Project title: Terminal Location Planning in Intermodal Transportation with Bayesian Inference Method

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Project description:

The objective of this project is to bring the inherent probabilistic features in the intermodal transportation network into the terminal location planning problem and solve this problem based on the Bayesian inference with the Markov Chain Monte Carlo (MCMC) method.

Considering the interconnection of the road mode and other modes such as railway transportation via terminals so that the road mode focuses more on many low-flow localized services and railway mode acts as the major backbone for high capacity and large range services, one important problem is to decide on the number of terminals and their locations given a set of potential locations and to determine the route paths of difference services. The current research in this area is focused on solving optimization problems using different representation models and different heuristic optimization methods. Despite many interesting results being reported, the current work assumes that the parameters in the transportation network are static. In fact, these parameters can change significantly either continuously or from time to time. For example, road condition and thus road capacity changes due to construction, congestion and weather. Also the delay of terminals decreases as advanced technologies are developed. Therefore, the effect of variations inherent in the transport network should be considered. This is particularly necessary and appealing as terminal planning affects long-term operation.

The intellectual merit of this project is the consideration of the probabilistic nature in the terminal location planning problem and the use of the MCMC method to solve this problem. In this project, the uncertainty of the parameters will be characterized with probability density functions (PDFs) based on prior information and the cost function will be mapped into a likelihood function. The design problem will be converted into the problem of finding parameter set solutions with high posteriori probability which is proportional to the product of the prior PDF and the likelihood. A MCMC algorithm will be developed to find these parameter sets by generating variates (samples) drawn from the probability distribution. This project has broader impact. Since the probabilistic features are inherent in transportation, the design model based on MCMC has the potential to provide a unified framework not only for the location planning but also for many other optimization problems in the intermodal transportation research. In addition, in this project a graduate student will be recruited and educated to focus on the probabilistic modeling and analysis of various problems in the intermodal transportation.