The effect of mobile phones as positioning sensors on Dynamic Origins-Destination matrices

Nelson R. Gómez-Torres
University of Puerto Rico at Mayagüez

Didier M. Valdés-Díaz
University of Puerto Rico at Mayagüez

1 Introduction

Most Departments of Transportation (DOT) in the U.S., rely on historical data in order to design and maintain their traffic control plans. Such data, while valuable, does not provide information about changes in the pattern of traffic flow in a timely manner. These changes in the pattern, might diminish the Level of Service (LOS) of the road network, and may not even be detected until it is too late to fix. Early detection, allows the DOT to: revert the change in pattern, provide alternate routes or begin improvements earlier than scheduled.

To maximize network’s capacity utilization, Dynamic Traffic Assignment (DTA) is needed. DTA employs Dynamic Origin-Destination (OD) matrices. To obtain OD matrices, the data should be obtained in short periods and data transmission must occur in real time. The solution proposed herein is the use of cell phones as sensors (probes) to construct OD matrices without user input.

The market penetration of mobile (cell) phones, make it a perfect instrument to detect vehicle (and user) locations. OD matrices are usually obtained from surveys, data from the census or small studies. Lately, research on the use of mobile phones for traffic parameters have increased and have shown to be an effective way to acquire data.

Previous research complemented positioning data (from the phones) with input from users. The complexities of avoiding user-input are regarding the rather irregular way in which a single vehicle (or person) moves. This technology promises to change the way transportation engineers gather data for OD matrices.

The objective of this study is to determine if mobile phone technology without user-input can detect the origin and destination of trips, and transportation mode used in the transportation system. This is done to avoid premature aging of the facilities, by improving the Dynamic OD matrices and utilizing that information to establish contingency plans.

2 Origin-Destination Matrices

- O-D Matrices are a mathematical representation of the volume of vehicles that want to go from Origin (O) to Destination (D)
- Road networks have to be divided into zones
- Zones are physical, social or organizational boundaries
- Dynamic O-D matrices are time-dependent O-D matrices which are updated in real time and change due to traffic conditions.

3 Background and Significance

Hellinga et al. sets out that determining traffic conditions from positioning data requires five steps: map matching, path identification, probe filtering, travel time allocation and travel time aggregation. The relation of these five steps with data from cell phones follows:

- **Map matching**: This step consists of determining the position of a vehicle in the transportation network.
- **Path identification**: When several paths can be utilized, this step deals with road selection. This problem is due to the time interval between data points.
- **Probe filtering**: Consists of determining the transportation mode being used. The data have to be analyzed to establish the transportation mode.
- **Travel time allocation**: Estimation of travel time in each link. When a change in travel mode occurs, this step separates the travel time in each mode.
- **Travel time aggregation**: The calculation of the average travel time for any link occurs in this step.

Previous research utilized user-input to perform probe filtering and travel time allocation. In probe filtering the specific topics are: identify travel mode and travel mode change. In travel time allocation the specific topics are: starting and ending trip times, and time of travel mode change. Furthermore, this research will include public perception to this use of cell phones.

4 What is next?

- Acquire data from mobile phones in Puerto Rico
- Design an algorithm that recognizes the characteristics of each travel mode possible in Puerto Rico
- Neural networks may help with this item
- Improve the travel mode algorithm to recognize the time where a change in mode is done
- Fuzzy logic will probably be used here
- Design an algorithm that detects the time when a trip has begun/finished
- Gather public opinion
- Prepare an informational and decision package to public officials and private companies

5 Key References


6 Acknowledgements

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