associated with a construction specification whereby records of paver and roller data were geo-spatially recorded during construction and penalties or bonuses were applied based on this construction data. The data for each day of construction is significant and requires advanced techniques for rapid processing that were developed here at the CAP Lab. There are only one or two other states this far into implementation of this technology at this time.

GREETINGS FROM CTSRC

Over the last 3 years, the CTSRC has been dealing with the challenges that come with a pandemic. Not only have we had to shift in the way we work and commute, but we are now working to analyze how our transportation system has evolved and how human behavior has impacted safety. Our team has drafted several papers on the impacts of COVID on traffic safety, in addition to the ad hoc analysis we conduct to support the CTDOT in understanding how safety trends are changing. In 2022, we have seen a record number of fatalities on our roadways in nearly every category from pedestrians, drivers and passengers, and motorcycles. The most troubling trend we have documented is the number of impaired and wrong way drivers in our state. These trends are not unique to Connecticut, but we are hopeful that the data systems we have established here at the CTSRC will provide unique insight into why we are seeing this increase in crashes and how we can stop them from occurring in the future.

With the relaxed restrictions due to COVID, participant research in our driving simulator resumed with two large scale studies on automated vehicles, driver alerts, and new driver assistance systems. We have started the development of a new virtual reality pedestrian simulator and are exploring the construction of an automated vehicle testing facility here on the Depot Campus.

In 2022, CTSRC continues to grow with the addition of 6 new research faculty and staff. We look forward to 2023 as the year where we can hopefully find innovative solutions to our emerging transportation safety challenges and expand our reach through new research initiatives and collaborations across many different disciplines.

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CTSRC Connecticut Transportation Safety Research Center

About Us

The Connecticut Transportation Safety Research Center (CTSRC), located at the Connecticut Transportation Institute at the University of Connecticut, is grant funded by the Connecticut Department of Transportation (CTDOT). The mission of the CTSRC is to support CTDOT in developing and maintaining a state-of-the-art crash data entry, collection, and safety analysis system. The CTSRC has been awarded a number of national awards for innovative programs and projects related to identifying the causes of road crashes and developing programs and policies to address roadway safety challenges effectively.

Goals

- Development of efficient tools for the collection and analysis of crash data
- Tracking, documenting, and researching safety improvements and needs in the state
- Researching and developing outreach programs to target Connecticut specific/identified safety concerns
- Developing custom training and early intervention programs to assist law enforcement in collecting uniform, timely and complete crash data
- Conducting transportation safety research that has state, national, and global implications and applications

Highlights

In 2022, the Connecticut Transportation Safety Research Center celebrated its 10-year anniversary. Founded in September of 2012, our partnership with the Connecticut Department of Transportation has grown from a staff consisting of Dr. Jackson (and a few borrowed graduate students from the computer science department) to a staff of 18 who have developed nationally recognized applications for transportation safety. The CTSRC is responsible for the development and maintenance of the Connecticut Crash Data repository (www.ctcrash.uconn.edu) and the Connecticut Roadway Safety Management System (https://crsms.uconn.edu/). Additionally, we have assisted CTDOT in establishing their Transportation Enterprise Database and open data portal (https://connecticut-ctdot.opendata.arcgis.com/). Furthermore, the CTSRC team is working to collect a magnitude of different datasets that will allow for the linkage of crash, roadway, and social factor databases to improve transportation safety.

THE T2 CENTER

For the past 40 years, the T2 Center has been serving the CT transportation community through highly valued professional development programs. We now offer eight comprehensive certificate programs, which include the public works academy, road master and road scholar programs, local traffic authority certificate, transportation leadership program, green snow pro, road safety champion, traffic signal champion and our newest traffic signal technician education program.

Over the past year, we have dealt with the challenges of providing in person training programs during COVID. We have come through these interesting times feeling an even stronger connection to this important community of professionals who work so hard to maintain our infrastructure and protect the quality of life for our communities in Connecticut.

Many successful virtual learning programs were built that will continue in the future, including a Complete Streets Spotlight series, the New England Chapter Connects webinars and our ever-popular Coffee and Conversations on timely topics. The center also worked with Connecticut legislature on the goal of reducing road salt on our roads, parking lots and sidewalks. Additionally, we have expanded our sustainable winter operations program through our Green Snow Pro educational effort, to include private commercial applicators.

As we commemorated our 40th anniversary, we reflected on all the great work we have done in collaboration with our partners and look forward to continuing this good work in the years to come.

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T2 Center
Training and Technical Assistance

About Us

The CT Training and Technical Assistance (T2) Center at the University of Connecticut is Connecticut's Local Technical Assistance Program (LTAP), one of 51 centers in the United States funded by the Federal Highway Administration and the State Department of Transportation.

The T2 Center enhances the quality and safety of our surface transportation system by improving the skills and increasing the knowledge of the transportation workforce in Connecticut. This goal is accomplished through a series of comprehensive professional development programs and technical assistance efforts.

The T2 Center team works very closely with many state, regional and national partners to maximize limited resources in order to meet our common goals. The T2 Center programs are highly valued by our CT transportation community.

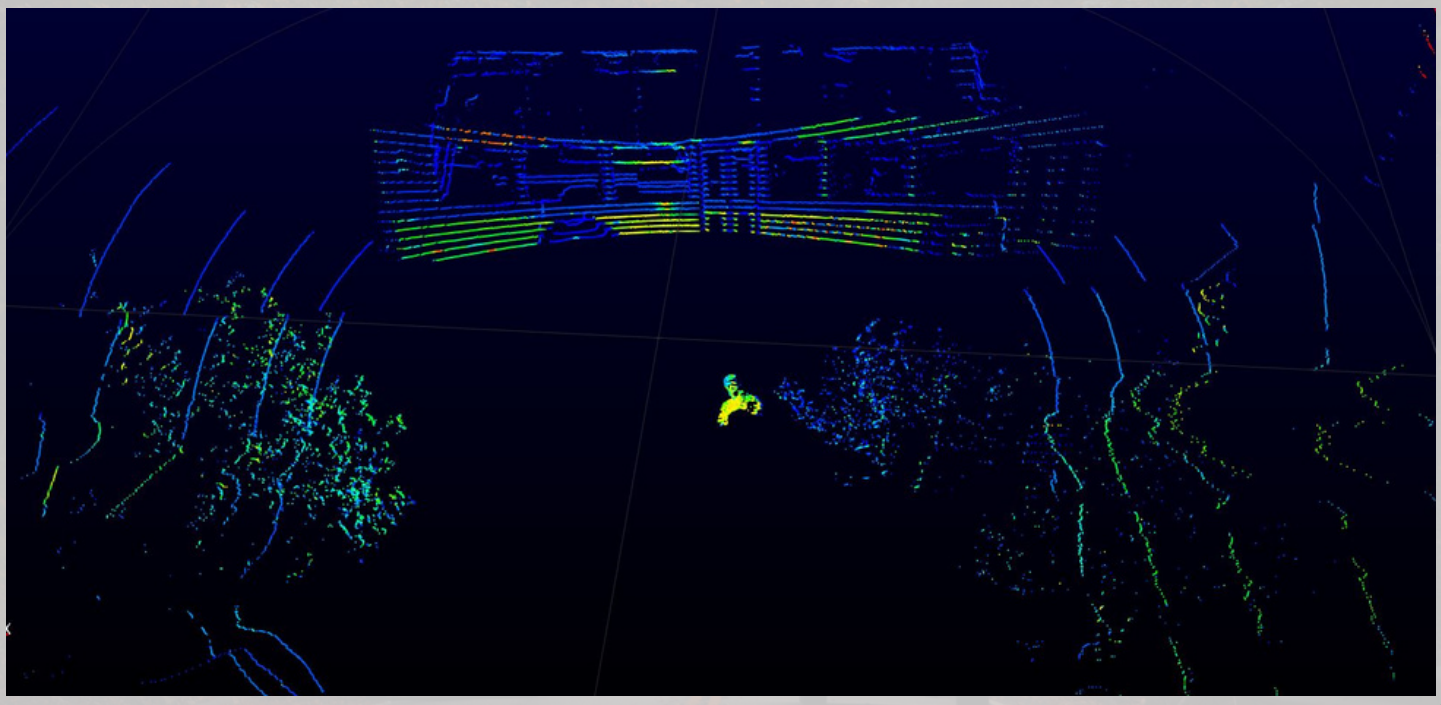
Highlights

- The T2 Center conducted 140 training sessions with over 3000 participants
- The Safety Circuit Rider program was reauthorized for an additional five years
- The Flagger Certification program resulted in twenty-six training sessions offered to the CT Public Works Community
- A Spring and Fall Public Works Academy program was successfully delivered
- The Traffic Signal Circuit Rider Program was reauthorized for an additional three years
- The Green Snow Pro educational program was expanded to include private commercial applicators
- Complete Streets Spotlights were held to share best practices
- The eighth cohort of the Transportation Leadership Program was selected
- The T2 Center developed a series of resources to support local municipal agencies as they navigate through the funding opportunities in the Bipartisan Infrastructure Law (BIL)
- CT Crossroads and Leadership Lessons newsletters provide many technical resources on critical topics
- A graduation ceremony was held at UCONN to celebrate CT transportation professionals who completed our certificate programs
- CT's first Traffic Signal Technicians Certificate program was completed

RESEARCH HIGHLIGHTS

LiDAR Data

Data becomes an increasingly important asset in today's world. It can inform decisions, improve understanding, and drive innovation. CTI works on using new tools and sensors to collect data that can be added to the traditional transportation assets. This includes using LiDAR (LIght Detection and Ranging), a remote sensing technology that uses lasers to measure the distance to an object or surface, to monitor and analyze traffic flow, patterns, and conflicts at intersections, to extract roadway infrastructure and roadside safety data elements, and to get real-time 3D mapping of the environment for navigation and data collection. CTI also investigates advanced data analysis tools and methods. We team up with professors from Computer Science to implement the SOTA (State-Of-The-Art) computer vision and natural language processing technologies for tasks such as image classification, text-to-sql, and text-to-image.



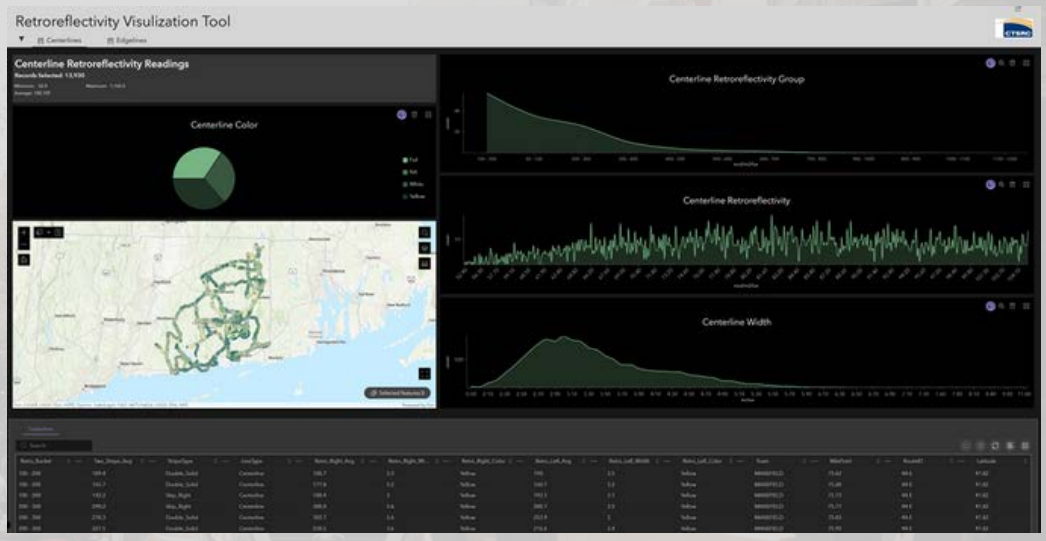
Wejo Data

Big data generated from various sources, such as roadway and vehicle sensors and devices, vehicle telematics and social media platforms provide additional insights to the investigation of roadway safety. Using big data can help transportation agencies better anticipate and prevent potential safety issues before a crash occurs, such as by identifying high-risk areas or forecasting the likelihood of crashes. Big data can also be used to monitor traffic patterns in real-time, allowing transportation agencies to respond to incidents and congestion more quickly and effectively. CTI has purchased large data samples of vehicle telematic data from the Wejo company and is exploring using vehicle telematic data to supplement the crash data to identify roadway incident hot spots in traffic safety analysis. The team is also extracting vehicle operating speed from Wejo data to investigate speeding activities across the state, which could potentially help transportation agencies identify locations with excessive speeding events allowing them to take action to prevent crash occurrences.

Lane Markings for Connected and Automated Vehicles

The Connecticut Transportation Safety Research Institute (CTSRC) at UConn is working with Consumer Report to conduct field testing of machine vision detection of lane marking using eight vehicles of various makes and models equipped with ADAS unit such as LDW and LKA. The consumer vehicle field testing will be funded by TETC and conducted under different lighting (night vs day) conditions. Furthermore, data from ADAS-equipped test vehicles are being collected from defined routes under existing conditions and then once new lane markings are added to existing routes.

The Study will track varying lane marking characteristics such as width, color, materials, design, condition, contrast and retroreflectivity, etc. to represent a wide range of in-service lane markings on real-world roadways. Machine vision lane marking detection quality scores will be collected through field testing to understand and evaluate the relationship between lane marking characteristics and machine vision detection accuracy. Outcomes from this study will be used to help the CTDOT and other IOOs determine the type, width, materials, and maintenance intervals of lane marking improvements to meet the demands of automated vehicles in the future.

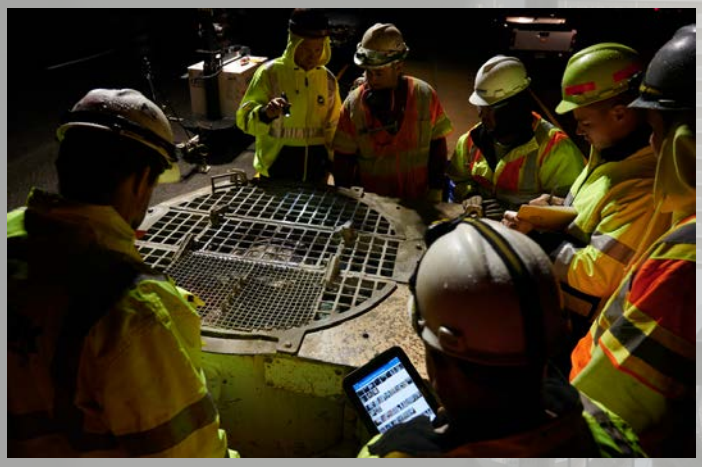


Pedestrian Safety

Dr. John Ivan is leading a study that began in May 2021 to help CTDOT determine how pedestrians and drivers interact with each other at intersections and discover how safe different types of crosswalk signals are. CDOT installed concurrent side street green signals in 2022 in specific areas of the state to determine if this is a safer, more efficient way to get drivers and pedestrians to interact. The goal is to make CT streets safer for everyone. Dr Ivan is optimistic that the concurrent side street green crosswalk signals will be a success and is excited to continue researching best practices.

Steel Beam and Repair of Steel Beam/Girder Ends

Dr. Zaghi and Dr. Hain's steel beam project seeks to facilitate the widespread implementation of a new repair technique for steel bridges with beam end corrosion. The repair entails welding headed shear studs onto the intact portions of the web and encasing the beam end in Ultra-High-Performance Concrete (UHPC), thus providing an alternate load path for bearing and shear forces. This alternative repair method saves time, limits traffic closures, and increases the load carrying capacity of deteriorated beams thus leading to safer and more durable bridge infrastructure.



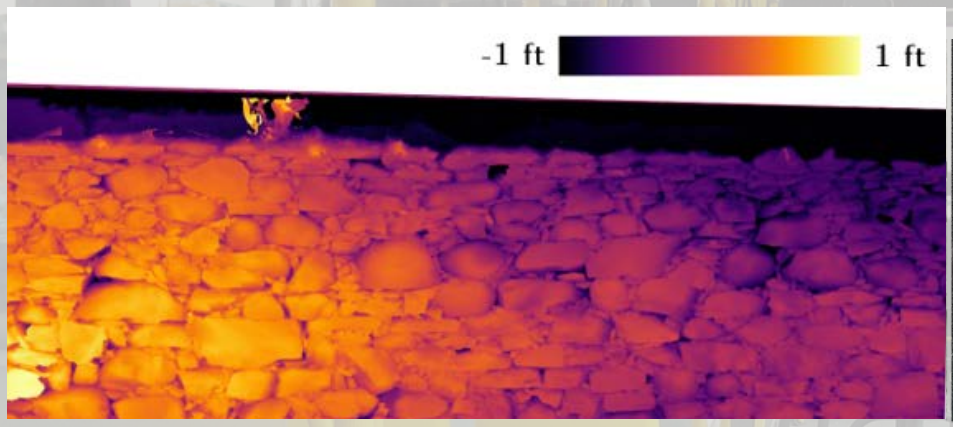
Approximately 25% of bridges in the nation have a steel girder superstructure system. A majority of these bridges were constructed between 1950-1980 and designed for a 50-year lifespan. The average age of steel girder bridges in the US is approximately 48 years, meaning that many of these bridges are at or near the end of their service life. Repair and replacement of aged bridges, compounded with the increase in traffic demands, has put a significant burden on federal, state, and local agencies. Therefore, new, innovative, and cost-effective solutions are necessary to address these challenges.

CTDOT has pioneered the development of an alternative repair strategy by supporting a promising research project with UCONN's CAP Lab. This two-year project works to enable the broad implementation of the repair method on different bridges with end corrosion problems. This entails devising a forming system that is adaptable to a large number of bridges and developing a simplified and automatized design process to enable rapid in-house designs.

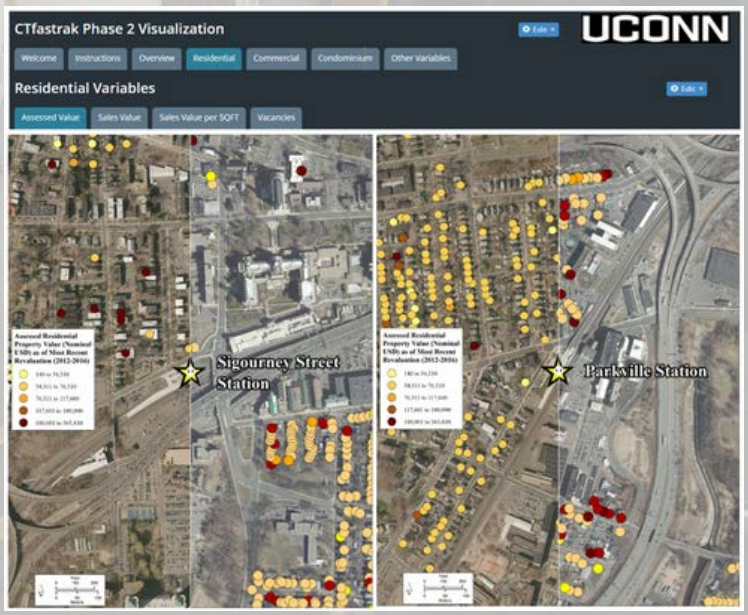
Retaining Wall Monitoring

Dr. Zaghi and Dr. Hain's is also working on a retaining wall project that aims to develop a reliable method for inspecting and monitoring stonemasonry retaining walls using 3D imaging technologies. These technologies will be used to generate high-resolution 3D representations of the walls, which can be used to accurately document their current in-situ conditions and provide a baseline for future comparison.

Screen Shot of 3D Model



CTfastrak Economic Impact



Dr. Cohen completed a project on the CTFastrak. The CTfastrak has been operating bus rapid transit (BRT) service in four Connecticut municipalities since March 2015. Among all of the BRTs in the U.S., there are only a handful that have a dedicated pathway, and CTfastrak is among this uniquely small number. This dedicated pathway enhances travel time reliability due to there being no traffic congestion, among other benefits. In conjunction with the construction and operation of CTfastrak, the Connecticut Department of Transportation (CTDOT) and local municipalities have been seeking to encourage Transit-Oriented Development (TOD) along the busway, including retail shops, restaurants, office space, and housing. CTfastrak is also unique because much of the 9.4-mile busway was constructed in former or existing rail right of ways, which minimized the construction disruption to existing businesses and residential properties. This uniqueness of CTfastrak was part of the motivation for this study of real estate impacts.

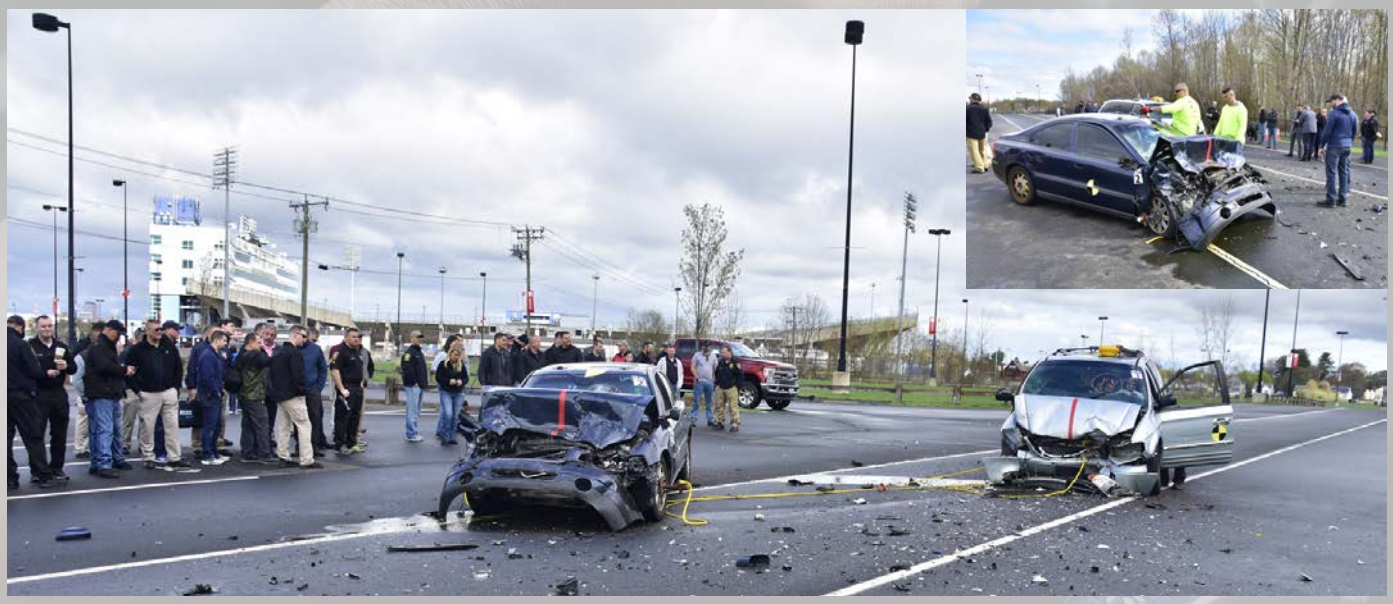
OUTREACH

From its inception, CTI has worked to develop strong outreach programs to serve the needs of Connecticut.

Traffic Safety and Injury Data Linkage

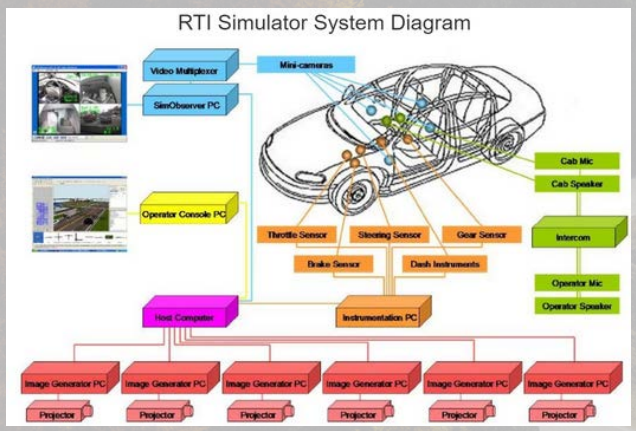
Our continued outreach has allowed for a data linkage program that encompasses all disciplines and their corresponding data bases to be brought together. This data is then used by numerous stakeholders in the overall effort to continue improvement of highway safety on roadways within the State of Connecticut. One great example of this is our Crash Emphasis Area Dashboard. This was created by members of the CTSRC and provides interactive data from the information provided by CTDOT.

The development of the CTSRC and its programs have allowed for the collaboration between numerous stakeholders including the Department of Emergency Services and Public Protection, the Connecticut Police Academy, the State Forensic Laboratory, the State Public Health Department and Office of the Chief Medical Examiner's Office. The CTSRC further partners with all Connecticut Law Enforcement agencies to assist with specialty training and investigative services in the area of crash documentation and investigation including live crash demonstrations and analysis.



Driver Simulation Lab

The core of the advancement in future transportation technologies is still safety. Before fully autonomous vehicles take the market and theoretically eliminate all human driving errors, there is still a long way to go to reduce fatal and severe injury crashes. CTI collaborates with Connecticut Department of Transportation to develop innovative Data-Driven Safety Analysis (DDSA) solutions to better assist with decision making. The Connecticut Roadway Safety Management System (CRSMS) implements the six-step safety management process as recommended by the Highway Safety Manual, a premier guidance document for incorporating quantitative safety analysis in the highway transportation project planning and development processes. In the current 5-year plan, CTI is working with CTDOT to add systemic safety analysis and vulnerable road user safety analysis capabilities to CRSMS. This systemic approach promotes proactively identifying high-risk roadway features correlated with specific severe crash types and improves safety with low-cost strategies. Vulnerable road user safety tools help states develop plans to improve the safety of vulnerable road users.



CT Green Snow Pro

CT Green Snow Pro education program provide training to support best practices for salt application and sustainable winter operations. The CT T2 Center began hosting this training in 2018 and has since trained nearly half of the state's cities and towns. The T2 Center offers two classes, the CT Green Snow Pro for Municipal Applicators, with a focus on roads, and the CT Green Snow Pro for Private Commercial Applicators, with a focus on parking lots and sidewalks. The T2 Center continues to collaborate with a statewide working group to address this important issue.

Balanced Mix Design

The CAP Lab is currently working with the Vermont Agency of Transportation (VTrans) on critical enabling work for their implementation of Balanced Mix Design – a national trend in testing and specifications for asphalt pavement construction. As one of the few labs in the northeast capable of running nearly every nationally recognized pavement performance test, we were well suited to assist VTrans in collecting plant-produced mix, fabricating test specimens for three separate tests to be performed at 10 labs spanning the northeast. The CAP Lab will also receive and compile test results from participating labs as their data is returned and the subsequent analysis will be provided to VTrans to inform their policies and specifications moving forward.

Crumbling Foundation Research

The UConn Crumbling Foundation Research Team has developed a method to obtain and analyze concrete samples that is minimally invasive and provides a measurement of the pyrrhotite concentration with high accuracy and precision. The goal is to develop a risk assessment framework for pyrrhotite-induced concrete deterioration and assist homeowners and stakeholders with decision making.

Speed Feedback Sign Program

The T2 Center's rural speed feedback sign program was a special project funded by CTDOT to deliver speed feedback signs and associated speed management training to all 119 Connecticut designed rural municipalities. The speed sign program has been extremely successful as towns are able to access data and use it to identify safety improvements to reduce speeds and crashes. Towns have also used the signs to educate the public about speeding. Additionally, the data is being shared with the CT Safety Research Center for a project on the effectiveness of countermeasures on human behavior and with DOT's Research & Performance Management Unit as an additional source of data for congestion planning. The program has now expanded to include urban municipalities.

Connecticut Public Works Academy

As public works agencies continue to be challenged with recruiting qualified public works professionals, the Connecticut Public Works Academy provides critical introductory level training for those staff that are new to public works and road maintenance.

The program is comprised of a series of six (6) weekly sessions aimed at providing education on those core competencies necessary to be a successful public works professional. This year the T2 Center offered a Spring and Fall series and they were full with a waiting list of interested participants.

Emerging Technology and Hot Topics Roundtables

The T2 Center provided many opportunities to the transportation community to come together to discuss emerging technologies and hot topics facing the transportation industry in Connecticut. These programs have built a solid learning community for sharing challenges, successes and best practices.

Transportation Leadership Program

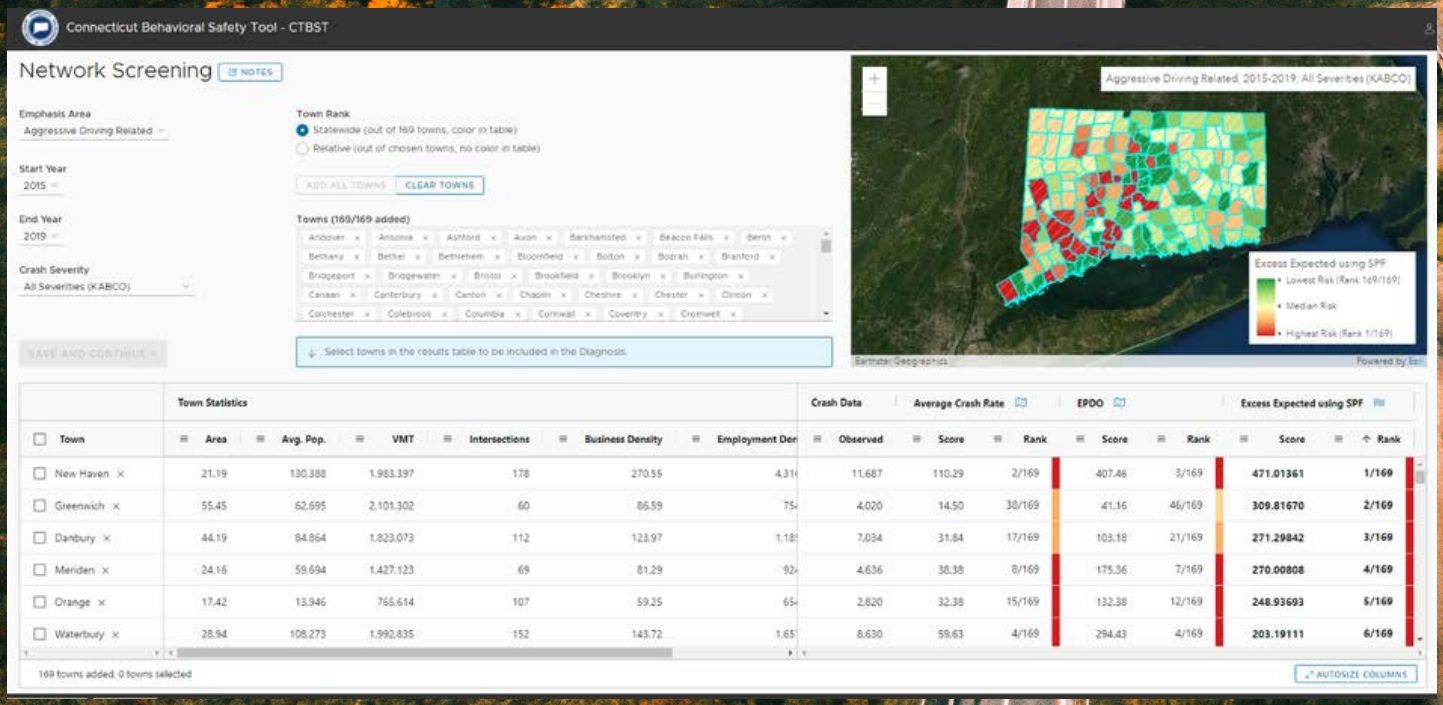
The future of our transportation system in Connecticut is dependent on having innovative leaders capable of growing strong, resilient teams. The CT Transportation Leadership Program is managed by the T2 Center and provides a comprehensive two-year professional learning opportunity. The program includes a Capstone project for each participant to address a current transportation related challenge.

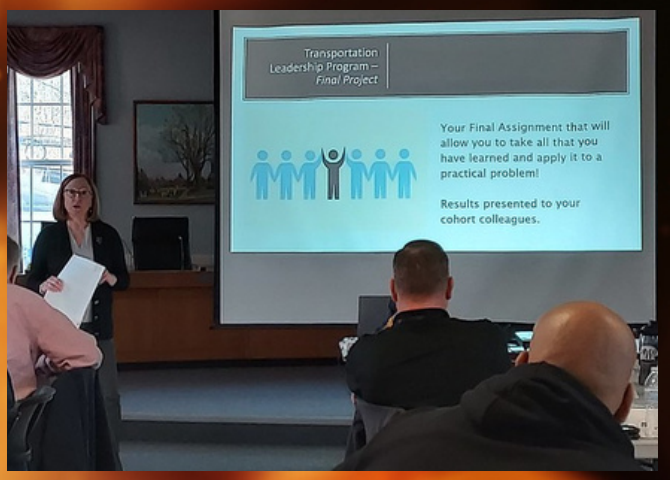
WHAT'S NEXT?

CONNECTICUT AND THE TRANSPORTATION INDUSTRY FACE MANY CHALLANGES IN THE UPCOMING YEARS. HERE AT CTI, WE ARE READY TO FACE THEM TOGETHER!

"Transportation equity has been identified as one of the most critical priorities to future transportation, which takes into account the needs of all populations, particularly those who may face challenges in accessing transportation facilities due to factors such as income, race, ethnicity and geographic location."
- Kai Wang, Ph.D.

Incorporating transportation equity into roadway safety ensures all populations have equal access to safe and reliable transportation options. CTI has been involved in multiple state-of-the-art projects to evaluate and improve transportation equity across the entire state. For example, the safety team conducted a project "Advancing the Behavioral Safety Analytic Tools Capabilities of the Connecticut Department of Transportation" sponsored by the U.S. Department of Transportation. This project collected and applied unconventional data elements, including but not limited to, citation data, socio-demographic data, toxicology data, and business data to investigate the transportation equity issues in traffic crashes related to driver behaviors. The project also created a web-based application tool to help transportation agencies identify hot spot locations related to driver behaviors and improve decision-making on budget planning and allocation.





The T2 Center will be working with municipal public works agencies to address the workforce challenges of recruiting, training and retaining their critical transportation employees.

The T2 Center will be taking the next steps in many timely trainings including Safe Transportation for Every Pedestrian, Modern Roundabouts, ADA Transition Planning, Combatting Rural Roadway Departures and Low Cost Safety Improvements.

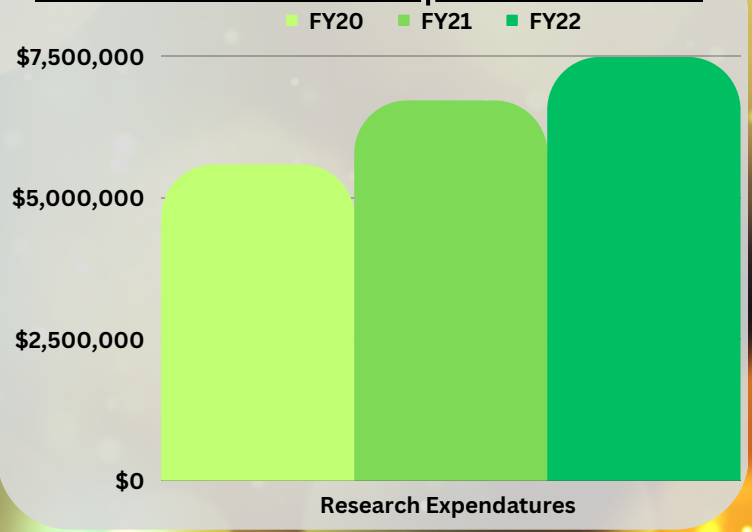
CTI will be providing valuable resources to assist local agencies in navigating the opportunities being presented in the Bipartisan Infrastructure Law.

The future direction of CTI looks towards automation, sustainable and equitable transportation, and infrastructure. The Institute is exploring investment and development of connected and automated vehicle facilities. These will complement the current full-scale driving and pedestrian simulator already housed at CTI.

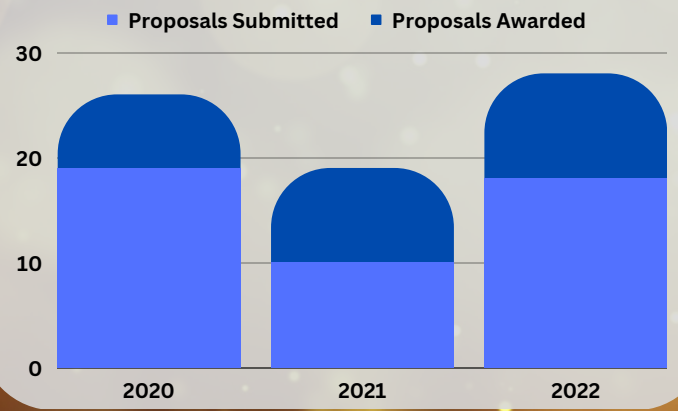
Grants and Financials

CTI managed 77 grants, totaling over $31.2M, with more than 25 unique researchers in FY22 (running July 1, 2021 - June 30, 2022). These grants come from various sources including CTDOT, Consumer Reports, USDOT, as well as from state, and federal sources. Our resaerch expendatures for FY22 was almost $7,500,000, which is an increase of $800,000 from the previous year! CTI Director Eric Jackson is working on numerous ways to diversify our funding and has a goal of doubling the Institute's funding within the next 5 years.

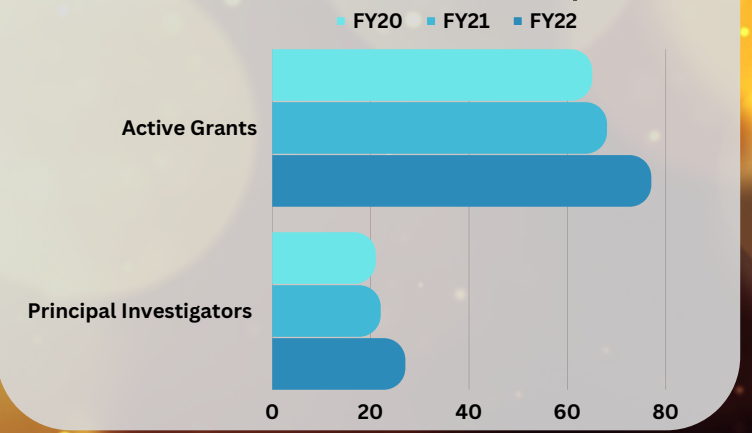
CTI Research Expendatures



Proposals



Active Grants and Unique PIs



Awards

The CTSRC GIS team along with the CTDOT won a prestigious Special Achievements in GIS (SAG) award from ESRI during their annual user conference for their work on the Transportation Enterprise Database (TED) DataMart and open data portal

Regina Hackett of the T2 Center won the New England APWA Meritorious Service Award for her work on the New England Chapter Connects Virtual Learning Series.

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CTI Connecticut Transportation Institute

A SPECIAL THANK YOU TO EVERYONE WHO KEEPS CTI DOING AMAZING WORK: PARTNERS, SHAREHOLDERS, FACULTY, AND STAFF. WE APPRECIATE ALL YOUR EFFORTS TO HELP MAKE CONNECTICUT ROADS SAFER.

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