World Academy of Science, Engineering and Technology
International Journal of Mathematical and Computational Sciences
Vol:14, No:12, 2020

Evaluating Traffic Congestion Using the Bayesian Dirichlet Process Mixture of Generalized Linear Models

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Abstract : This study applied traffic speed and occupancy to develop clustering models that identify different traffic conditions. Particularly, these models are based on the Dirichlet Process Mixture of Generalized Linear regression (DML) and change-point regression (CR). The model frameworks were implemented using 2015 historical traffic data aggregated at a 15-minute interval from an Interstate 295 freeway in Jacksonville, Florida. Using the deviance information criterion (DIC) to identify the appropriate number of mixture components, three traffic states were identified as free-flow, transitional, and congested condition. Results of the DML revealed that traffic occupancy is statistically significant in influencing the reduction of traffic speed in each of the identified states. Influence on the free-flow and the congested state was estimated to be higher than the transitional flow condition in both evening and morning peak periods. Estimation of the critical speed threshold using CR revealed that 47 mph and 48 mph are speed thresholds for congested and transitional traffic condition during the morning peak hours and evening peak hours, respectively. Free-flow speed thresholds for morning and evening peak hours were estimated at 64 mph and 66 mph, respectively. The proposed approaches will facilitate accurate detection and prediction of traffic congestion for developing effective countermeasures.

Keywords : traffic congestion, multistate speed distribution, traffic occupancy, Dirichlet process mixtures of generalized linear model, Bayesian change-point detection
Conference Title : ICSRD 2020 : International Conference on Scientific Research and Development
Conference Location : Chicago, United States
Conference Dates : December 12-13, 2020