Generating Origin-Destination Matrices from Mobility Data

Origin-destination (OD) matrixes are an essential source of information for traffic management and transportation planning. Given a set of geographic areas, an origin-destination (OD) matrix displays the number of trips that start/end in any pair of areas in the set. However, the classical acquisition of OD information via mobility surveys and traffic counts is either very expensive or less accurate due to the snapshot character of the counts. Yet, the wide distribution of mobile devices in today’s world offers new possibilities for the collection of OD information.

This lecture introduces two methods for the collection of OD information in a distributed streaming environment. One main focus hereby is on the privacy-preserving evaluation of the data. The first method employs a crowd sourcing approach where smartphones act as sensor nodes. Based on on-board localization technology, a filter hierarchy is used to detect the traffic flows of each user. A subsequent aggregation and anonymization step ensures that the data of all users is centralized in a privacy-preserving manner. The second method relies on stationary Bluetooth sensors that detect Bluetooth-enabled devices in their neighborhood. In order to join the information of several sensor nodes in a privacy-preserving way, sketch data structures are applied. Sketches are effective data structures for the approximation of continuous data streams. Their inherent data compression properties can be exploited to guarantee privacy. The lecture will give an introduction to the applied data structures and their theoretic guarantees. Finally, the lecture will discuss different techniques for the evaluation of OD matrices.

Outline

1. Introduction and Motivation
2. OD Matrix Generation via Mobile Sensors
   - Flow Detection on Mobile Devices
   - Anonymization Techniques
3. OD Matrix Generation via Stationary Bluetooth Sensors
   - Sketching Techniques
4. Evaluation of OD Matrices