A Tool for Monitoring Roads: How an AI Program Could Keep Watch for Crashes

Juan Medina, PhD; Xiaoyue Cathy Liu, PhD

The traffic patterns of your daily commute are usually predictable. Folks working on road safety, traffic operations, accessibility, or related transportation improvements can use the consistent data to implement the most effective traffic management strategies. Events that don't adhere to a pattern (e.g. crashes, but also major sporting events, weather, etc.) need their own plans, but these events are unpredictable. Even if cities have ways to respond to these non-recurrent events, they first need to know when something is abnormal on the road. What if responders could identify that a crash has happened within just a few minutes of the incident? Even better, what if responders could know when the conditions on the road mimic those of past crashes and respond accordingly before a crash happens? With this new study, "Network Effects of Disruptive Traffic Events," researchers sought to develop the framework for a monitoring tool that allows transportation professionals to do just that.

A variety of organizations came together to make this research possible. Juan Medina and Xiaoyue Cathy Liu from the University of Utah (UU) spearheaded the NITC-funded project. This study used raw datasets from the Automated Traffic Signal Performance Measures (ATSPM), managed by Utah's Department of Transportation (UDOT), and crash data from UU's Utah Transportation and Public Safety—Crash Data Initiative (UTAPS-CDI) provided crash information. Read on to learn the significance of these programs.

ABOUT THE RESEARCH

The goal of the project was to provide the groundwork for future research that would lead to contextualized incident response alternatives for each unique case, anticipate their intended outcomes on network performance, and use such forecasts to select optimal response strategies. As stated in the paper,

> Ultimately, the exploration of events and the magnitude of their disruptions is intended to be characterized. With enough observations of specific 'types' of events, models therefore become more representative of the actual responses of the network.

Interestingly, the signals (like from ATSPM) can identify reported events as well as unreported events when they occur. Having a database to keep track of the resulting traffic patterns could allow city planners to better plan for disruptive traffic events like crashes. The tool itself will be a useful compilation tool for agencies that have access to similar uncompiled information. The data collected by the tool will be useful for anyone with concerns about improving traffic operations, safety analyses, or accessibility. Cities will be able to use the findings of this research to improve travel time reliability, environmental outcomes, and user safety.

DATA COLLECTION

Medina and Liu wanted data from Salt Lake valley arterials as opposed to freeways because more research on non-recurrent traffic events has been concentrated on freeways. At first the researchers tried to use the videos that were recorded at intersections as sources of information about crashes. They found that the videos provided unsatisfactory data about the scenes of the incidents due to their limited and uncontrolled fields of view as well as image processing limitations.

The next step was to look toward other means of data collection in the Salt Lake valley. The raw datasets from UDOT's ATSPM collect an array of information from crashes on arterials, such as the location of the impact, the moment the crash occurred, and the moment traffic conditions returned to normal. The researchers combined this information with crash data from UTAPS-CDI, which includes narratives from crash events, crash severity, the manner of collision, and many other standard and non-standard elements. Collecting information from both sources enables the verification and cross-validation of disruptive events. Integrating this data allows for a framework to monitor for traffic flow anomalies in the network. This could help operators understand circumstances of non-recurrent events, which could be applied to previously unidentifiable disturbances.

PROOF OF CONCEPT

"Network Effects of Disruptive Traffic Events" provides a proof of concept for a monitoring tool using a Long Short-Term Memory program. LSTM neural networks can easily replicate well-defined trends while being flexible by accounting for random variation. In other words, LSTM would not only be able to record results of traffic anomalies but also be able to identify when road conditions are similar to those of past crashes. The monitoring tool itself does not yet exist, but the infrastructure is being built using the aforementioned datasets to create an information library that the tool can learn from. Staff that build the hardware and monitor the system are also necessary. The researchers are currently working on making the database of information publicly available.

ABOUT THE AUTHORS

The research team consisted of Juan Medina and Xiaoyue Cathy Liu of the University of Utah.

ABOUT THE FUNDERS

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THE REPORT and RESOURCES

For more details about the study, download the full report "Network Effects of Disruptive Traffic Events" at nitc.trec.pdx.edu/research/project/1082

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