A Study on Public Transport Mobility Flows in Singapore

Sarah J. Berkemer[1, 2], Shantal Lichang Cheong[3], Jared Edgerton[4], Marina Kogan[5], Ricky Laishram[6], Alan R. Pacheco[7], Alex Shannon[8], Matthew D. Sweitzer[9], and Xindi Wang[10]

[1]Bioinformatics Group, Department of Computer Science, and Interdisciplinary Center for Bioinformatics, University of Leipzig, Härtelstraße 16-18, D-04107 Leipzig, Germany
[2]Max Planck Institute for Mathematics in the Sciences, Inselstraße 22, D-04103 Leipzig, Germany
[3]Strategic Planning Group, Urban Redevelopment Authority, Singapore
[4]Department of Political Science, The Ohio State University, Columbus, OH 43210, USA
[5]Computer Science Department, University of New Mexico, Albuquerque, NM 87131, USA
[6]Electrical Engineering and Computer Science, Syracuse University, Syracuse, NY 13210, USA
[7]Bioinformatics and Biological Design Center, Boston University, Boston, MA 02215, USA
[8]Center for Urban Science and Progress, New York University, New York, NY 10003, USA
[9]School of Communication, The Ohio State University, Columbus, OH 43210, USA
[10]Network Science Institute, Northeastern University, Boston, MA 02215, USA
[+]All authors contributed equally to this work

ABSTRACT

In the study of cities as complex systems within which many sub-systems operate and interact, the sub-system of people movement within a city is a key component in the activities and interaction of people and the urban environment. Understanding human mobility behavior within a city allows us to gain insights on human choice and community behavior. It has the potential to inform the work of urban planners in the planning of land use and transportation infrastructure to support mobility flows within a city.

In this study, a subset of data comprising of one day of public transport (PT) journeys from commuter card records from Singapore was analyzed to understand the PT mobility network structure (see Figure 1, left panel) and detect community clustering within the city-state at the broad level. Preliminary findings from assortativity analysis suggest key differences in travel patterns throughout the day, particularly during the lunch hour. Evidence of higher distance assortativity by PT mode (i.e. bus and train) was found for mobility flows during the lunch hour, while low distance assortativity by PT mode was found during other times of the day. Using a walktrap community detection algorithm, preliminary analysis suggests that the number of communities detected are highest during the morning and evening peak hours, with a slight increase in communities detected during the lunch hour.

An analysis of mobility patterns in relation to neighborhood characteristics was also conducted to better understand if different groups of the population from neighborhoods exhibiting varying spatial characteristics travel on the PT network differently. A community clustering study by Planning Areas (see Figure 1, right panel) found that the communities detected tended to be clustered along the train network, suggesting that mobility flows on the train network have a stronger influence on community clustering compared to mobility flows on the bus network. To understand if people are more likely to travel to a destination Planning Area that exhibits similar spatial and demographic characteristics as their origin area, a cosine distance similarity analysis was proposed to measure the trend in PT mobility flows between areas that are highly similar (including within-area travels) to highly different.

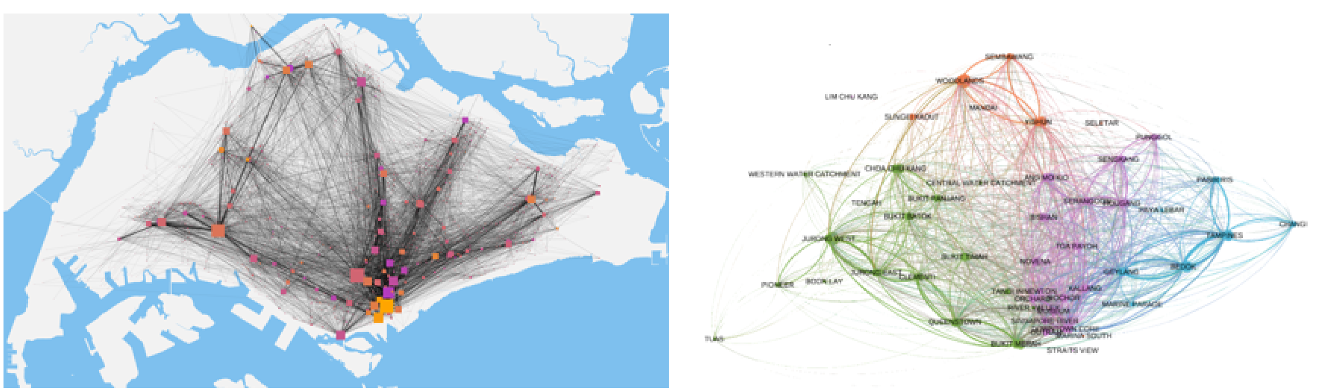

Figure 1. Islandwide network structure (full day). Node size and edge weight correspond to the number of travelers to a destination or along a route, respectively. Left panel shows the full network. Right panel shows the results of community detection methods.