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Applying space syntax to traffic volume models of micro-mobility

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ABSTRACT

The relationship between space syntax and traffic has attracted considerable interest and significant research in this regard has been carried out related to pedestrian, cyclist, and car traffic flows. Novel micro-mobility solutions have not yet been scrutinised in a similar way. A novel framework was developed to overcome this gap. It aims to model micro-mobility traffic, taking into account its spatial and temporal variations, based on various parameters, including choice, integration and angular choice at gliding radii.

The framework is tested with electric scooter tracking data from the city of Mannheim, Germany. Thereby, a more detailed insight into people's mobility can be gained than through traditional data collection methods. The research results can be used by local authorities to inform infrastructure planning and maintenance works for micro-mobility.

KEYWORDS

Micro-mobility, E-scooters, GPS, Traffic modelling, Routing

1 INTRODUCTION

Space syntax theory and derived methodologies have been useful for a wide range of applications in transport planning. Building on the "theory of natural movement" (Hillier et al., 1993), especially the movement of pedestrians and cyclists, but also of cars and public transport users have attracted research interest (e.g. Chiaradia et al., 2005; Jayasinghe et al., 2019; Law et al., 2014; Patterson, 2016; Paul, 2013; Raford et al., 2007). Whereas the relationship between network loads and spatial configuration has been widely covered, the integration of space syntax methods in "classic" transport planning remains incomplete.

This is also true for the field of micro-mobility (e.g. electric scooters and bicycles) which's popularity – induced by the coronavirus pandemic, the rising awareness for environmental challenges and societal change – has increased. Consequently, not only the usage of private micro-mobility but also the deployment of shared micro-mobility services has grown rapidly worldwide. This development results in significant challenges for authorities to develop regulation, to manage conflicts between modes and to provide appropriate infrastructure. At the same time, shared micro-mobility services are rich sources of revealed preference data with high potential for mobility research.

2 FRAMEWORK

This research contributes to the application of space syntax in the transport modelling field, with a focus on micro-mobility routing. A novel analytical framework is developed that uses tracking data from shared micro-mobility services to understand the relationship between spatial configuration and routing of micro-mobility users. To this end, the framework takes into account various factors which have been shown to influence micro-mobility demand, such as the closeness to points of interest and public transport (e.g. Li et al., 2020), population and workplace densities (e.g. McCahill & Garrick, 2008), perceived safety (e.g. Pucher et al., 2010), and – in addition – integration, choice and angular change of "gliding" radii.

In contrast to previous research, the framework identifies both spatial and temporal clusters of micro-mobility traffic volumes which are then used as dependent variables in a regression analysis. By this, the variation within the relationship between spatial configuration and micro-mobility traffic can be explored, overcoming a gap of existing research which only looks at static volumes and not taking into account the influence of time on mobility patterns. The framework is tested, using the city of Mannheim, Germany, as a case study. By using GPS tracking data, this research overcomes a weakness of previous studies which have not considered e-scooters and – if covering micro-mobility – relied on manual gate counting.

3 CONCLUSIONS

The research results can be used by local authorities to inform infrastructure planning and maintenance works for micro-mobility. Especially time-adaptive infrastructure interventions such as the temporal transformation of car into micro-mobility lanes can be planned. The integration of space syntax-derived measures in the framework is especially valuable since the necessary network data is publicly available either through open data portals or collaborative sources. This lowers the application threshold for institutions without considerable experience in micro-mobility modelling.

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