UTC Spotlight
University Transportation Centers Program
August 2008
U.S. Department of Transportation, Research and Innovative Technology Administration

This monthly report from the University Transportation Centers Program highlights some of the recent accomplishments and products from one of the University Transportation Centers (UTCs) managed by the U.S. Department of Transportation's Research and Innovative Technology Administration.

Artificial Intelligence for Real-Time Traffic Management

To help ease freeway congestion and improve safety, Morgan State University and Clemson University developed a prototype for a new traffic surveillance system. This proposed vehicle-infrastructure integration (VII) system assesses and predicts traffic conditions via wireless communication between roadside sensors and the increasing number of cars that have Global Positioning System (GPS) technology. Data gathered from this communication can estimate the speed of traffic, the location of incidents (such as accidents and disabled vehicles) and the likely number of lanes blocked, resulting in improved mobility and safety for everyone on the road.

Because a real world evaluation of the proposed framework would be expensive, the researchers evaluated their prototype in a microscopic traffic simulation environment using the Paramics® microsimulation software. The freeway networks in Spartanburg, SC, and Baltimore, MD, were used as study sites.

Advantages and Objectives

Freeway congestion is major problem in many urban areas. It has been estimated that freeway incidents account for one-half to three-fourths of total congestion on metropolitan freeways in the United States. Incident detection is the first and most important stage of incident management. The earlier an incident is detected, the sooner the incident is cleared, and the sooner other drivers are alerted to take alternate routes.

Highway traffic surveillance systems are widely used for incident management, real-time traffic management, traveler information, and hazard evacuation. Some of the most widely used methods are closed circuit television systems, driver reports processing, highway crew patrols, and automatic incident detection (AID) systems.

Morgan State and Clemson researchers used the VII concept, in which vehicles and infrastructure sensors communicate with one another, to improve the effectiveness and efficiency of existing traffic surveillance systems. Equipping vehicles and roadside infrastructures with wireless communication interfaces makes it possible to provide constantly changing data, such as speed, acceleration/deceleration, position, and maneuver data, to the traffic surveillance system. The expected substantial improvement in the quality and availability of information would in turn increase the safety and mobility of large-scale highway systems.

The proposed framework does not require all cars to be equipped with the device. Researchers found the incident detection rate to be almost 100 percent when only 25 percent of vehicles on the road were equipped with the wireless equipment. Also, only some roadsides are equipped with the sensors. The proposed system, or algorithm, is hierarchical, meaning when an incident happens the equipment on the car sends the information to the closest vehicle that has the equipment, and that car passes

this information to the next one, until a roadside sensor receives this information from the car closest to it. The roadside sensor then aggregates the data and sends it to the local traffic center. The local traffic center, in turn, sends the necessary information to the regional center. This hierarchical organization prevents redundant information from being sent to each center.

Sample Results

The researchers tested the accuracy of their hierarchical incident detection system, known as the Support Vector Machine (SVM), by using the Paramics® traffic simulator.

When the incident detection results for SVM were compared to results for California Algorithm #7, a well-known incident detection system used by traffic control centers, SVM proved to be superior. SVM achieved a 100 percent incident detection rate and a lower false alarm rate than the California algorithm.

If used in the real world, SVM has the potential to result in faster response to emergency situations, thereby reducing congestion and increasing the safety and mobility of roadways for everyone.

Figure 1: Comparison of California Algorithm and the Proposed (SVM) Algorithm for Detection Rate and False Alarm Rate

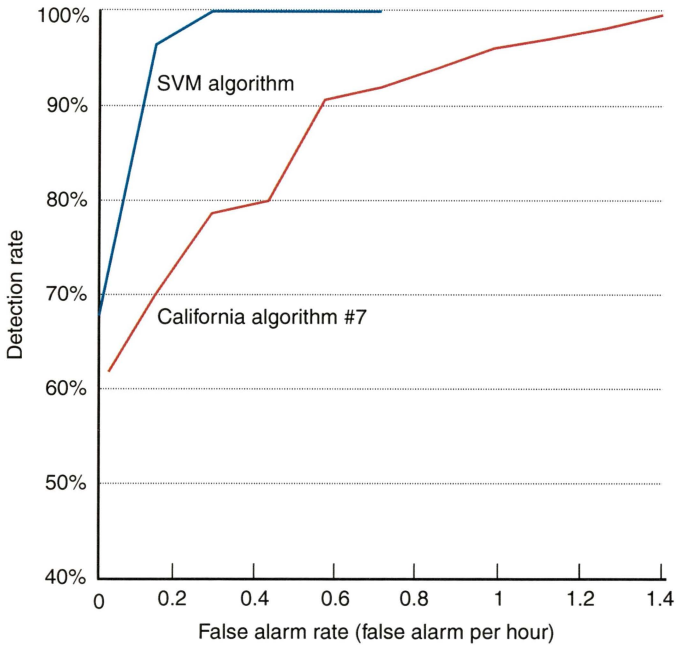
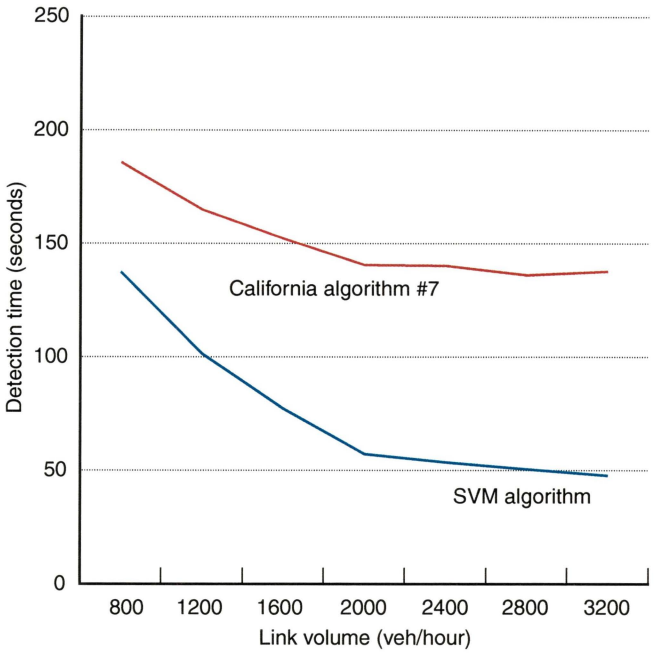


Figure 2: Comparison of California Algorithm and the Proposed (SVM) Algorithm for Detection Time



About This Project

DOT invests in the future of transportation through its University Transportation Centers Program, which awards grants to universities across the United States to advance the state-of-the-art in transportation research and to develop the next generation of transportation professionals.

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