Title: Terminal Location Planning in Intermodal Transportation with Bayesian Inference Method (7/16/2012-12/31/2013)

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Objectives: 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 problem becomes even more difficult due to various variations such as in the demand of services and terminal capacity. The technical 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 using a Bayesian inference framework with the Markov chain Monte Carlo (MCMC) method. In addition, the project also aims for graduate education by supporting and educating a Ph.D. student.

Expected products:

1. A set of software programs using MCMC to solve the terminal location problem with probabilistic features.
2. A small research group focusing on Bayesian inference theory and applications in the area of operation research in various transportation problems.
3. Publication submission to disseminate the research results.

Benefit: This project shall have broader impact. Since the probabilistic features are inherent in transportation, the design model based on MCMC designed through this project has the potential to provide a unified framework not only for the location planning but also for many other design problems in the intermodal transportation research. This project also contributes to graduate education. A Ph.D. student is supported and educated through this project to work towards his dissertation on the topic of probabilistic modeling and analysis of various problems in the intermodal transportation.

Research accomplished to date:

1. We have successfully recruited a PhD student, Robert Wesley Henderson, who has the civil engineering background in his bachelor degree, and has been actively involved into the research.
2. We have developed the nested sampling-based MCMC program that works well for some simple mathematical examples.
3. We have developed two sample-generating techniques used in the nested sampling method. One technique is to produce uniform samples in high dimensional tetrahedron. This is related to modeling the service flows that can simultaneously pass though a given route path. The technique involves investigation of the order statistics, Dirichlet distribution and Poisson random process. The other technique is generating samples uniformly in the prior domain under a likelihood constraint. This technique determines the convergence of the MCMC system and requires the integration of conjugate-gradient method.