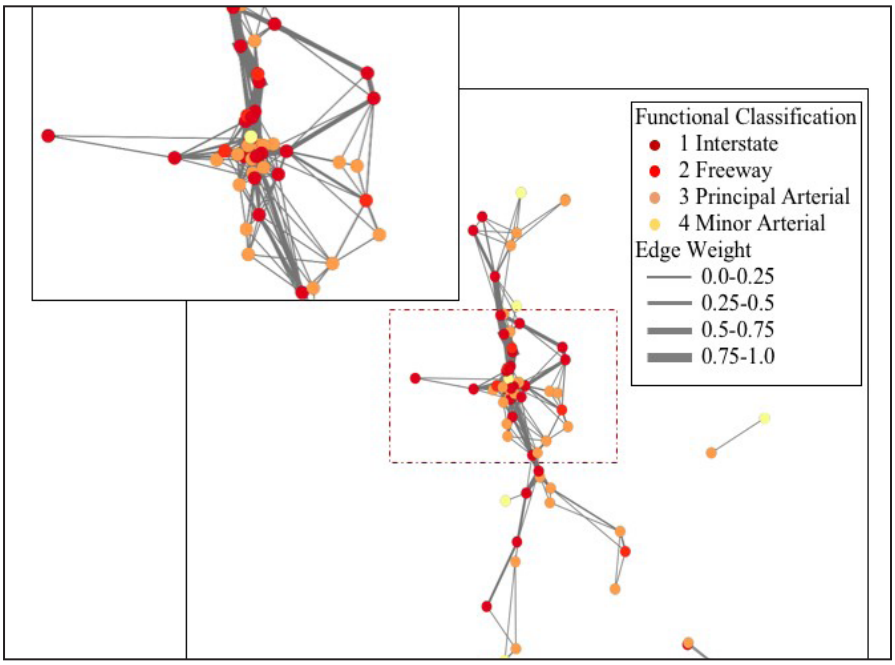
MOUNTAIN-PLAINS CONSORTIUM

RESEARCH BRIEF | MPC 21-428 (project 543) | March 2021

Big Transportation Data Analytics



the **ISSUE**

Traffic volume data are crucial in many applications, including transportation operation analysis, congestion management, and accident prevention. Yet an extensive capture of accurate volume information on a large-scale network can be difficult and costly. The Utah Department of Transportation deploys more than 100 continuous count stations to collect traffic volumes at different locations in order to achieve balanced geographic coverage. Even so, it is still difficult to capture traffic characteristics of the entire Utah road network within a short time period.

the **RESEARCH**

The researchers implemented machine learning techniques to predict hourly traffic volumes using features associated with the variation of traffic volume. To achieve this, spatial-temporal features as well as traffic flow characteristics are collected from multiple sources. Then a fraction of road segments with ground-truth volume data is trained through the proposed models in combination with collected features. Finally, the constructed models are tested on new locations for performance evaluation.

A secondary objective of the study is to enhance prediction accuracy by exploring methods to quantify the spatial dependency among road segments. The researchers present a spatial prediction of hourly traffic volume using Utah's road network. Specifically, they created a traffic network graph leveraging probe trajectory data, and implemented a graph-based approach – breadth first search – to search neighboring sites in this graph for computing spatial dependency. The proposed spatial dependency feature is subsequently incorporated as a new feature fed into XGBoost, a software suite for machine learning. The proposed model is tested on Utah's state road network.

MOUNTAIN-PLAINS CONSORTIUM REGION 8

A University Transportation Center sponsored by the U.S. Department of Transportation serving the Mountain-Plains Region. Consortium members:

Colorado State University
North Dakota State University
South Dakota State University
University of Colorado Denver
University of Denver
University of Utah
Utah State University
University of Wyoming

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Project Title

Big Transportation Data Analytics

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the **FINDINGS**

Numerical results not only indicate high computational efficiency of the proposed model, but also demonstrate significant improvement in prediction accuracy of hourly traffic volume compared with the benchmarked models. In this study, XGBoost was capable of training a large-scale dataset with high computational efficiency. Feature importance analysis further verifies the relevance of the proposed spatial dependency feature, accounting for 13.8% of the total importance among all features. In addition, spatial analysis shows that the proposed spatial dependency feature demonstrates its superiority for densely clustered regions.

the **IMPACT**

Hourly traffic volume provides more valuable information than annual average daily traffic for micro-level operational analysis. However, it is quite challenging to estimate hourly traffic volume at a new location with high accuracy.

This research indicates statistical modeling and machine learning methods might be employed to partially or fully supplant expensive and labor-intensive short-duration traffic count programs for predicting traffic volume and reliability changes based on the historic traffic count records, depending on variables such as traffic incidents, work zones, adverse weather, and others. Based on statistical measures of fit, a best analytical approach, or set of approaches, can be incorporated into a DOT's traffic operation program to predict future traffic volumes and reliability for state and federal-aid routes, and for new planned highway segments. This information also could be used to automatically feed the annual Highway Performance Monitoring System (HPMS) reporting UDOT is required to prepare, as well as to provide planning-level traffic forecasts.

For more information on this project, download the entire report at https://www.ugpti.org/resources/reports/details.php?id=1025

For more information or additional copies, visit the Web site at www.mountain-plains.org, call (701) 231-7767 or write to Mountain-Plains Consortium, Upper Great Plains Transportation Institute, North Dakota State University, Dept. 2880, PO Box 6050, Fargo, ND 58108-6050.