The geometric limits of growing urban bicycle networks

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City planners worldwide are increasingly realizing that cycling can be a promising solution to their unsustainable car-centric transport systems. However, common bicycle network planning practices follow piecewise ad hoc approaches which do not take into account the transportation network and its structural complexity as a whole. Here we take a first step in exploring systematically the general geometric limitations in the development of urban bicycle networks, using tools from network science. We study the process of growing a graph triangulation between an arbitrary set of points of interest routed on a city's existing street network. We run different variations of this growth process on 62 diverse cities, tested against a random null model. We find that growth phases tend to start with decreasing directness and connectedness followed by improvement, implying fundamental consequences to sustainable urban planning policy: To be successful, cities must invest into bicycle networks 1) with the right growth strategy, and 2) boldly, to overcome short-term deficiencies until a critical mass of bicycle infrastructure has been built up. Further, we find distinct overlaps of our synthetically grown networks in cities with well-developed existing bicycle networks, showing that our model is realistic and has the added potential to identify missing links. We grow networks from scratch because most cities on the planet have negligible bicycle infrastructure to start from, thus making our approach a generally applicable starting point for sustainable urban bicycle network planning with minimal, readily available data requirements. We release our network growth algorithms as open source, thus making them arbitrarily extendable with refinements.

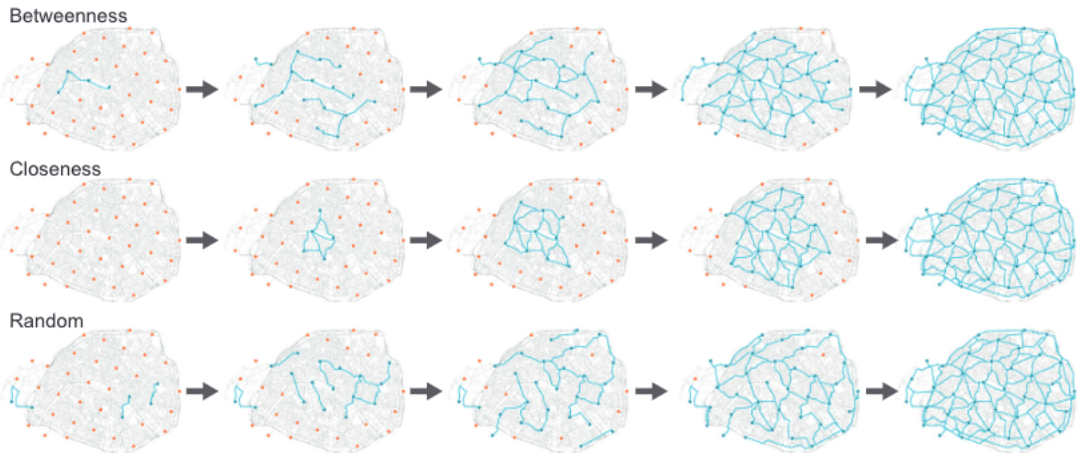

Fig. 1: Three strategies of growing bicycle networks from scratch. Each strategy has its unique advantages, disadvantages, and geometric limitations.

References:

M. Szell, S. Mimar, T. Perlman, G. Ghoshal, R. Sinatra. **Growing Urban Bicycle Networks**, *arXiv:2107.02185* (2021), https://arxiv.org/abs/2107.02185