

# Spatial Analysis of Social Networks in Urban Environments: Integrating Big Data and Cartographic Techniques for Understanding Mobility Patterns

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**Keywords:** social networks, spatial mobility, Big Data, cartographic techniques, urban spaces

## Abstract:

Urban environments function as complex hubs for social engagement and physical movement in today's interconnected societies. With technological progressions shaping social dynamics, the focus shifts to exploring how individuals interact, socialize, and travel within city landscapes. Combining Big Data analysis and cartographic techniques can provide valuable insights into the visual representation of social networks and spatial mobility within urban environments. By integrating mobile phone data (Call Detail Records, CDRs), e-bike-sharing data, and geospatial data, the study seeks to examine patterns of social connectivity and spatial mobility. The focus lies in exploring visualization approaches and cartographic representations that can effectively illustrate the complex interplay between social networks, mobility patterns, and the spatial features of urban areas.

This study builds upon the author's previous unpublished MSc thesis research that adopted a data-driven approach to analyse the social network of call pairs across Estonia, utilizing passive mobile positioning data from a major mobile operator. The current research expands this foundation by incorporating e-bike-sharing data from Tartu, collected over a few days in July 2019, to explore the spatial dynamics of social networks and mobility patterns within urban environments.

The established methodology of detecting home locations (aggregated by antenna locations) based on diurnal calling rhythms and frequent antenna locations is applied to assign spatial context to the call pairs. Home location detection enables identifying the origin (caller's home) and destination (callee's home) for each interaction. Along with network analysis techniques (such as degree centrality, edge weight, and edge betweenness calculations), cartographic visualization approaches are examined to represent the complex relationships between social networks. The example (see Figure 1) of a spatially distributed network of call pairs represents the cartographical approach to visually examine the spatial extent of dispersion of call pairs, the patterns of concentrations, and far-flung connections of ties. The example map is presented and discussed among colleagues, though further steps of evaluation of its visual approach require examination.

The visualizations developed in this study are primarily intended for urban planners, policymakers, and researchers in the fields of urban studies, social geography, and transportation. These stakeholders can benefit from the insights provided by the visual representations to inform decision-making processes related to urban development, transportation planning, and social infrastructure.

Therefore, we take the subset dataset of mobile phone data (CDR) covering the area of Estonia, apply the methodology we have developed, and further explore the cartographical techniques to visually represent the social networks and spatial mobility patterns within urban areas.



Figure 1. The network of call pairs. The map displays the spatial patterns of calling partners based on antenna locations. Author: Lika Zhvania.