Uncertainty in Bus Arrival Time Predictions: Treating Heteroscedasticity With a Metamodel Approach - DTU Orbit (18/01/2019)

Arrival time predictions for the next available bus or train are a key component of modern traveler information systems (TISs). A great deal of research has been conducted within the intelligent transportation system community in developing an assortment of different algorithms that seek to increase the accuracy of these predictions. However, the inherent stochastic and nonlinear nature of these systems, particularly in the case of bus transport, means that these predictions suffer from variable sources of error, stemming from variations in weather conditions, bus bunching, and numerous other sources. In this paper, we tackle the issue of uncertainty in bus arrival time predictions using an alternative approach. Rather than endeavor to develop a superior method for prediction, we take existing predictions from a TIS and treat the algorithm generating them as a black box. The presence of heteroscedasticity in the predictions is demonstrated and then a metamodel approach is deployed, which augments existing predictive systems using quantile regression to place bounds on the associated error. As a case study, this approach is applied to data from a real-world TIS in Boston. This method allows bounds on the predicted arrival time to be estimated, which give a measure of the uncertainty associated with the individual predictions. This represents to the best of our knowledge the first application of methods to handle the uncertainty in bus arrival times that explicitly takes into account the inherent heteroscedasticity. The metamodel approach is agnostic to the process generating the predictions, which ensures the methodology is implementable in any system.

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