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23-CFR-Vol-1

Highway Safety
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Traffic Monitoring Guide
Methods and Procedures
Data, Survey Methods, Traffic Monitoring, and Asset Management
1990 Survey of Traffic Monitoring Practices Among State Transportation Agencies of the United States
National Criminal Justice Thesaurus
New York State Traffic Monitoring Standards for Short Count Data Collection

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Springer Nature
The objective of these AASHTO Guidelines is to improve the quality of the traffic information that supports decisions at all levels of the transportation profession. The Guidelines provide a reference for professional traffic monitoring and establish a process for adoption of national traffic nomitoring standards. They specifically address concerns of state transportation agencies.
Variability in Traffic Monitoring Data. Final Summary Report
American Association of State Highway & Transportation Officials
The accurate measurement of vehicle classification is a highly valued factor in traffic operation and management, validations of travel demand models, freight studies, and even emission impact analysis of traffic operation. Inductive loops are increasingly used specifically for traffic monitoring at highway traffic data collection sites. Many studies have proven that the vehicle speed can be estimated accurately by using dual-loop data under free traffic condition, and then vehicle lengths can be estimated accurately. The capability of measuring vehicle lengths makes dual-loop detectors a potential real-time data source for vehicle classification. However, the existing dual-loop length-based vehicle classification model was developed with an assumption that the difference of a vehicle's speed on the first and the second single loop is not significant. Under congested traffic flows, vehicles' speeds change frequently and even fiercely, and the assumption cannot be met any more. The outputs of the existing models have a high error rate under non-free traffic conditions (such as synchronized and stop-and-go congestion states). The errors may be contributed by the complex characteristics of traffic flows under congestion; but quantification of such contributing factors remains unclear. In this study, the dual-loop data and vehicle classification models were evaluated with concurred video ground-truth data. The mechanism of the length-based vehicle classification and relevant traffic flow characteristics were tried to be revealed. In order to obtain the ground-truth vehicle

event data, the software VEVID (Vehicle Video-Capture Data Collector) was used to extract high-resolution vehicle trajectory data from the videotapes. This vehicle trajectory data was used to identify the errors and reasons of the vehicle classifications resulted from the existing dual-loop model. Meanwhile, a probe vehicle equipped with a Global Positioning System (GPS) data logger was used to set up reference points for VEVID and to collect traffic profile data under varied traffic flow states for developing the new model under stop-and-go traffic flow. The research has proven inability of the existing vehicle classification model in producing satisfactory estimates of vehicle lengths under congestion, i.e., synchronized or stop-and-go traffic states. The Vehicle Classification under Synchronized Traffic Model (VC-Sync model) was developed to estimate vehicle lengths against the synchronized traffic flow and the Vehicle Classification under Stop-and-Go Model (VC-Stog model) was developed to estimate vehicle lengths against the stop-and-go traffic flow. Compare to the existing models, under the congested traffic flows, the newly developed models have improved the accuracy of vehicle length estimation significantly. The contribution of this research is reflected in the following aspects: 1) An innovative VEVID-based approach is developed for evaluating the concurred dual-loop data and resulted vehicle classification and relevant traffic flow characteristics against video-based ground-truth vehicle event trajectory data, which is difficult to conduct with traditional approaches; 2) Innovative vehicle classification models for both synchronized traffic and stop-and-go traffic states are developed through such an evaluation process; 3) The algorithms for processing the dual-loop vehicle event raw data have been improved by considering the influence of traffic flow characteristics;. 4) A GPS-based approach is developed for setting up the reference points in field in conjunction with application of VEVID, which is proven a safety and efficient approach compared to traditional manual approaches. And the GPS-based travel profile data is greatly helpful in developing the new models.

Traffic Monitoring Guide

Transportation Research Board

Traffic monitoring is one of the primary activities of state highway agencies. A reliable estimation of the traffic is vital for the management and future planning of the roadways, and as well as the apportionment of the federal funding. Traffic Monitoring Program in states is responsible for collecting, storing, processing, and disseminating the traffic data. Determination of volume and vehicle classification trends, utilization of appropriate MADT and AADT estimation methods, establishment of Traffic Pattern Groups (TPG) and use of the adjustment factors to expand the short duration counts are some of the primary activities within states' traffic monitoring program. □ DelDOT Traffic Monitoring Program has been evaluated and updated to establish the TPGs and derive the adjustment factors to represents the current traffic conditions in Delaware. Analysis of data revealed few problems that should be

addressed (i.e. adjustment factors are sometimes not properly used, and TPGs are not regularly evaluated/updated). Additionally, a national level survey conducted to understand the issues and challenges that state highway agencies facing in collecting and processing of state traffic monitoring data, specifically continuous and shortduration data. Both survey responses and DelDOT analysis results have shown that a Knowledge-based Expert System (KBES) application can contribute to states' traffic monitoring program by informing and guiding the user to improve the traffic monitoring related decisions. □ The primary objective of this study was to develop a KBES application, called TMDEST, for providing assistance and decision support tool to the transportation agencies in states' traffic monitoring programs, specifically in TPG analysis. TMDEST asks focused and relevant questions to the user and provide situation-specific advice in six modules. In some modules, the user is asked to provide numerical input such as the number of stations and coefficient of variation value if available. □ Class/Weight Trend Module is designed to guide the user to identify the most important vehicle classes and the trucks that exert the most weight by using FHWA's VTRIS W-Tables. MADT/AADT Methods Module and TPG Methods Module are designed to inform the user regarding the major MADT/AADT estimation methods and TPG analysis methods to recommend the most appropriate methods based on the presence and amount of missing data and the inclusion of temporal variations. TPG Groups Module provides an approximate estimation of TPGs based on roadway functional classification and seasonal variation. Sample Size Estimation Module is designed to test the number of continuous count stations in each TPG for statistical significance. Lastly, Adjustment Factors Module incorporates all possible adjustment factors and evaluates the necessity of the use by asking multiple-choice questions to the end user regarding the extent of the collected short duration data. □ Overall evaluation of the TMDEST revealed that each module well satisfies the design specifications, and in general, the developed tool (1) informs and guides the user regarding the methods and procedures, (2) provides an approximate method for establishing TPGs. Additionally, verification, validation, and evaluation of the TMDEST showed that the expert system based tool was built right and does the job that it intends to do. Utilization of an expert system development tool (Exsys Corvid® Core) significantly expedited to the verification and validation process. The simple proof method was used to evaluate each module for completeness, consistency, and correctness. Although the majority of the content in the knowledge base was obtained from FHWA's traffic monitoring guide, simple true/false test was applied to the modules where the content was partially generated to validate the knowledge base. TMDEST and each module are considered as valid and applicable tool in states traffic monitoring program. Lastly, a discussion of further work is provided to improve the extent of the TMDEST in states' traffic monitoring program.

Enhancing Arizona

Department of Transportation's Traffic Data Resource
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This book introduces the concepts of mobility data and data-driven urban traffic monitoring. A typical framework of mobility data-based urban traffic monitoring is also presented, and it describes the processes of mobility data collection, data processing, traffic modelling, and some practical issues of applying the models for urban traffic monitoring. This book presents three novel mobility data-driven urban traffic monitoring approaches. First, to attack the challenge of mobility data sparsity, the authors propose a compressive sensing-based urban traffic monitoring approach. This solution mines the traffic correlation at the road network scale and exploits the compressive sensing theory to recover traffic conditions of the whole road network from sparse traffic samplings. Second, the authors have compared the traffic estimation performances between linear and nonlinear traffic correlation models and proposed a dynamical non-linear traffic correlation modelling-based urban traffic monitoring approach. To address the challenge of involved huge computation overheads, the approach adapts the traffic modelling and estimations tasks to Apache Spark, a popular parallel computing framework. Third, in addition to mobility data collected by the public transit systems, the authors present a crowdsensing-based urban traffic monitoring approach. The proposal exploits the lightweight mobility data collected from participatory bus riders to recover traffic statuses through careful data processing and analysis. Last but not the least, the book points out some future research directions, which can further improve the accuracy and efficiency of mobility data-driven urban traffic monitoring at large scale. This book targets researchers, computer scientists, and engineers, who are interested in the research areas of intelligent transportation systems (ITS), urban computing, big data analytic, and Internet of Things (IoT). Advanced level students studying these topics benefit from this book as well.
Traffic Monitoring Guide
CRC Press
For highway maintenance and planning purposes, it is desirable to characterize each road segment by its traffic flow [such as the annual average daily traffic (AADT) and the AADT for each vehicle class], by the weight distribution of vehicles that travel on its roads [such as the annual average daily equivalent single axle loadings (ESAL) and the annual average daily weight per vehicle for each vehicle class]. As with almost any data collection effort, the monitoring data suffer from errors from many sources. This report summarizes results of a two year empirical research effort, which was sponsored by the Federal highway Administration, (i) to study and characterize the variability in the traffic data (volume, classification, and weight) from the continuously monitored road segments, and (ii) to study the extent to which this variability is transferred to, and affects the precision of the data produced form the road segments which are monitored only one or two days each year. The

ultimate hope is not only that states will eventually be able to publish an estimate of a characteristic such as AADT for each road segment, but also that each estimate will be accompanied by a statement of how good the estimate is in terms of the estimated variability or precision which will likely be experienced as a coefficient of variation (i.e., the quotient of a standard deviation and a mean). This report provides highlights of research reported in five working papers.

Highway Safety Artech House

Modern highway engineering reflects an integrated view of a road system's entire lifecycle, including any potential environmental impacts, and seeks to develop a sustainable infrastructure through careful planning and active management. This trend is not limited to developed nations, but is recognized across the globe. Edited by renowned authority

LSA, list of CFR sections affected IntraWEB, LLC and Claitor's Law Publishing

This guide is designed to provide direction on the monitoring of traffic characteristics. It begins with a discussion of the structure of traffic characteristics monitoring and traffic counting. The next two sections cover vehicle classification and truck weighing. The last section presents the coordinated record formats for station identification, traffic volume, vehicle classification, and truck weight data.

The Handbook of Highway Engineering DIANE Publishing

The Code of Federal Regulations is the codification of the general and permanent rules published in the Federal Register by the executive departments and agencies of the Federal Government.

Stratification of Locally Owned Roads for Traffic Data Collection Transportation Research Board

This unique resource gives you a hands-on understanding of the latest sensors, processors, and communication links for everything from vehicle counts to urban congestion measurement. Moreover, you learn statistical techniques for quantifying data accuracy and reducing uncertainty in both current system state assessments and future system state forecasts.

Highway Traffic Monitoring and Data Quality Highway Traffic Monitoring and Data Quality

The deployment of Intelligent Transportation Systems (ITS) that incorporate some type of data collection or traffic surveillance capabilities has been rapidly increasing over the past decade. More recently it has been recognized that these data collection systems can be used as additional sources of mobility data, augmenting traditional data sources such as relatively sparsely distributed permanent count stations and supplementary 48-hour volume counts. Most of the research conducted to date has focused on data archiving systems that have freeway system data collection equipment as their primary data source. However, little is known about the feasibility of using advanced signal control systems (ASCSs) as sources of mobility data. A possible cause for the relative inattention to the use of advanced signal system equipment is that using an intersection as a source for road segment volume counts is contrary to conventional traffic data

collection principles, which stipulate that road segment volume counts be taken outside the influence area of intersections. The purpose of this research was to determine if data collected from an advanced arterial signal control system could be used to generate information that would be useful for transportation engineering analyses other than signal optimization and control. This research also looked at some of the technical challenges and limitations to using data collected by an arterial signal control system and presents an analysis of the validity of the data. The premise investigated is that data from signal control system surveillance equipment can be used to calculate daily volume counts for a roadway segment. This premise was tested by screening and aggregating data from signal system data collection equipment and comparing it with data from traffic monitoring equipment located in close proximity to the intersections being analyzed. The results of this research support the conclusion that reasonable volume estimates can be generated from system detectors located upstream of the intersection stop bars if the system detectors are deployed on all major approach through lanes. This research also demonstrated that the utility of ITS data requires more than simply the deployment of ASCS or other ITS data collection equipment. In order for an ITS archived data management system to be successfully implemented, the data product needs of the end users must be considered in the design and deployment of the traffic monitoring and control system, as well as the data management system.

System Design, Prototyping, and Testing American Association of State Highway & Transportation Officials

Numerous factoring and baseline values are required to ensure annual average daily traffic (AADT) data are collected and reported correctly. The variability of numerous methods currently used are explored so that those in the traffic community will clearly know the limitations and the extent of each method used and how to properly utilize methods for their agency to obtain the necessary results. Federal Highway Administration (FHWA) Travel Monitoring Analysis System (TMAS) data from 14 years consisting of 24 hours of the day and 7 days of the week volume data from over 6000 continuous permanent volume traffic data sites in the United States comprised the reference dataset for this research. Randomly selected (with some constraints) sites each include one year of 100% complete daily reporting and the set of sites represent 12 functional classes, years 2000 through 2013, 43 states and DC, and various volume ranges. Four AADT estimation methods were examined for accuracy when data from various time periods were removed. This report is a final task report that summarizes identified inaccuracies with current methods that are used for AADT estimation, and includes the analysis methodology and summary statistics findings.

Title 23 Highways (Revised as of April 1, 2014)

The Arizona Department of Transportation (ADOT) undertook a review and

evaluation of the technologies used by the agency to process, store, manage, and disseminate traffic data. Traffic count information constitutes the most elemental data that ADOT uses for planning, analysis and monitoring, and yet often remains the least accessible within the agency. ADOT found that different functional departments often duplicated traffic counts, count information was often little understood, and hence not trusted, and consistent data were not accessible throughout ADOT -- there was not a single source where traffic data were collected and disseminated. Through the research ADOT identified a hierarchy of actions designed to more effectively manage this most basic resource, and to restore confidence among users. An implementation plan was developed and is now being acted upon within the department.

AASHTO Guidelines for Traffic Data Programs

This synthesis report will be of interest to DOT administrators, supervisors, and staff, as well as to the consultants that work with them. Metropolitan Planning Organization (MPO) regional and local agency staffs might also find it informative. The synthesis was initiated in response to a recommendation made during the Highway Performance Monitoring System (HPMS) Reassessment, which was undertaken by the FHWA in 1997/1998 to expand data sharing and partnering more widely among states, MPOs, and local governments. It documents current arrangements among state DOTs, MPOs, and other local and regional agencies to partner in the collection and share in the use of HPMS data. Key elements examined include institutional arrangements, the use of data and data sharing, cost and resource requirements, technical capabilities/barriers, implementation processes, and data quality and capability, as well as successes, failures, and difficulties. Case studies of successful state and MPO partnerships are included.

Length-based Vehicle Classification Using Dual-loop Data Under Congested Traffic Conditions

"The primary purpose of these standards is to ensure that data from traffic monitoring activities involving funds administered and/or provided by New York State are received by the NYSDOT Highway Data Services Bureau in the appropriate format"--Page [2].

Special Speed Monitoring Survey: Trucks and Buses

This synthesis will be of interest to traffic engineers, highway planners, and others concerned with the collection of traffic data for traffic engineering studies, for long-range planning, and for evaluation of traffic law enforcement. Information is presented on current practice in traffic data collection and analysis. Although types of highway traffic data collected over the past 50 years have not changed significantly, the quantities, analysis procedure, and presentations of these data have changed as a result of changing policies, operational concerns, and capabilities resulting from new technologies. This report of the Transportation Research Board describes the technology (both hardware and software) that is being used for traffic data collection, and discusses technological

advances that have not yet been applied to the acquisition and presentation of traffic data.

Summary and Recommendations of the Conference on FHWA Truck Travel Data

Each state in the United States can be viewed as a universe of road segments. For each road segment in each state, it is desired to know various traffic characteristics based on count data, classification count data, and weigh-in-motion data. These data are absolutely essential for highway design, maintenance, safety, and planning. Given no cost constraints, each road segment would be continuously monitored every day of the year. However, in practice, a few road segments are monitored continuously every day of the year to produce annual characteristics of traffic flow. The remaining road segments are monitored for one or two days each year, and this resulting data are'adjusted' (using factors based on data collected from the continuously monitored road segments) to produce estimates of annual characteristics. With this general approach, each state strives to provide estimates of annual characteristics for each road segment within its jurisdiction. In 1985, the Federal Highway Administration (FHWA) published the Traffic Monitoring Guide to assist states in achieving this end. As with almost any data collection effort, the monitoring data suffers from errors from many sources. In this paper, we report some empirical findings in a research project sponsored by the FHWA. This research project studied the variability in the traffic data from the continuously monitored road segments from state(s) and, the extent to which this variability is transferred to and affects the precision of the data produced from the road segments which are monitored only one or two days each year. The ultimate hope is that states will eventually be able to not only publish an estimate of a characteristic such as Average Annual Daily Traffic (AADT) for each road segment, but also that each estimate will be accompanied by a statement expressing how good the estimate is in terms of its estimated variability or precision, which will likely be expressed as a coefficient of variation.

Traffic Monitoring in Recreational Areas

Highway Traffic Monitoring and Data QualityArtech House

New Mexico Development of a Traffic Monitoring System

This report examines the quality of state crash information; the activities states undertook using 411 grant funds to improve their traffic safety data systems, and the progress they made using the grant funds; and NHTSA's oversight of the grant program.

A Virtual Environment for Transportation Data (VETD)

The objective of this research was to investigate the potential uses of the annual submittal and output data that result from the Highway Performance Monitoring System (HPMS), to determine what the data needs and uses of the Virginia Department of Highways and Transportation are, and to make recommendations as to how the HPMS data could be effectively used by the agency. A literature search and a survey of the 50 state

transportation agencies were conducted to determine what innovative applications of the HPMS are being developed in the field. The Virginia Department of Highways and Transportation was also surveyed to determine what its current data needs and uses are, and to then relate the HPMS applications to Departmental data needs. It is recommended that the Department (1) distribute the HPMS report to key persons in the organization as an educational tool, (2) have the districts and divisions review the.annual data table summaries for potential applications, (3) review the HPMS data prior to requesting the collection of new data or extensive system level calculations to avoid duplication of effort, and (4) commit itself to maximum usage of the HPMS, keeping abreast of developments in HPMS applications, and integrate the analytical package into Department activities.

Assessing Roadway Traffic Count Duration and Frequency Impacts on Annual Average Daily Traffic Estimation

Highway Safety: Improved Monitoring and Oversight of Traffic Safety Data Program Are Needed