INDOT Research

TECHNICAL *Summary*

Technology Transfer and Project Implementation Information

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PERFORMANCE METRICS FOR FREEWAY SENSORS

Introduction

Performance measures play a critical role in the operation of Intelligent Transportation Systems (ITS), because they provide feedback to the operators regarding system operations and efficiency. Traffic management systems use archived data, provided by various sensors, as a basis for describing normal conditions and predicting traffic conditions that may be expected at a particular time and place in the highway system.

However, one of the primary concerns of ITS data users is how to assess the quality of the data. Although detectors are usually tested immediately after installation, they operate under very difficult conditions and are susceptible to degradation in accuracy or complete failure. Therefore, the development of data quality control procedures to screen erroneous data has become a critical issue.

This report proposes a set of quality control metrics for the Indiana Department of Transportation to use for ensuring high quality data is provided by all sensors. The quality control program provides a tool for assessing the quality of traffic data in terms of accuracy and availability and sustaining that quality over time.

Findings

This study found that in many cases, the quality of the traffic data provided by the detection devices during the period November 2003 to February 2004, on I-80/94, was suspect. Several performance metrics such as flow continuity test, speed comparisons, data availability and average effective vehicle length test were developed and applied, revealing significant inconsistency in data quality provided by microloops and Radar Traffic Microwave Sensor (RTMS). Therefore, there is a need for implementing automatic quality control measurements immediately after sensor installation and at regular intervals to ensure the quality of the data.

The first performance test used in this study was the comparison of the volume of the vehicles captured by two closely spaced detectors with no entering or exiting ramps between them, to assess the continuity of the traffic flow. To examine the accuracy of the results, simple 24-hour graphs were plotted (Figure 1), using the total volume of the vehicles passing over the detectors in all three lanes. The generated graphs indicated that only 38% of the eight locations reported consistent results (Table 7-1 in report).

The second performance test assessed the consistency of the speed data reported by the microloops and RTMS. For the 24-hour speed comparison tests, the expectations were the same; speed data should be consistent between two closely spaced sensors, with no entering or exiting ramps between them (Figure 2). However, in this case the analysis was performed for each lane separately as not all the lanes were expected to provide the same magnitude of speeds. The examination of the graphs indicated that 25% of the twenty-four lanes had reported consistent speeds over several hours (Table 7-2 in report).

The third performance test was performed to assess the availability of the data provided by the microloops and RTMS sensors (Figure 3). The analysis revealed data reporting frequency within expected tolerance at 71% of the ninety-nine lanes examined (Tables 7-4 and 7-5 in report).

The fourth performance test was a screening data procedure known as Average Effective Vehicle Length (AEVL) test, which examined the relationship of occupancy, volume and speed data for identifying gross inconsistencies (Figure 4). The results indicated that in 32% of the ninety-nine lanes examined, the performance of the sensors was within the expected range (Tables 7-7 and 7-8 in report).

To maintain a high level of data accuracy, ITS data should be continuously monitored for errors and inconsistencies. Therefore, it is recommended that automatic quality control checks should be applied on a regular basis to ensure the quality of the data.

Implementation

This study has developed a quality control procedure that can be used by Indiana Department of Transportation to evaluate the performance of ITS sensors deployed to freeway arterials. Possible metrics that ensure preservation of data quality at a high level, for a long period of time are summarized as follows:

- Implement formalized procedure for vendors and contractors to provide as-built installation documentation. For microloop detection technology, a proposed as-built diagram is depicted, as well as the associated dimension table. For the RTMS technology, a proposed as-built diagram is depicted in and the associated table is illustrated.
- Apply quality control measurement immediately after sensor installation and at regular intervals to validate both the sensors and communicating infrastructure. Examples of these metrics are illustrated in Figures 1, 2, 3 and 4.
- Co-locate microloops and RTMS sensors to ensure that quality control tests can be run without massive manual data collection efforts.
- Report occupancy to one decimal to facilitate more robust average effective vehicle length estimation during periods of low volume.

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