Portable Roadway High Water Detection System for Driver Safety and Infrastructure Assessment

Identifying cost-effective technology to be used in future roadway flood warning systems

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Project No. 18SATSA05

PI: Dr. Hatim Sharif, Dr. Samer Dessouky (UTSA)

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This project addresses a dire need to improve the ability to assess and reduce the impacts of severe weather events on travelers' safety as 77% of flood fatalities in Texas occur on flooded roads. This study aims to evaluate the performance of flood warning systems installed in Texas during Hurricane Harvey and devise a portable high water detection system based on the weigh-in-motion (WIM) technology that can serve as the core of a future roadway flood warning system: recording data on the flood depth, duration, and type of passing vehicle. A mechanism for two-way communication between the portable high water detection system and traffic control systems will also be developed. In conjunction with other post-event data, the system is envisioned to assist in the evaluation of flooding impacts on the roadway system.

Background

Dense roadway networks and abundant low-water crossings contribute to the significant and increased rates of roadway flooding. Several ephemeral streams in Texas have steep slopes. Highly intermittent flow of these streams reduces the overall financial efficiency of such large, expensive structures at road-stream crossings.

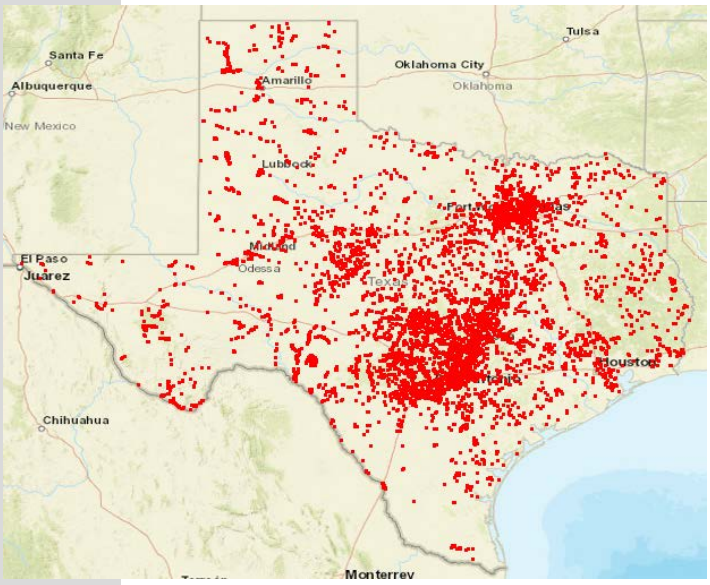

Figure 1. Low-water crossings across Texas.

Therefore, many crossings are constructed as armored sag vertical curves, often with small corrugated metal culverts used to prevent long-term ponding of water upstream of the roadway embankment. In flood conditions, water flows over the road, posing immediate danger to crossing vehicles, and leading to the majority of vehicle-related flood fatalities. Only six inches of water reaching the bottom of most passenger cars causes loss of control and possible stalling, and two feet of rushing water can carry away most vehicles, including sport utility vehicles and pickups.

Project Summary

This study will conduct the following tasks:

Task 1: The research team will first undertake a thorough review of the available literature. Available past research and reports of a related nature, from Texas, across the South-Central regiona, and nationally, will be reviewed. A major focus will be identification and prioritization of risk factors associated with flooded roads, especially those related to infrastructure, and the effectiveness of engineering countermeasures to improve safety.

Task 2: The research team will collect operational and safety data from crash sources such as National Oceanic and Atmospheric Administration (NOAA) Storm Data, TxDOT, and Texas Department of Health Services. Focus will be on the entire state of Texas.

Task 3: The Research team will conduct a thorough evaluation of the functionality of existing road flood warning systems in Texas during Hurricane Harvey, especially in Greater Houston area.

Task 4: The Research team will identify a portable high water detection system to detect rising water levels and issue an alert regarding the possibility of roadway flooding as an alternative to the current expensive and stationary technology.

Status Update

Review of Texas flood fatality data indicates that 77% of the fatalities with known circumstances are motor vehicle-related. Confirmed motor vehicle-related flood fatalities were reported for every year of record (shown in Figure 2), except for the severe drought year of 2011 when no flood fatality occurred in Texas. The 59-year average of confirmed fatalities is 9.45 per year. The graph of monthly distribution of motor vehicle-related flood fatalities (not shown) is bimodal with peaks in May and October. Review of the reports indicates that 57% of the motor vehicle-related fatalities took place at night. More than 60% of the vehicle-related flood fatalities are caused by flash floods.

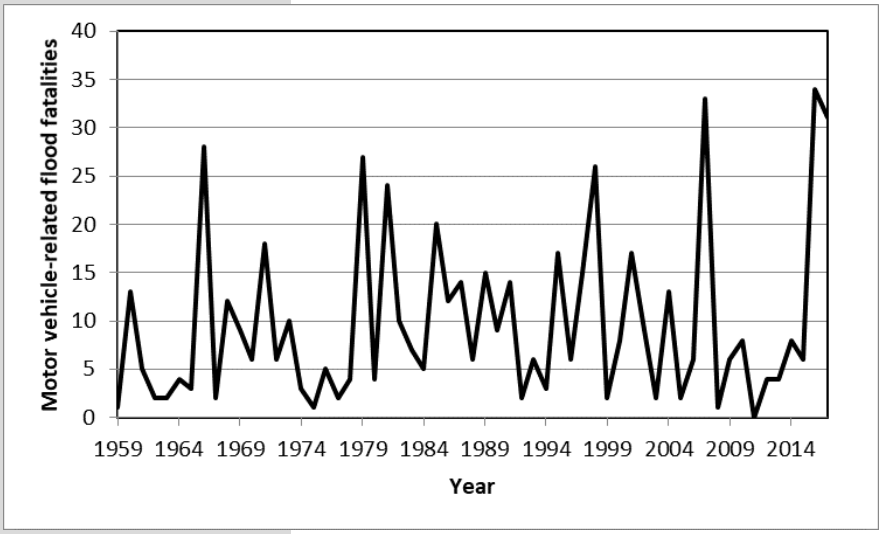

Figure 2. Annual vehicle-related fatalities at Low-water crossings in Texas.

Impacts

The research will determine ways to address safety issues at low-water crossings and provide the safest possible solutions for motorists and members of local communities. A new low-budget, portable high water detection system will be identified. The research outcomes will help traffic engineers integrate new technology into traffic control systems, identify and analyze roadways safety problems and opportunities, select the most effective strategies to address them, determine project limits, and evaluate the priority of proposed improvements.

Tran-SET

Tran-SET is Region 6's University Transportation Center. It is a collaborative partnership between 11 institutions (see below) across 5 states (AR, LA, NM, OK, and TX). Tran-SET is led by Louisiana State University. It was established in late November 2016 "to address the accelerated deterioration of transportation infrastructure through the development, evaluation, and implementation of cutting-edge technologies, novel materials, and innovative construction management processes".

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