massDOT
Massachusetts Department of Transportation

Transportation Research Quarterly

Providing highlights of MassDOT's transportation research activities and other helpful information **2023 Q1**

Safety and Research

"The data are telling us where to focus our resources and our funds. It happens to be the needs are elevated in environmental justice communities, which guides us to improve safety for all road users."

Bonnie Polin, State Safety Engineer, MassDOT Highway Division

Safe System Approach as the guiding model to address roadway safety.

The Commonwealth of Massachusetts' top priority is ensuring the safety of all roadway users. The 2023 Strategic Highway Safety Plan (SHSP) provides a framework for how the Commonwealth will work to make Massachusetts roadways safer for all people. No matter how people get around, it is essential that everyone feels safe traveling throughout the Commonwealth. Safe systems approach is a more human centric approach that differs from conventional safety approaches.

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Safe System Approach operates on the notion that we can acknowledge human mistakes and keep impact energy on the human body at tolerable levels. To make the system successful we must identify and mitigate the risks in transportation system to prevent crashes, rather than wait for the crash to occur and react afterward. The system approach shares accountability with everyone who has a role to play, including those who plan, program, design, construct and maintain the roads along with those who utilize them.

In addition to the Safe System Approach the SHSP prioritizes equity and collaboration. By incorporating equity to all actionable efforts this plan will seek to address disproportionate harm that vulnerable populations suffer. By partnering with supporting municipalities and other public entities the SHSP will seek to address safety locally and regionally. Stakeholders from the community, philanthropy and business will all play important roles.

Research Project Highlight

Uncovering the Root Causes to Truck Rollover Crashes on Ramps

In the United States, heavy truck related crashes account for about 4% of total crashes, but 8% of total fatal crashes. Crashes involving heavy trucks usually occur on highways and tend to have significant and large-scale traffic impacts. In 2016 alone, truck related crashes in Massachusetts resulted in losses of over $22M in terms of delay time and $1.7M due to emissions and wasted fuel consumption. To understand what causes truck rollovers on highway ramps in Massachusetts, this study conducts a thorough review of literature and best practices, such as traffic signage and pavement markings, on reducing highway ramp truck rollovers. The narratives of all ramp truck rollover crashes between January 2015 and February 2022 at selected ramps in Massachusetts have been manually reviewed. The locations and types of traffic signs, slopes, and curve radii of seven identified highway ramps are also obtained and carefully investigated together with the trajectory analysis results. Based on the analysis, practical and specific safety improvement recommendations are provided for each site to the Massachusetts Department of Transportation (MassDOT).

The main innovation of this study is to use Artificial Intelligence (AI) methods to analyze traffic videos and better track truck patterns within travel lanes in order to better understand causes of truck rollovers. Using historical crash data such as police crash reports to study ramp truck rollovers has limitations, as it cannot cover near-crash events and does not reveal vehicle trajectories leading to crashes or near-crashes. Being able to include near-crash events in a safety study is important since this can potentially generate useful new data and lead to additional insights into how to prevent ramp truck rollovers.

Researchers found that, over 95% of ramp truck rollovers are single-vehicle crashes. Speeding is the predominant reason for such crashes and accounts for about 56% of all rollovers. Various pavement marking and dynamic traffic warning signs are identified as the two most popular speed-reduction countermeasures adopted by many transportation agencies. The trajectory-based safety analysis approach generated through this research can provide important inputs for understanding driver behavior at/near highway ramps, and it can be added as an effective tool to the road safety audit toolbox.

New Research Project Highlight

Accessible Bus Stop Design in the Presence of Bike Lanes

Improvements in multimodal policy and design guidelines have led to a marked increase in dedicated bike infrastructure and more inclusive transit infrastructure in recent years. While these multimodal design improvements have generally led to safer or more reliable biking and bus experiences, additional design guidance are needed for the successful, safe integration of transit riders at the intersection of bus and bike infrastructure. There is a pressing need for a better understanding of the impacts of bicycle infrastructure on transit user safety (e.g., conflicts between bicycles traveling on adjacent bike lanes and transit riders) and on bus stop accessibility. The exploration of mitigation plans and designs will potentially lead to a more accessible, equitable, and safe travel experience for all riders.

To achieve this outcome, this research will complete multiple tasks starting with a literature review and key informant interviews. Researchers from UMass Amherst will interview city officials from four North American cities and one city in the Netherlands. In the next task they will investigate bus rider and bicyclist behavior and interactions when bicycle infrastructure is adjacent to floating and constrained bus stops using video surveillance and Light detection and ranging (LiDAR) point cloud data. LiDAR will be used to scan up to 10 floating/constricted bus stops. This innovative use of LiDAR will summarize locations, design and geometric characteristics of the bus stops as well as the bicycle infrastructure near these bus stops.

Researchers by using literature, best practice methods, and the results of their analysis will propose design improvements and guidance to mitigate conflicts between bus riders of all abilities and bicyclists. The products of this research will be readily available to MBTA and MassDOT, which can use them to improve the safety and operation of the selected bus stops.

Final task before the report is completed will document a recommended methodology for the MBTA to assess all of its floating and constrained bus stops for mitigating bicycle-bus rider conflicts. The final report will summarize guidelines on the design, location, and implementation of accessible bus stops when integrated with bicycle infrastructure.

A Look at Who We are – Team Highlights

Each MassDOT research project team is comprised of a Project Champion(s), a Principal Investigator(s) and a Project Manager. The Project Champion serves as the MassDOT technical representative, the Principal Investigator conducts research investigation and produces deliverables per project scope and schedule, and the Project Manager takes charge of the overall project administrative management and coordination. Highlighted below are the key members of "Uncovering the Root Causes to Truck Rollover Crashes on Ramps" project team.

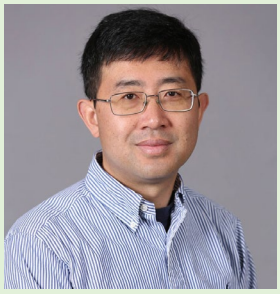
Project Champion – Jeffery DeCarlo

Dr. Jeffery DeCarlo hasa doctorate (Ed.D.)in Education, Leadership and Technology from Dowling College,a M.A.in Business Administration and Management from Webster University, anda B.S.in Accounting from Marist College.He holdsanFAA Air Transport Pilot (ATP) certificate andisa Project Management Institute certified Project Management Professional (PMP). Asa strategy and technology consultant for the federal government and DOD, he advanced aviation industry safety initiatives, and has supported DOD aviation system acquisition and airworthiness activities.

Project Champion – Dakota DelSignore

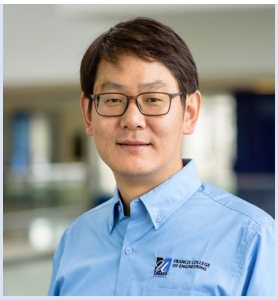
Dakota DelSignore is a Traffic Safety Engineer at MassDOT. He received his Bachelor of Science degree in Civil Engineering from the University of Vermont. He joined MassDOT in January 2021 where his role within the Traffic & Safety Section, primarily consists of working with and analyzing crash data across the state. Dakota also assists the State Safety Engineer with various activities such as safety pilot and research projects, coordinating material grant programs, and many other safety initiatives including promotion of the Safe System Approach.

Principle Investigator – Benyuan Liu



Dr. Benyuan Liu has been a faculty member in the Department of Computer Science at the UMass Lowell since 2004. He received his Ph.D. degree in computer science from the UMass Amherst. Dr. Liu's main research interests are in the area of application, design and performance analysis of mobile computing, data mining and computer networking technologies. Using a mix of theoretical and experimental approaches, he seeks a fundamental understanding of the performance limits and efficient protocol design of new and emerging computing and networking technologies.

Principal Investigator – Yuanchang Xie



Dr. Yuanchang Xie is an assistant professor in the Dept. of Civil and Environmental Engineering at UMass Lowell. His research covers traffic flow modeling, traffic control and simulation, traffic safety, GIS-T applications, intelligent transportation systems, network and facility location modeling for emergency response logistics and hazardous materials transportation, and transit operations. Dr. Xie is a member of the Transportation Research Board's Transportation Safety Management Committee and Transportation of Hazardous Materials Committee.

Principal Investigator – Chengbo Ai

Dr. Chengbo Ai is an assistant professor at the Department of Civil and Environmental Engineering at UMass Amherst. He received his Ph.D. from Georgia Tech in Transportation Systems Engineering and his BS from Peking University in Electrical and Computing Engineering. His interdisciplinary research focuses on developing computational models, AI algorithms, and remote sensing hardware systems as they are applied in transportation asset management, geometry design, roadway safety, pavement preservation and maintenance, and many other critical transportation applications.

Events & Announcements

massDOT Transportation Innovation CONFERENCE

May 2-3, 2023 • DCU Center, Worcester, MA

The annual MassDOT Transportation Innovation Conference provides a forum for innovative transportation systems, management ideas, and initiatives. Each year, the conference provides an important opportunity for transportation practitioners to share knowledge, sponsor peer-to-peer learning, and collaborate on issues of mutual interest. A specific focus of this year's conference will be on MassDOT's investment in infrastructure. Conference participants will have the opportunity to discuss innovative methods and technologies being presented in the following categories:

- Promoting Safe and Equitable Transportation
- New Techniques in Design and Materials
- Innovation in Construction Methods
- Advancing Municipality Modernization in the Commonwealth
- Implementing New Technologies
- Streamlining the Project Delivery Process

The event is open to all transportation practitioners from federal, state, and local transportation agencies, Metropolitan Planning Organizations, transit agencies, academia, and private industry. Register for the conference.

The New England University Transportation Center (UTC) was awarded as the Region 1 UTC by USDOT under the Bi-partisan Infrastructure Law

Led by University of Massachusetts Amherst, this safety-focused consortium consists of universities and colleges in Massachusetts and other New England states, including Bunker Hill Community College, Holyoke Community College, Massachusetts Institute of Technology, Norwich University, University of Connecticut, University of Maine, and University of New Hampshire. Using a multidisciplinary and multimodal approach to understanding the interaction of infrastructure and humans linked by technology, the consortium has the potential to lead to advances in research and education on some of the most important aspects of transportation safety. MassDOT is committed to continue our partnership with the consortium members to deepen our understanding of priority safety topics, explore new solutions, and pilot innovations.

UTC 1987 2026

TRB TRANSPORTATION RESEARCH BOARD

No time to conduct a literature search yourself? TRB Library Snap Searches can help

Snap Searches are designed for the busy professionals and researchers who would like to quickly get up to speed on complex research topics. They provide a succinct summary of current activities at TRB on a given topic. Follow the link below for the TRB snap search results for "Safety and Human Factors."

TRB Snap Search: Safety and Human Factors

massDOT Massachusetts Department of Transportation

U.S. Department of Transportation Federal Highway Administration

AASHTO

TRB TRANSPORTATION RESEARCH BOARD OF THE NATIONAL ACADEMIES

NCHRP NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM

MassDOT Research Resources

In Progress MassDOT Research

	Start Date
Massachusetts Depth to Bedrock	March 2021
Massachusetts-Specific Trip Generation Rates	March 2021
Multisource Data Fusion for Traffic Incident Detection	April 2021
Accessibility to Public Health Phase I	May 2021
Revised Load Rating Procedures for Prestressed Concrete Beams	May 2021
Outdoor Information Panels to Convey Real-time Travel Information for Ridership Recovery	May 2021
Mycofiltration Design and Treatment Option	July 2021
Optimizing MassDOT's High Performance Asphalt Overlay Mixtures	July 2021
Using Traffic Signals to Reduce Speeding Opportunities	July 2021
Ultra High-Performance Concrete Reenforced with Multi-scale Hybrid Fibers	August 2021
Development of Improved Inspection Techniques Using LIDAR for Deteriorated Steel Beam Ends	March 2022
Smart Work Zone Safety Control and Performance Evaluation	April 2022
Tree Preservation and Planting for Complete Streets Development	April 2022
Development of a Salt Spreader Controller Program	April 2022
Post-Fire Inspection of Concrete Structure Phase III- In-Situ Experiments	April 2022
Building Information Model for Transit Infrastructure: Feasibility and Gap Analysis	May 2022
Methods to Identify Problematic Carriers	June 2022
3D Printing Applications for Bridge Element Repair	June 2022
Evaluating Safety Impacts of Two-stage Bike Boxes	August 2022
Field Study to Determine Salt Usage Efficiency on Two Pavement Types	August 2022
Implementing AASHTO Mechanistic-Empirical Pavement Design Guide Phase III	November 2022
LIMMS Development Planning *	March 2023
Accessible Bus Stop Design in the Presence of Bike Lanes *	March 2023
Cross-Modal Assessment of Sustainable Transportation Networks *	March 2023
A Pavement Marking Inventory and Retroreflectivity Condition Assessment Method Phase II*	March 2023

Recently Completed MassDOT Research

	Completion Date
Discover the Root Causes for Truck Rollover at Highway Ramps *	March 2023
Construction and Material Best Practices for Concrete Sidewalk Phase II – Hot Placement *	March 2023
Safety Impacts of Yellow Flashing Permissive Left-Turn Indications – Approach Analysis *	March 2023
Post-Fire Damage Inspection of Concrete Structures (Phase II) – Experimental Phase *	February 2023
Implementing AASHTO Mechanist-Empirical Pavement Design Guide Phase II	September 2022
Understanding the Asset Management Systems Utilized by Municipalities in Massachusetts	September 2022
Use of UAS for Surface Transportation Emergency Response	July 2022
A Pavement Marking Inventory and Retroreflectivity Assessment Method Using Mobile LiDAR Phase I	June 2022

Additional Resources

Transportation Research and Information Database (TRID) is a comprehensive bibliographic database containing more than 1.3 million records of transportation research.

Research in Progress (RiP) Database contains information on more than 12,000 current or recently completed federally-funded transportation research projects.

AASHTO Publications include the most accepted technical guides, specifications, and manuals of the industry.

Contact Us

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* Accessible project document will be posted on the MassDOT Research website in the coming month.