# 2021 RESEARCH PROJECT STATEMENT

**Research Topic:**
Automated Guardrail Inventory and Condition Evaluation

**Research Budget and Timeline:**

- $80,000-$100,000
- 9-12 months (of which final 3 months are for review)

**Problem Statement and Objectives**
The presence and condition of the installed guardrails are critical for roadway safety. Many public transportation agencies, including the Massachusetts Department of Transportation (MassDOT), are responsible for a large inventory of guardrails and are responsible for making timely repair or replacement if any guardrail is damaged or missing. Also, the Manual for Assessing Safety Hardware (MASH) by the American Association of State Highway and Transportation Officials (AASHTO) is the new state of the practice for the crash testing of safety hardware devices. By 2020, the locations of all bridge rails, transitions, other barriers, terminals, sign supports, and breakaway hardware on the National Highway System (NHS) must comply with the MASH standards. It is critical for state departments of transportation, e.g., MassDOT, to develop a comprehensive guardrail inventory to better plan and manage the statewide guardrail MASH upgrades, and to implement a statewide guardrail geodatabase that can be integrated with the transportation asset management plan. Traditionally, manual field or windshield surveys are used for inventorying and updating guardrail information. However, such a practice often leads to time-consuming effort and may expose the field engineers to a dangerous working environment. Also, many conditional defects may easily be overlooked during the windshield survey. With the advancement of mobile light detection and ranging (LiDAR) and computer vision, it becomes feasible for state transportation agencies to leverage the widely available data for a more cost-effective and efficient method for inventorying and updating guardrail information.

The objectives of this study include:

1) Develop an automated method (including algorithms and procedures) for identifying the presence of guardrails along the roadway, and for extracting the critical information, including georeferenced starting and ending points, terminal types, curb presence, lateral offset (from the edge of the pavement to the guardrail), and elevation (from the pavement surface to the tip of the guardrail).

2) Develop an automated method (including algorithms and procedures) for identifying typical conditional changes for guardrails, including face dentation, end terminal

damage/missing, guardrail support deficiency, and bolt missing or connection failure. This effort could serve as a model for MassDOT to follow in the development of a formal In-Service Performance Evaluation program for roadside safety hardware, a new focus of FHWA.

**Anticipated Outcomes and Deliverables**

This proposed study is aimed at developing and validating new automated LiDAR and video-log imagery processing methods for identification and extraction of in-service guardrail, and then for evaluating the condition and compliance of the guardrails using representative pilot-testing road sections. It is anticipated that ten road sections of interstate and non-interstate roadways, with various lengths and guardrail coverages, will be analyzed within the study.

The anticipated products include a complete, georeferenced guardrail inventory for the selected pilot-testing sections, integrating the in-service presence and condition information, in support of evaluating the MASH compliance and network-level maintenance strategy. The outcome from this research effort may better guide MassDOT in the implementation of an In-Service Performance Evaluation program for the significant miles of guardrail installations out on our roadways.

Deliverables:

1. Technical Memorandum documenting existing guardrail inventory and condition evaluation practices on a National level and what data MassDOT has that can be leveraged to initiate this effort for this research effort.
2. Preparation of dataset that contains LiDAR data point cloud and video log of images captured during Mobile LiDAR Data Acquisition efforts for pilot study roadways.
3. Inventory Geodatabase identifying guardrail locations, including initial draft database for format and functionality review, iterative revisions to the database to include identified guardrail properties and a final version that provides condition assessment extracted from the LiDAR dataset captured.
4. Draft Report presenting the results of the database formulation and include an evaluation of the feasibility of this methodology being expanded to complete a statewide inventory and condition assessment.
5. Final Report summarizing all task activities and deliverables.
6. Final Presentation.