Public transportation networks as complex systems: between data processing and statistical physics

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In this study, we present quantitative analysis of some public transportation networks (PTN) viewed as complex systems [1]. We apply a multi-disciplinary approach integrating methods in both data processing and statistical physics [2] to investigate the correlation between PTN topological features and their operational stability.

Initially, to present a PTN in the form of a complex network (i.e. a graph consisting of vertices-nodes and edges-links), we perform a coarse-graining procedure to merge stations considered to be within a reasonable walking distance (e.g. stops across the street) by implementing a DBSCAN clustering algorithm to the transport dataset.

Subsequently, we analyse the topological features of the resulting complex networks calculated for various network representations reflecting PTN operational features. In the second part of our analysis we assess the vulnerability of PTN by generalising the percolation scenario and removing network constituents according to different protocols (attack scenarios). We observe correlations between network topological features and its stability with respect to random failures and targeted attacks.

1. Yu. Holovatch, R. Kenna, S. Thurner. Complex systems: physics beyond physics. Eur. Journ. Phys. **38**, 023002 (2017).
2. R. de Regt, C. von Ferber, Yu, Holovatch, M. Lebovka. Transportmetrica A: Transport Science (2018) 2324–9943 (online); arXiv:1705.07266.