In January 2011, Connecticut endured snowfalls the likes of which most of us have never experienced. Amazingly, the transportation network continued to rebound quickly to facilitate the movement of people and goods. As the snow melted, the impacts of a harsh winter became evident. The damage to the roads throughout the state was substantial.

Before the year ended, Connecticut was hit with more two uncharacteristic storm events, Tropical Storm Irene in August and the out-of-season wintery nor’easter in October. Both of these events had a significant impact on the transportation network and mobility. For parts of Connecticut, there were lengthy power outages, transportation disruptions and road closures.

The extreme weather events experienced throughout 2011 highlighted both the resiliency and vulnerability of our transportation system and provided a living laboratory to reveal its strengths and its weaknesses. The unprecedented challenges faced by state and local agencies underscored the vital role that the Connecticut Transportation Institute (CTI) plays in the transportation community and in maintaining Connecticut’s transportation system.

These events exposed the vulnerabilities of the transportation system, yet provided opportunities for CTI to contribute our expertise in research and education to be of assistance. For Example:

- The Connecticut Advanced Pavement Laboratory worked to mitigate the impacts of the damage caused by the harsh winter using polymerized asphalt materials to increase the durability of the asphalt pavements.

- The Technology Transfer Center developed special educational outreach programs focused on emergency response and worker safety during a disaster. The value of these programs was evident from the minimal number of injuries sustained by local agency crews in their roles as first responders during the aftermath of the storms.

CTI fostered new relationships within the state to improve the transportation system, safety and infrastructure. One such initiative is the Connecticut Crash Data Repository (CTCDR). The CTCDR is a web tool comprising crash data from the Department of Public Safety (DPS) and the Connecticut Department of Transportation (CT DOT). It provides members of the traffic-safety community with timely, accurate, complete and uniform crash data to make long-range state and local transportation safety improvement plans.

Another CTI initiative is the development of the Connecticut Transit Working Group. The objective of this group is to work with the transit community to identify Connecticut public transit needs and develop strategies for meeting these needs. The Working Group consists of representatives from CT DOT, CT Transit, regional transit districts, and UConn.

As we look toward a future that is rich with tremendous growth opportunities, we will renew our commitment to providing creative solutions to emerging problems in the use of alternative energy, infrastructure monitoring, environmental and community sustainability, and advanced materials for transportation.

– Mun Y. Choi
Acting UConn Provost, former Dean, School of Engineering

CTI continues to serve as the focal point of transportation research throughout Connecticut. As financial resources for transportation construction and maintenance continue to decline, the role of CTI will enlarge to ensure that the transportation community is current with and trained to employ new technologies to achieve optimal benefits for the long-term sustainability of our transportation system.

James Mahoney
More than 25 years ago, the Federal Highway Administration (FHWA) answered a pressing need for training and technical assistance at the local level by creating the Local Technical Assistance Program (LTAP). The Connecticut Technology Transfer Center is one of 58 Local Technical Assistance Centers who help agencies build, maintain and operate America’s transportation system by delivering timely and relevant training and technical assistance.

Connecticut’s local transportation agencies face unprecedented challenges in their efforts to continue to meet the demands of an aging infrastructure, especially in these difficult economic times. Even with limited resources, the Center staff remains committed to providing the highest quality professional learning opportunities and services that will assist local agencies in addressing their transportation needs.

As we look back on the past year, we are very proud of the impacts we have made and look forward to many more years of service to the transportation community.

Technology Transfer Center Program Director

Donna Shea

Program Highlights

- Provided 74 trainings and special events to over 3,000 participants in the areas of safety, infrastructure management and workforce development
- Developed and implemented the first Connecticut Transportation Leadership Program for Public Works professionals
- Honored a group of 87 transportation professionals who have completed the Connecticut Road Master, Road Scholar, Legal Traffic Authority Certificate Programs and the new Public Works Academy
- Received the 2011 Business Partnership with Public Works Award
- Partnered with the CT Department of Transportation to develop a series of trainings via streaming media
- Connecticut Creative Solution Awards were presented to the Town of Simsbury, Town of East Hartford and the City of New London
- Mary McCarthy, T2 Training Specialist, honored with Award of Excellence from the Connecticut Training and Development Network
- T2 Staff served on many state, regional and national committees including the Federal Highway Administration LTAP/TTAP Strategic Planning Committee
- Partnered with the Connecticut Highway Street Supervisors Association (CHSSA) to host the Technology Transfer Expo with more than 60 vendors and 500 participants
- Worked closely with the public works community to advance issues related to the role of public works in emergency response
- Coordinated educational sessions for the Connecticut Association of State Highway Officials (CASHO) for their 2011 Equipment and Technical Show
- Introduced the first Connecticut Roadway Safety Poster Contest for school children
- Donna Shea, Program Director, actively participated on the Connecticut Highway Work Zone Safety Council
- Assisted the Center for Resilient Transportation Infrastructure (CRTI) in the development of the National Transportation Security Center for Excellence (NTSCOE) strategic plan
The CAP Lab during the past year has conducted research on several research projects intended to extend the service life of the asphalt pavements as well as improve the construction of these pavements in Connecticut. The CAP Lab also conducted research sponsored by Tilcon Connecticut to determine the applicability of using mechanical foaming for the production of asphalt pavements containing polymer modified asphalt.

The CAP Lab developed a certification course for the Connecticut Department of Transportation for field technicians testing Portland Cement Concrete at the time of placement. The CAP Lab also conducted numerous certification courses for the NorthEast Transportation training and Certification Program (NETTCP) on the testing and inspection of transportation construction materials. The CAP lab is very active with various NETTCP technical committees. The CAP Lab also is active with the North East Asphalt User Producer Group.

THE USE OF WARM MIX ASPHALT FOR PILOT PROJECTS IN CONNECTICUT

In cooperation with ConnDOT and FHWA, the CAP Lab conducted a study with the placement of Warm Mix Asphalt (WMA) on 4 different construction projects during the 2011 construction season. WMA allows the asphalt pavement to be mixed and placed at lower temperatures as compared to conventional asphalt pavement. This has several benefits including the reduction in fuel consumption during production as well as reducing emissions at the mix plant as well as the paving project. WMA technology is quickly being adopted across the United States and has been used commonly in parts of Europe for more than 10 years.

THE DEVELOPMENT OF A SPECIFICATION FOR THE USE OF POST-CONSUMER ASPHALT ROOFING SHINGLES IN ASPHALT PAVEMENTS

In cooperation with ConnDOT and FHWA, the CAP Lab developed a specification for the use of post-consumer (tear-off) asphalt roofing shingles in asphalt pavements. Each year, enormous quantities of asphalt roofing shingles are removed and replaced from residential and commercial buildings. Asphalt roofing shingles have a very high asphalt binder content and have an aggregate coating on them. Using them in asphalt pavements does present a challenge as the asphalt binder in the roofing shingles is much harder than the asphalt binder used for paving. Therefore, the development of the specification had to take this into account so as to not compromise the asphalt pavement’s performance. This draft specification is being used in a pilot project during the 2012 construction season. After the results from the 2012 pilot project have been collected, the specification will need to undergo additional changes to allow the use of recycled asphalt pavement along with recycled asphalt shingles.
The Center for Transportation and Livable Systems (CTLS) was established in 2005 as a federal University Transportation Center (UTC). CTLS supports research, education and outreach activities that fall under its thematic focus “Sustainable and Livable Transportation Systems for Smart Growth.” The CTLS theme engages multi-disciplinary engineering and planning activities that promote a sustainable transportation system and livable communities connected by this system. The following Sustainability and Livability Principles jointly developed by USDOT, EPA and HUD are represented in the research activities of CTLS:

1. Provide more transportation choices.
2. Promote equitable, affordable housing.
3. Increase economic competitiveness.
4. Support existing communities.
5. Leverage federal communities.

CTLS pursues an innovative, integrative, and multi-disciplinary vision of sustainable transportation systems under the direction of Dr. Nicholas Lownes (Civil & Environmental Engineering). In addition to the previous principles, sustainable transportation systems harness and integrate advanced technology for communications, sensing and monitoring. Sustainable transportation systems will be less dependent on fossil fuels, and as such will utilize alternative fuels and will require supportive infrastructure and policy—all guided by cutting-edge research and outreach. For detailed information on CTLS activities, be sure to visit www.ctls.uconn.edu.
Connecticut Cooperative Transportation Research Program

The Connecticut Cooperative Transportation Research Program (CCTRP) has been a joint venture of the University of Connecticut Department of Transportation since 1962.

2011

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Joint Highway Research Advisory Council (JHRAC)

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Norman W. Garrick Associate Professor, Civil & Environmental Engineering
John N. Ivan—Vice Chair, Professor and Associate Head, Civil & Environmental Engineering
Kazem Kazerounian Associate Dean for Research & Strategic Initiatives, School of Engineering

CCTRP Active Research

IMPROVING SURVEYING ACCURACY AND EFFICIENCY IN CONNECTICUT: An Accuracy Assessment of GEOID03
Project JH 06-10, PI: Dr. Thomas Meyer, Robert Baron, Steven Fish and Derek Massalski

INCORPORATING WET PAVEMENT FRICTION IN TRAFFIC SAFETY ANALYSIS
Project JH 07-5, PIs: Drs. John Ivan and Nalini Ravishanker

STRUCTURE AND PROPERTIES OF IONOMER MODIFIED ASPHALTS (IMAS)
Project JH 08-1, PI: Dr. Robert Weiss

ASSESSING AND QUANTIFYING PUBLIC TRANSPORTATION ACCESS
Project JH 08-5, PI: Dr. Nicholas Lownes

EXPERIMENTAL TESTING OF CONTROLLABLE DAMPING DEVICES TOWARD EXPANDING THE LIFESPAN OF EXISTING HIGHWAY BRIDGES
Project JH 08-6, PI: Dr. Richard Christenson

Final Reports Issued

IMPROVING SURVEYING ACCURACY AND EFFICIENCY IN CONNECTICUT: AN ACCURACY ASSESSMENT OF GEOID03 AND GEOID09,

Dr. Garrick has been an Associate Professor at the University of Connecticut since 1994. In June 2010, he was awarded the Educator of the Year Award by The Connecticut Greenways Council. Dr. Garrick serves on the board for Congress of New Urbanism. He specializes in urban streets and highway design, urban planning, bicyclist and pedestrian facility design, urban transportation systems, and sustainable transportation planning. In 2010 alone, Dr. Garrick was invited to 11 talks ranging from sustainable transportation planning to city friendly transportation planning.

John Ivan
Dr. Ivan is Professor and Associate Head of the Department of Civil and Environmental Engineering at the University of Connecticut. He spent the spring semester 2009 as a visiting researcher at Lund University, Sweden, and the academic year 2002-2003 as a Fulbright scholar at the Institute for Transport Studies at the University of Karlsruhe in Germany, and as a Research Engineer at the Texas Transportation Institute at Texas A&M University. He has earned B.S., M.S. and Ph.D. degrees in Civil Engineering at Carnegie Mellon University, Massachusetts Institute of Technology and Northwestern University, respectively. He teaches courses in traffic engineering, transportation planning and decision analysis and conducts research in the application of statistical forecasting techniques for measuring the sustainability of transportation systems and engineering, especially highway safety and operations. He has been an investigator on 31 research projects at a total of more than $3 million in funding, and published as author or co-author 30 peer-reviewed journal articles and 36 peer-reviewed conference papers. He has coordinated preparation for the academic accreditation of the Civil Engineering Program since 2000 and is an associate editor of the Journal of Transportation Safety and Security. In 2011 he was elected to the Connecticut Academy of Science and Engineering.

Dr. Jackson has been an Assistant Research Professor at the University of Kentucky in 2002 and his Masters (2004) and PhD (2008) at the University of Connecticut. His previous research efforts include conducting research on driver behavior and vehicle dynamics impacts on vehicle emissions. Dr. Jackson has also been involved in research with the Department of Transportation to preserve their historical photolog archive and enhance their photolog activities with 3D imagery. Dr. Jackson is currently leading a research effort in the state to provide timely, accurate and complete access to motor vehicle crash data to researchers, planners and the Department of Transportation with the goal of improving safety on the state’s transportation network. Since 2009, Dr. Jackson has been the principal investigator on 7 projects totaling more than $2 million dollars in research funding.

Nicholas Lownes
Dr. Lownes is an Assistant Professor in the Civil and Environmental Engineering program at the University of Connecticut. In 2010 he became director of the Center for Transportation and Livable Systems (CTLS). Dr. Lownes earned his PhD (2007) from the Department of Civil, Architectural and Environmental Engineering at The University of Texas at Austin (UT). While at UT, Dr. Lownes was named an Eno Fellow in 2006 and won the 2007 SWUTC Outstanding PhD Student of the Year. In 2007, he joined the faculty at the University of Connecticut (UConn) in the department of Civil and Environmental Engineering. In 2009, Dr. Lownes won the 2009 C.R. Klewin, Inc. Excellence in Teaching Award. He has authored or co-authored over two dozen journal articles and conference proceedings and made over fifty presentations at conferences and technical meetings. His research interests include public transportation systems, traffic microsimulation and transportation economics. Since joining the University of Connecticut in 2007, Dr. Lownes has successfully been a part of 17 funded projects totaling $1.7 million in grants. His research areas include public transportation systems, public transportation economics, traffic micro-simulation, and network modeling.

Dr. Zofka is an Assistant Professor in Civil and Environmental Engineering at the University of Connecticut. In 2010, Public Works Magazine wrote about his study on perpetual pavements in Connecticut. He also submitted conference papers to American Society for Nondestructive Testing. In January 2011, his student, Alex Bernier, was awarded 2nd place in the Eleventh International Contest on LTPP Data Analysis for his paper titled, Friction Modeling Based on Long Term Pavement Performance Data. Dr. Zofka’s research focus includes pavement design, characterization and experimental testing of bituminous materials, reclaimed asphalt pavements (RAP), theory of viscoelasticity, and composite materials and micromechanics. In 2010, Dr. Zofka published papers whose topics ranged from developing alternative procedures for determination of hot-mix asphalt creep compliance to transportation asset management.
ASSESSING AND QUANTIFYING PUBLIC TRANSIT ACCESS
Measuring ease of access to transit services is important in evaluating existing services, predicting travel demands, allocating transportation investments and making decisions on land development. A composite index for assessing accessibility of public transit is described. It involves use of readily available methods and represents a more holistic measure of transit accessibility integrating developer, planner and operator perspectives. The research reviews previous and current methods of measuring accessibility and selects three methods for application in a case study in Meriden, CT. Inconsistencies are noted across the methods, and a consistent grading scale is presented to standardize scores. This research proposes weighting factors for individual methods to formulate a composite measure based on individual accessibility component measures.

Integrating transit needs into transit accessibility indexing is considered in this research for the evaluation of existing transportation systems and service gaps and for the identification of priority areas for future investments in transportation infrastructure. An accessibility-based transit need indexing model is detailed that focuses on the necessity of evaluating transit needs and transit accessibility simultaneously. A need index is developed to identify areas in high need of public transit services using economic and socio-demographic information. The need for transit service is then modeled as the lack of transit accessibility and correlates different access indicators with their ability to predict transit service need. This model maps areas with different levels of transit accessibility and transit needs using a single score, which may be easily interpreted by planners examining transit equity. The model has been applied to the city of Meriden and New Haven, CT and results have been compared with a general approach for consistency and effectiveness. The research also highlights the model’s usefulness through a representative example of its application.

PI: Nicholas E. Lownes, Ph.D., P.E.
Joint Highway Research Advisory Council (JHRAC)

EVALUATING APPLICATIONS OF FIELD SPECTROSCOPY DEVICES TO FINGERPRINT COMMONLY USED CONSTRUCTION MATERIALS
The main objective of the project is to identify the most successful spectroscopic method and recommend its use in Quality Assurance/Quality Control activities in real-life construction projects. The project scope of work embrace three phase. In Phase I, the research team conducted a comprehensive literature search on the state-of-the-art practice in identifying most common highway construction materials by means of spectroscopy. Four methods were identified as applicable: Fourier Transform Infrared Spectroscopy, Gel Permeation Chromatography, X-Ray Fluorescence Spectroscopy, and Raman Spectroscopy. The second phase of research consisted of the series of laboratory experiments with stationary and portable equipment to identify most promising combination of method/materials to recommend them for further evaluation in the field. As a result, the portable Attenuated Total Reflection (ATR) Spectrometer was recognized as most successful instrument for fast and reliable analysis of chemical composition of a wide range of materials, including paints, epoxies, Portland cement concrete, asphalt, and polymer additives. These days, the final stage of the project is in its prime. The Team performs field trips to verify applicability as well as precision and accuracy of the ATR in real project conditions. The final report is expected to be delivered by the end of this year.

PI: Adam Zofka
Second Strategic Highway Research Program (SHRP2)

COMPREHENSIVE FORENSIC EVALUATION OF THE LONG TERM PAVEMENT PERFORMANCE (LTPP) SPECIFIC PAVEMENT STUDY (S.P.S.-9A) PROJECT IN CONNECTICUT
This project focuses on six experimental pavement sections on Rt. 2 in Colchester, CT. These sections were constructed in 1997 in order to compare different mix designs (Superpave vs. Marshall) as well as the effects of including Reclaimed Asphalt Pavement (RAP), and different amounts of anti-stripping agents. Sections were reconstructed in 2009 and over 200 cores were collected at that time. Initial forensic work involved 360-degree high-resolution panoramas of all the field cores and dimensioning of all layers within each core. All images and data were then organized in hierarchical online database that contains also location maps, field images, and other metadata. This information was used to assign each core and its layers to specific forensic testing, such as basic permeability and density testing, low-temperature cracking testing and interlayer shear bond strength testing. In addition to mechanical testing, Fourier Transform Infrared Spectroscopy is also used to compare oxidation levels of asphalt mixes coming from different test section as well as through the pavement depth. Results from the laboratory investigation will be compared with a high-quality weight-in-motion traffic data and weather data. The final report is expected to be finalized in the summer of 2012.

PI: Adam Zofka
Connecticut Department of Transportation

STATE MOTOR VEHICLE CRASH DATA REPOSITORY
The purpose of this project is to develop a Connecticut Crash Data Repository (CTCDR), data query and analysis toolset to provide members of the traffic-safety community with timely, accurate, complete and uniform crash data. The Crash Repository designed at the University of Connecticut will allow agencies that capture PR-1 data to submit accident files electronically to the repository. The system will be designed so that agencies regardless of how they utilized electronic or manual entry would be able to upload or enter data into the repository. The system will be designed as a secured web portal so that only registered users are able to enter, view and download data. This will allow Law Enforcement agencies across Connecticut to populate this database and have access to the statewide data if they choose.

Pl: Eric Jackson
Co-Pls: John Ivan, Steve Demurjian and Dong-Guk Shin
State of Connecticut, Office of Highway Safety

TEMPORAL MODELING OF HIGHWAY CRASH SEVERITY BY INVOLVED PERSON AGE
This project will use leading edge statistical methods to uncover temporal patterns in the severity level (fatal, serious injury, minor injury, slight injury and no injury) for persons involved in highway crashes in Connecticut. Existing State data sources will provide data describing the time and weather conditions for each crash and the vehicles...
and persons involved over the time period from 1995 to 2008 as well as the traffic volumes and the characteristics of the roads on which these crashes occurred. Controlling for characteristics known to be related to severity, e.g., age, gender, alcohol use, vehicle type, collision type, land use setting (surrogate for prevailing speeds), and road characteristics, temporal analysis and modeling will be used to identify changes in the involvement of elderly drivers (65 years and over) in crashes and the severity level of the crashes in which they are involved. The expected outcomes of the project will be both a robust prediction model for the likelihood of an individual to have a specific severity outcome if he/she is involved in a highway crash, as well as to identify trends in the crash outcomes for senior motor vehicle travelers that point to significant impacts on public health and safety as the elderly become a larger portion of the population.

PI: John Ivan
Co-PI: Nalini Ravishanker
New England University Transportation Center (USDOT)

ASSESSING THE RELATIONSHIP BETWEEN TRANSPORTATION MODE CHOICE AND TRANSPORTATION LAND CONSUMPTION

The goal of this study is to develop models relating mode choice to the amount of land used for transportation in a city. With the increased emphasis being placed on building transit oriented developments in Connecticut and across the country, there is an immediate need to improve our knowledge relating to the efficient use of land in dense urban places and how this land allocation is affected by mode choice in our transportation system.

The wider importance of this work stems from the fact that there is growing consensus that compact, dense urban areas are some of most sustainable places, particularly from the perspective of the transportation, energy and climate impacts. Our proposed research is grounded in the fact that there is also growing evidence to suggest that such compact, dense urban zones are difficult, if not impossible, to create in the face of high levels of car use. However, this evidence is largely based on qualitative observation, as there is currently no realistic model for quantifying the complex interrelationship between car use level and land consumption.

This research aims to remedy this gap in our knowledge by building on both the empirical work that we have done at UPenn and the theoretical models that were developed at UPenn. The model resulting from this project will add needed rigor for urban planning by providing tools for quantifying the economic, social and environmental advantages and costs associated various types of transportation systems and understanding the extent to which mix of modes support the building of sustainable urban places.

PI: Norman Garrick, Ph.D.
Co-PI: Alexander Vias, Ph.D.

DEVELOPING AN INDEX FOR COMPARING SUSTAINABILITY OF STATEWIDE TRANSPORTATION SYSTEMS

We will complete the final phase of the University of Connecticut-UTC’s signature research initiative, the creation of an index that measures sustainable transportation for states. Over the past three years the project has generated several research papers, funded numerous graduate students, and raised the profile of the University of Connecticut as a place of innovative research and education that considers transportation and the built environment as integrated components of the urban fabric. In the final stage of this project, we will finish populating the index with data, and release the index to the policy community via a web-based tool.

Our intention is to offer an alternative indicator of transportation to that provided by the Texas Transportation Institute whose focus has been on mobility and congestion reduction. The index contains components that reflect economic, environmental, and social components of transportation that reflect the changing priorities of US policymakers. The index ties very neatly to current administration’s focus on energy policy and structural exposure of the US economy to increases in the price of fossil fuels. The recent collaborations between federal agencies responsible for transportation, housing, and energy underscore the timeliness of this index.

PI: Norman Garrick, Ph.D.
Co-PI: Carol Atkinson-Palombo, Ph.D.

BRIDGE MONITORING IN CONNECTICUT
Expansion and Operation of a Bridge Monitoring Network in Connecticut

Researchers at the University of Connecticut have been using a network of long-term monitoring systems on different bridges in Connecticut to develop structural health monitoring approaches based on normal vehicular input. The recent efforts have included significant improvements to the monitoring systems, using advances in monitoring equipment, to improve both the quality of the data and to automate the data collection. Based on this research, we have been able to develop structural health monitoring techniques that can be tailored to different bridge types to provide warning of major changes in the structural integrity.

PI: Dr. John DeWolf
Co-PI: Dr. Richard Christianson
Sponsored by the Connecticut Department of Transportation and the Federal Highway Administration

STUDY TO BETTER MANAGE BRIDGE INFRASTRUCTURE
Validating and Assessing the Integrity of Troubled Bridges in Connecticut

Richard Christenson, Jeong-Ho Kim and John DeWolf are doing research using a portable field monitoring system to conduct short-term monitoring to provide information on troubled bridges. This information is intended for use by the Connecticut Department of Transportation to better manage their bridge infrastructure. The results of this research will allow better planning for renovations and replacements, as well as supplementing the data developed in bi-annual inspections.

PI: Richard Christenson
Co-Pls: Jeong-Ho Kim, John DeWolf
DIGITAL PRESERVATION OF A HIGHWAY PHOTOLOG FILM ARCHIVE IN CONNECTICUT

The Connecticut Department of Transportation has been photologging the state’s transportation network for over thirty-five years. Connecticut’s first van was constructed in the 1970’s. Photologging refers to the use of an instrumented vehicle which is designed to capture successive photographs and roadway data at defined intervals. Initially photolog images were captured on movie quality film. However, in 1996 ConnDOT made the switch to digital image capture. Approximately 11.5 million frames of images were captured before the switch to digital capture and computer distribution at ConnDOT’s research facility. The goal of this project is to digitize the images captured on 35mm movie quality film in order to preserve the historical footage and increase the accessibility of these images. In addition to the film transfers the research team also completed a successful pilot test of 3D photolog technology using stereo cameras in the photolog van. Implementation and implications of 3D roadway imagery is being discussed for future years of photolog data collection.

PI: Eric Jackson  
Co-PI: James Mahoney

CTI Funding Expenditures

Total Expenditures: $2.66 Million

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Connecticut Department of Transportation

Mission Statement

The mission of the Connecticut Transportation Institute (CTI) is to conduct integrated multidisciplinary research, education and related services that promote safety and efficiency in multimodal passenger and freight transportation systems and, in turn, enhance livable communities, sustainable economies and the environment.