Michigan Department of Transportation
RESEARCH Administration

RESEARCH SPOTLIGHT

Project Information

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Enhancing Michigan's traffic monitoring network with intelligent transportation system sensors

MDOT relies on a statewide network of continuous count stations (CCS) to collect vehicle volume, speed and class data for long-term traffic monitoring. Intelligent transportation system (ITS) sensors collect similar information for real-time congestion management and are typically easier to install and maintain. Researchers evaluated the feasibility of combining CCS devices and ITS sensors to improve the network's coverage and eliminate data redundancies. They proposed a new CCS/ITS network that would provide the required information at a significant cost savings.

PROBLEM

The Traffic Monitoring Guide of the Federal Highway Administration (FHWA) includes coverage requirements for different types of roads, such as rural highways and urban arterials. Since traffic patterns change over time, periodic evaluations of the existing CCS network are necessary to meet these requirements. Most CCS devices are intrusive, requiring pavement cutting for installation and repair. MDOT uses nonintrusive ITS devices, such as side-fire radar sensors mounted on roadside poles, to collect similar data for congestion management. Researchers studied whether these sensors provide vehicle count, speed and class information that is sufficiently reliable for long-term traffic monitoring. Then they made recommendations for incorporating ITS sensors into the existing CCS network.

Researchers proposed adding nonintrusive MVDS sensors (shown here on roadside poles) to MDOT's traffic monitoring network to improve coverage while reducing installation and maintenance costs.

RESEARCH

Researchers conducted a web-based survey about traffic monitoring program experiences in other states. Responses from 11

(continued)

> "This project will reduce future traffic monitoring costs by streamlining our data collection and management efforts while taking advantage of newer, nonintrusive technology."
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states (California, Florida, Idaho, Minnesota, New Jersey, New York, Ohio, Oregon, Pennsylvania, Virginia, and Washington) indicated that broader efforts to improve CCS networks are underway. Several states are considering the integration of ITS sensors into their traffic monitoring programs.

Next, researchers compared vehicle count, speed and class information collected from 2015 through 2016 at 124 CCS sites in Michigan with corresponding data from nearby microwave vehicle detection system (MVDS) units. These units are nonintrusive side-fire radar sensors with lower installation and maintenance costs. Researchers also evaluated whether any existing CCS devices provided redundant information due to close physical proximity.

The comparison of vehicle count, speed and class data from CCS and ITS-MVDS devices showed that MVDS data were of acceptable accuracy for volume and speed if properly calibrated. CCS classifies vehicles into 13 groups while MVDS can only distinguish four vehicle types by length. For these four classes, levels of agreement between the two types of devices were satisfactory.

Since MVDS sensors are more susceptible than CCS devices to weather damage over time, researchers developed a semiannual maintenance plan, including on-site calibration. They also examined whether using neural network methodology to impute missing data would reduce the impact of data losses.

RESULTS

To meet the FHWA traffic monitoring requirements, researchers recommended the installation of additional devices, especially in the northern parts of the state and on rural freeways and urban arterials. Specifically, they suggested replacing 12 CCS sites with existing MVDS units and adding 37 new MVDS units. Researchers recommended removing two of the existing CCS devices since they provided redundant information.

The proposed new network would consist of 110 existing CCS and 49 MVDS devices (12 existing and 37 new). Researchers showed that this network would provide sufficient coverage in six functional clusters defined by geography and type of highway (urban, urban/rural, rural, rural north, recreational, and recreational corridor).

Compared to keeping the current network and adding new CCS devices with higher installation and maintenance costs, researchers estimated that the proposed upgrade would save more than $200,000 annually for the next 20 years, or $4 million total.

Researchers stressed the importance of a semiannual (spring and fall) on-site calibration of the 49 MVDS units. Although these sensors tend to provide less complete long-term data than CCS devices, especially in unfavorable weather conditions, the researchers demonstrated that their proposed missing data imputation methods would result in a high-quality traffic monitoring system.

VALUE

Incorporating nonintrusive ITS sensors into the CCS network is a more cost-efficient approach for obtaining reliable information on vehicle volume, speed and class than maintaining the existing system and adding CCS devices.

Given the broader interest in adding ITS sensors to CCS networks to meet monitoring requirements, MDOT has the opportunity to take on a leadership role in these efforts, such as developing site-specific calibration plans and using innovative missing data imputation methods to minimize the impact of data losses.

Research Administration

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