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A link-based approach for measuring walking accessibility

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1 Introduction

Walking is the most fundamental mode of transport, without which door-to-door trip is simply impossible. An accessible and walkable neighbourhood is conjectured to encourage more walking trips that not only benefit pedestrians' health and well-being but also contribute to environmental sustainability (Liang et al., 2024). Defined as the ease of walking to reach relevant opportunities or destinations, walking accessibility is an important measure of the extent a community is pedestrian friendly.

This study focuses on the analysis of walking accessibility in a pedestrian environment. As summarized by Vale et al., (2015), there are four ways of walking accessibility measures, (1) distance-based, (2) gravity-based, (3) topological or infrastructure-based, and (4) some sort of walk score-type. Most of the existing walking accessibility studies are conducted based on neighbourhood-level information. Nevertheless, the street-level walking facility attributes, e.g., sidewalk width, slope, crossing facilities, etc., can have significant impacts on pedestrian behavioural preferences and hence on walking accessibility (Liang et al., 2023). To rectify this issue, this study analyses walking accessibility while considering the effects of microscopic walking attributes. Accounting for various street-level walking facilities such as sidewalk distance, slope, footbridge, escalator, etc., we develop an approach for measuring walking accessibility based on the link-based recursive logit (RL) model (Fosgerau et al., 2013), which is calibrated with pedestrian' revealed route choices. The results will be used to find the utilities of walking trips based on their corresponding walking facility attributes, and to delineate the walking accessibility performance of an area.

In this study, we conduct our analysis using Kwun Tong, Hong Kong, as a case study. To obtain pedestrians' revealed route choices, we perform unobtrusive following surveys to record their GPS trajectories, which are then matched into a 3D pedestrian network using the Hidden Markov Model algorithm. Without requiring the generation of choice sets, the link-based RL model is employed to formulate pedestrians' route choice behaviour. The estimated results, i.e., the coefficients for different attributes, can reflect the attribute importance and the corresponding route utility or disutility. Alongside that, the walking accessibility for a given origin node, also known as the overall satisfaction of a pedestrian to walk from that origin to all possible destinations in a network, is calculated as the maximum expected utility of that node.

The contributions of this study are as follows. Firstly, the proposed link-based walking accessibility approach accounts for street-level walking attributes, which can provide a more detailed and precise characterization of reality. Secondly, other than capturing the detailed facility information, revealed preferences that can reflect the actual decisions by pedestrians are incorporated in the measurement. Thirdly, the adoption of a link-based recursive logit model makes our accessibility measure independent of choice sets, which overcomes the bias arising from the choice set generation procedure. Besides, with the ability to depict the current level of walking accessibility, our approach can be readily utilized to appraise the expected accessibility improvement for any infrastructure scheme, thereby providing an objective measure to prioritize planning decisions for a more walkable neighborhood.

2 References

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