Chapter 16

The Application of Venue-Side Location-Based Social Networking (VS-LBSN) Data in Dynamic Origin-Destination Estimation

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ABSTRACT

Location-Based Social Networking (LBSN) allows users to confirm their current locations and trip purposes by “checking in” with places of interests (“venues”) registered at the LBSN Websites. Such individual activity data provides the potential to collect dynamic travel demand data in a temporal and spatial resolution that cannot be achieved using traditional survey-based methods. In this chapter, the authors investigate and propose LBSN data-based urban travel demand estimation methods—specifically, the dynamic Origin-Destination (OD) demand estimation. This chapter investigates the feasibility of using VS-LBSN data to estimate dynamic Origin-Destination (OD) travel demand for general trips. A combined non-parametric cluster and regression model is used to establish the relationship between VS-LBSN data and the trip production and attraction. A modified gravity model-based trip distribution

method with three friction function variations is proposed to estimate the OD matrix. The proposed methods are calibrated and evaluated against the ground truth OD data from CMAP (Chicago Metropolitan Agency for Planning). The results demonstrate the promising potential of using VS-LBSN data for dynamic OD estimation.

INTRODUCTION

In this study, we propose a dynamic (time-dependent) Origin-Destination (OD) travel demand monitoring system based on venue-side location-based social network (VS-LBSN) data for the operations and management of an urban transportation network. The Origin-Destination (OD) matrix describes the number of trip exchanges between the origins and destinations in a transportation network during a specified time period which is a crucial input in prevailing transportation planning. With the recent development in Active Traffic and Demand Management (ATDM) technologies in the US, the practical needs for collecting dynamic demand information such as dynamic OD matrix increase significantly. Dynamic OD matrix can be directly adopted by transportation agencies to monitor, manage, and respond to dynamic travel demand changes within urban networks and provide reliable inputs for proactive solutions to address mobility, reliability, and sustainability issues. In this study, we propose the use of venue-side location-based social network (VS-LBSN) data to generate dynamic OD information. The study is based upon the existing work by the research team on static OD demand estimation based on VS-LBSN data (Jin, Yang, Cebelak, Ran, & Walton, 2013; Yang, Jin, Cheng, & Ran, 2013).

Background

Recent developments in computing technologies, wireless communication, and social media technologies present many new means to obtain travel demand information with spatial and temporal solutions that cannot be achieved by traditional survey-based methods. Table 1 summarizes the characteristics of the traditional and emerging travel demand data collection methods. The proposed VS-LBSN method is added to the last column of the table, distinguishing it from the user-data-based social media methods. Although the emerging technologies may not capture complete traveler and trip characteristics as do the traditional survey-based methods, they provide compelling alternatives in terms of collecting data with high spatial and temporal resolution and large sample sizes. Three major limitations can be observed among the emerging technologies. The first limitation is the privacy concern. With the exception of Bluetooth-based technologies (in which the tracking ID is a device ID not attached to any personal information), these technologies contain information that can be used to trace the identity of travelers. The privacy concern can create legal and political issues for transportation agencies, especially in large-scale traffic data collection. The second problem concerns whether the data can be collected passively without interfering the original system or the travelers. License plate matching requires high-resolution or low-angle roadside videotaping not usually available through regular CCTV cameras. Some smartphone application-based survey methods require users to actively participate or use the application for the survey purposes. Data mining through social media also requires that the users consent to share their online information. The last key limitation is the lack of trip purpose and location confirmation from users. Many passive data collection technologies such as GPS, Bluetooth, and cellphone-based methods do not have built-in location and trip purpose confirmation. To obtain such information, those methods either rely on an application that allows users to enter their trip information or data mining models to
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