DRISI
Caltrans Division of Research, Innovation and System Information

Research Results

Transportation Safety and Mobility

Analysis and Prediction of Spatiotemporal Impact of Traffic Incidents for Better Mobility and Safety in Transportation Systems

Develop a program to identify and address pedestrian safety problems in California, with the goal of reducing pedestrian fatalities and injuries.

MAY 2019

Project Title:
Analysis and Prediction of Spatiotemporal Impact of Traffic Incidents for Better Mobility and Safety in Transportation Systems

Task Number: 2816

Start Date: January 1, 2015

Completion Date: December 31, 2015

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WHAT IS THE NEED?

Traffic congestion is major a problem throughout the world. It impedes our mobility, pollutes the air, wastes fuel, and hampers economic growth. While weather, construction zones, physical bottlenecks, seasonal events (e.g., school schedule) can all lead to congestion, a key contributor to traffic congestion is road accidents - events that disrupt the normal flow of traffic, usually by physical impedance in the travel lanes. According to National Safety Council (NSC) the total direct costs attributable to car accidents was $276 billion in 2012 [NSC12]. Moreover, National Highway Traffic Safety Administration (NHTSA) reported that motor vehicle accident casualties numbered 2.4 million injuries and 33,561 deaths in the US in 2012 [NHT12].

The above effects combined represent a huge social and economic detriment to the US, and pose a serious concern for drivers, law enforcement, and transportation agencies. Hence, reducing the impact of traffic accidents has been one of the primary objectives for transportation policy makers. The wealth of data collected from traffic sensors and accident logs offers an unprecedented opportunity to mine and understand the traffic incidents towards mitigating the consequences.

[NSC12] National Safety Council Report,
http://www.nsc.org/Documents/NSC%20MV%20Fatality%20Estimates.pdf

[NHT12] National Highway Traffic Safety Administration Report, http://www-nrd.nhtsa.dot.gov/Pubs/811856.pdf

WHAT WAS OUR GOAL?

Our goal was to quantify the impact (i.e., backlog and clearance-time) of road accidents on the up-stream traffic direction and in the surrounding network (e.g., arterial streets) of the accident.

WHAT DID WE DO?

The research studied the problem of real-time traffic prediction with missing values and missing sensors for large road networks. The researchers proposed a dynamic traffic model where each vertex is associated with a set of latent attributes that captures both spatial (in network space) and temporal properties. Moreover, as these attributes are time dependent, they also accurately estimate the traffic patterns and their evolution over time. To efficiently infer these time-dependent latent attributes, the researchers developed both global and incremental learning algorithms on sensor data streams, enabling real-time traffic prediction under a batch window setting. Extensive experiments verified the effectiveness, flexibility and scalability of our model in identifying traffic patterns, completing missing values, and predicting future traffic conditions.

For future work, the researchers plan to embed the current framework into real applications such as ride-sharing or vehicle routing system, to enable better navigation using accurate time-dependent traffic patterns. Another interesting direction is to incorporate other data sources (e.g., GPS, incidents) for more accurate traffic prediction.

WHAT WAS THE OUTCOME?

Development of a Dynamic Topology-aware Temporal (DTT) model that learns the behavior of traffic in both normal conditions and during accidents from the historical traffic sensor datasets. This research exploits four years of real-world Los Angeles traffic sensor data and California Highway Patrol (CHP) accidents logs collected from Regional Integration of Intelligent Transportation Systems (RIITS) under Archived Traffic Data Management System (ADMS) project.

WHAT IS THE BENEFIT?

Develop data mining and machine learning algorithms to effectively predict the impact of traffic incidents in both space and time. Specifically, develop machine learning techniques to predict a) the travel-time delays on the upstream traffic and surrounding streets, and b) when and how the delay will occur in the transportation network in both time and space.

LEARN MORE

Link:
http://dl.acm.org/citation.cfm?id=2939860

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