Network algorithms for the identification and classification of gaps in urban bicycle networks based on OSM data

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What is the best location to build new bicycle infrastructure in a city? This planning decision can be conceptualized as an optimization problem: the goal is to find the most efficient solution – that is, the one that has the highest (positive) impact on the bicycle network at least cost. However, identifying locations that will significantly improve network quality is far from being a straightforward task. The first challenge is to put a number on network quality improvement in order to make different planning decisions comparable; the second is the often cumbersome collection and processing of data required by the chosen approach (e.g. input from large-scale user surveys). Our data-driven, computational approach for the identification of gaps in bicycle networks simultaneously addresses both these challenges. We show how the detection and prioritization of gaps in an urban bicycle network can be automatized by topological network analysis of open source data from OpenStreetMap (OSM). To this end, we develop a four-step procedure (identify, cluster, classify, and prioritize) for finding the most important network gaps based on topological network metrics. We apply our procedure to Copenhagen, Denmark, and report the 101 top priority gaps found in the network. To evaluate our results, we compare our findings with the current Cycle Path Prioritization Plan (*Cykelstiprioriteringsplan 2017-2025*) of the Municipality of Copenhagen, and find considerable overlaps with citizen survey data. The procedure takes into account the entire urban bicycle network and can therefore meaningfully complement localized, manual planning processes for effectively consolidating dense urban bicycle networks. Our work shows how network analysis based on open-source topological data can serve as a powerful and cost-efficient tool for decision-making support in bicycle network planning.
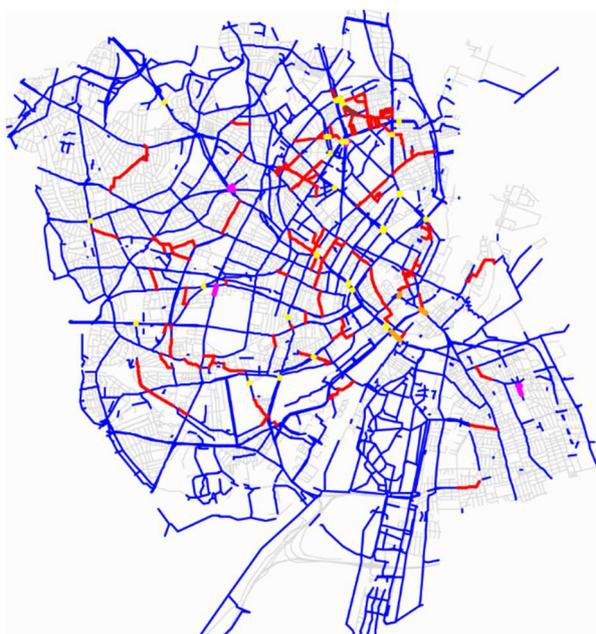
Fig. 1: Top 101 gaps in the bicycle network of Copenhagen by class: missing links in red, bridges in orange, intersections in yellow, right-turn lanes in pink, roundabouts in brown. The street network is shown in grey, the bicycle network in blue.

References:

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