Abstract – Modelling route choice of cyclists in Zurich

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Cycling is becoming an increasingly popular mode of transport in many regions of the world. For Switzerland, and similar to other countries, the COVID-19 pandemic has boosted cycling (Molloy et al., 2020; Meister et al., 2021b) on top of a general trend of increased bike usage (BfS, 2010, 2015). Apart from their positive effects on health and low land-use requirements, private (e)-bikes have very low life-cycle emissions and hence make them ideal to quickly decarbonize a substantial share of urban transport (Cazzola and Crist, 2020). The urgency of the climate crisis justifies additional research into cycling to generate up-to-date insights for policy makers. A central element is the design of urban cycling networks, which requires sophisticated route choice models. The route choice of cyclists has been subject to previous revealed-preference studies, see e.g. Casello and Usyukov (2014), Hood et al. (2011) or Broach et al. (2012). More recent works use GPS-measured trajectory data and large-scale networks with increasing levels of detail, e.g. Prato et al. (2018). They typically apply so-called Path-Size Logit (PSL) models and report similar results, with factors like length, cycling infrastructure, gradient, surface and traffic volumes being found to have significant impact on route choice. Notable work includes Menghini et al. (2010) which was the first cycling route choice study using GPS-data collected in Zurich. Only limited studies have focused on bike-sharing systems like e.g. Scott et al. (2021) and González et al. (2016) and even fewer on e-bikes, e.g. Dane et al. (2019). The impact of e-bikes on route choice is of specific relevance, due to their large substitution and decarbonization potential, especially in regions with distinct topological conditions like e.g. Switzerland.

This paper presents the results of state-of-the-art route choice models for cyclists in the city of Zurich. The data includes approx. 4500 cycling trajectories, thereof approx. 850 from e-bikes. These trajectories were recorded through a GPS-tracking app within the MOBIS study Molloy et al. (2020), and include socio-demographic characteristics. The network is sourced from OSM and enriched with several cycling relevant attributes, including gradients, type of existing cycling infrastructure, speed limits and traffic lights, as well as traffic counts. It includes 230.000 links covering a surface of approx. 350 km2 making it specifically dense compared to other recent studies. The raw trajectory data is map-matched to the network using a common Hidden-Markov-Model approach (Meister et al., 2021a). The choice set generation is based on the BFSLE algorithm as described in Felder et al., (2022). We present descriptive statistics as well as the model results which specifically point out the difference between regular and e-bikes. From a methodological perspective, we provide valuable insights in how to deal with the varying degrees of accuracy within the raw trajectory and network data, as well as the matching and choice-set generation processes. Finally, this work is part of greater efforts to incorporate a corresponding route choice model into the agent-based simulation framework MATSim (Horni et al., 2016) to performed detailed network evaluation.

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