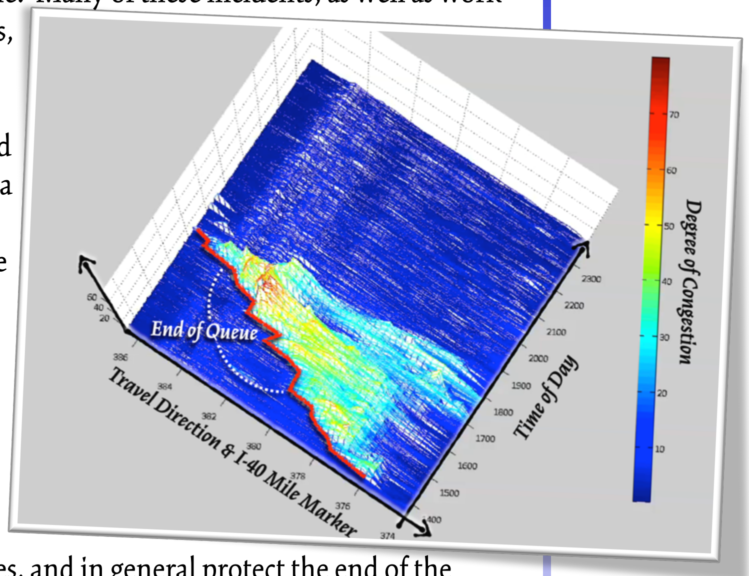
***Project #*** RES2016-06

***Project Title*** Traffic Queue Prediction Warning System

***Purpose*** In 2011, more than 107,000 roadway incidents, such as crashes, disabled vehicles, and derbies, were reported, verified, responded to, and managed by TDOT's HELP Program, just in the four major metropolitan areas alone. Many of these incidents, as well as work zones and special events, can lead to long and unexpected queues that cause not only delay and inconvenience but also a hazardous situation at the tail end of the queue (EOQ) that can catch unsuspecting motorists by surprise as they approach the suddenly slowed down or even stopped traffic at high speed. To save lives, reduce secondary crashes, and in general protect the end of the queue and the motorists approaching the end of queue at a high speed, TDOT has successfully deployed HELP trucks to alert, advise, and, for some cases, actively control the approaching traffic. A challenge though is to have a better handle of the queue, once formed, in terms of where the end of the queue is and how fast it might grow and move. As such, this study proposes to develop a dynamic queue prediction model that utilizes real-time traffic data to estimate the behavior of the queue and the locus of the end of the queue.




A series of analyses of actual freeway incidents and related traffic data performed by UT for TDOT includes a major crash on I-40, which is shown in the diagram above. A tractor-trailer crashed and blocked multiple lanes around 2 PM near mile marker 376 on I-40. With TDOT's RTMS data and the incident records, the queueing process was reconstructed and visualized in the diagram. The red line demarks the end of queue, or at least approximates the EOQ at a frequency of 30 seconds (TDOT RDS data). The end of queue moves like a wave, also known as shockwave in literature, but it does not always propagate at the same speed or even in the same direction. There were a few times the EOQ stalled, before progressing again. There was another time the EOQ even began to retreat, but only reestablished itself again some 30 minutes later. Imagine a HELP truck driver trying to determine where to set up his/her truck to warn approaching motorists, the unstable movement of the queue could make this rather challenging. By studying different cases with comprehensive data and incident logs and video footages, the UT research team will develop a model capable of taking in real-time data to predict the end of queue location and movement dynamically.

The proposed study will also assess quick information dissemination means for warning motorists approaching the vicinity of the end of the queue. Another focus of the study will look at the location and setup of the HELP truck upstream of the end of the queue. Microscopic simulation tools as well virtual reality based Driving Simulator may be employed to verify some of the "protect the queue" strategies. A framework will be developed in the end to help TDOT move towards a implementable real-time queue prediction, management, and warning system.

***Scope/Significance***

The proposed study is important and challenging in many ways. To ensure success in the short study timeframe and within budget, the study is scoped in the following fashion to make it more manageable.

- The focus of the study will be on the urban freeways in the major metropolitan areas.
- The study is limited to the availability of real-time data that can be obtained from and through TDOT.
- The proposed study is a research effort. The focus will be on the algorithms development and strategies assessment aspects of individual pieces of the eventual system.

***Outcomes***

- State of the Art Review
- EOQ Detection Algorithms using TDOT RDS
- Ideas/concepts for real-time warning mechanisms

***Time/Status***

The study began at the end of 2015 and is to complete in 2018.

***Contact Info***

Brad Freeze, Director of Operations, TDOT
phillip.b.freeze@tn.gov, 615.741.5017

Lee D. Han, Professor of Civil Engineering, UTK
lhan@utk.edu, 865.974.7707