COST EFFECTIVE STRATEGIES FOR ESTIMATING STATEWIDE AADT

SUMMARY REPORT
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Annual Average Daily Traffic (AADT) is defined as the average daily measure of the total volume of vehicles on a roadway segment over a year divided by 365 days. AADT is one of the most important traffic measures used in many transportation engineering projects (e.g., roadway design, transportation planning, and traffic safety analysis). In many cases, yearly traffic volume can be directly counted with Automatic Traffic Recorders (ATR) along the roads. However, installing and maintaining ATRs along every road is prohibitively expensive because of the number of roads and the cost to install and maintain the ATRs. To compensate for this reality, AADT is often estimated based on the short-term counts on an as-needed basis. Since this input is needed for most transportation engineering projects, the accuracy of AADT estimation using short-term counts is critical for any transportation study that uses AADT as an input parameter.

To identify accurate and cost-saving methods for estimating AADT, the research team began with a review of federal legislation in terms of data collection requirements. This included different state traffic monitoring program manuals as well as legislative documents themselves, including HPMS, SHSP, MAP-21, and the FAST Act. It was determined that the South Carolina Department of Transportation (SCDOT) meets all federal requirements. As part of the review of common practices, available technology for count collection was explored and summarized based on strengths and weaknesses. While mature and established technologies such as pneumatic tubes continue to hold value, new technology such as LIDAR, Probe Vehicles, Crowdsourcing and Unmanned Aerial Vehicles (UAV) have emerged as promising prospects for use in future data collection.

Next, a national survey was developed and distributed to state DOTs in the United States, as well as the governing bodies in Canadian Provinces. This survey sought to understand the AADT data collection procedures of other states, as well as challenges faced and opportunities for improvement. This survey identified some trends in the responses. Namely, that the primary use for the data was reporting to the federal government, but the data are also used in traffic safety studies and for pavement management. Many states indicated a desire to work with local agencies to conduct these counts, as well as improving communication with these agencies to collect accurate and well-coordinated data. A second survey was distributed to cities and counties within South Carolina. This survey collected information on how cities and counties use the AADT data provided by SCDOT, as well as needs the cities and counties have, and the challenges they have. From this information, the researchers determined recommendations for improving the data collection plan in South Carolina. While ten of the responding cities and counties were satisfied with the data provided by SCDOT in the past, 15 cities and counties indicated that more timely and accurate data would be beneficial in the future. Seven city and county agencies indicated challenges with performing short-term counts, with the primary concerns being lack of staff and vandalism or accidental destruction of short-term count equipment.

Lastly, the research team developed three separate models for estimating AADT. The first, based on the Origin-Destination Centrality Method, estimated AADT using deterministic variables based on the theory of centrality. It was found that the number of count stations can be reduced by 60% without compromising accuracy. Although the result was positive in this case study, the assumptions made in the input parameters may not be applicable at all sites, thus producing an inaccurate estimation of AADT.

The next model developed was based on regression. Based on certain roadway characteristics like functional class, setting, and socioeconomic variables such as mean income, age, poverty level, number of vehicles and other inputs, regression models were used to determine which of the factors affect AADT. The last model developed was based on Machine Learning (ML). Two methods were used to determine which performed the best, the Artificial Neural Network (ANN) and the Support Vector Regression (SVR) methods. A case study was conducted based on a complete year of data from 2011, with 2016 data used for model validation. Evaluating both models, it was found that the SVR method outperformed the ANN method when compared to the ground truth AADT data from the ATRs. For each functional class, the SVR model performs the best, with lower RMSE and MAPE values. Overall, when comparing the SVR method with the factor method, the SVR method has an average percent error of 3% while the factor method has an average percent error of 6%.

Pilot testing to evaluate the regression and ML models were conducted with new data that were not used previously for model calibration. Overall, the SVR based machine learning model performed the best, compared to the Artificial Neural Network (ANN) or the Ordinary Least Squares (OLS) linear regression model. As such, a software, *estimAADTion*, was developed, based on the SVR method for use by SCDOT. This software functions using 24-hour counts, rather than the typical 48-hour counts conducted by SCDOT. This will allow the reallocation of temporal and fiscal resources as seen fit by SCDOT.

Future opportunities for improvement of AADT data collection by SCDOT includes annual ATR counts at each location and improved delivery of data to cities and counties within South Carolina. In addition, an improved scheme for the vehicle classification tree was developed as part of this project. Utilization of this improved scheme will allow for more accurate classification of pickup trucks and buses. Next, in the event of an evacuation, the method used by the Delaware DOT can be used in conjunction with the South Carolina formula to estimate the number of occupants per evacuating vehicle. This method considers census data, GIS data, and percent occupancy of seasonal units along the coast which will likely result in a more accurate occupancy estimation. Finally, in terms of estimating AADT, based on the results of the pilot study of each of the models developed, the SVR-based machine learning model will allow for cost-effective and accurate estimation of AADT. As such, it is recommended to use the *estimAADTion* software, developed for this project. Each of these opportunities identified will strengthen the South Carolina data collection plan in future years.

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