Title: Mobility Modeling and Prediction in Bike-Sharing Systems

Abstract:
As an innovative mobility strategy, public bike-sharing has grown dramatically worldwide. Though providing convenient, low-cost and environmental-friendly transportation, the unique features of bike-sharing systems give rise to problems to both users and operators. The primary issue among these problems is the uneven distribution of bicycles caused by the ever-changing usage and (available) supply. This bicycle imbalance issue necessitates efficient bike re-balancing strategies, which depends highly on bicycle mobility modeling and prediction. In this paper, for the first time, we propose a spatio-temporal bicycle mobility model based on historical bike-sharing data, and devise a traffic prediction mechanism on a per-station basis with sub-hour granularity. We extensively evaluated the performance of our design through a one-year dataset from the world's largest public bike-sharing system (BSS) with more than 2800 stations and over 103 million check in/out records. Evaluation results show an 85 percentile relative error of 0.6 for both check in and check out prediction. We believe this new mobility modeling and prediction approach can advance the bike re-balancing algorithm design and pave the way for the rapid deployment and adoption of bike-sharing systems across the globe.