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Intrinsic assessment of the attribute completeness and accuracy in OpenStreetMap road data

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Abstract:

OpenStreetMap (OSM) is an open-source, collaborative mapping platform offering comprehensive geospatial data from volunteers worldwide. Over the years, it has evolved into a widely used data source for applications such as navigation and transportation modelling. In these applications, the quality of OSM road data plays a critical role in ensuring usability and reliability.

The quality of OSM data can be assessed extrinsically by comparing it to reference datasets (e.g., authoritative data sources) (Haklay, 2010). However, in many regions, obtaining a reliable reference dataset is challenging. To address this concern, researchers have proposed intrinsic data quality measures, which rely on information derived from OSM data itself (Barron et al., 2014; Nejad et al., 2022).

Many studies on OSM road data quality focus on geometry completeness. Despite regional differences, studies presented a convincing picture of the overall level of road coverage in OSM data (Barrington-Leigh & Millard-Ball, 2017). Yet, for applications such as navigation, especially when guiding navigators according to different navigation modes (vehicular, pedestrian, or cycling), the quality of attribute data is critical. For example, to provide guidance to car drivers, attribute data on speed limit would be beneficial. Therefore, this study examines the attribute information of road data, focusing on attribute completeness and accuracy.

The diverse applications of OSM introduce varying data requirements, with its quality often assessed based on its "fitness-for-use" (Barron et al., 2014; Senaratne et al., 2017). Navigation, one of OSM's primary application domains, demands high attribute completeness and accuracy. Among navigation scenarios, vehicular navigation is particularly complex, given its dependency on precise road attributes for routing and guidance. This makes car driving a compelling starting point for investigating intrinsic road data quality.

To assess the attribute completeness of road data for car driving scenarios, we invited experts in the automotive domain for a focus group study. The focus group discussion was guided by two main questions: "What are the important attributes for car driving?" and "What are their levels of importance and why?". In the expert workshop discussions, we identified relevant attributes for car driving and categorised their levels of importance (Table 1).

Level	**Basic requirements**	**High quality**	**High confidence**
	Road class	Urban	Controlled access
	Speed limit	Turn restrictions	
	Travel direction	Continued turn restrictions	
	Road surface	*Lane information*	
	Automobile access	*Railway crossings*	
		Pedestrian crossings	

Table 1. Relevant attributes for car driving and their levels of importance. The italic-styled attributes are relevant to guidance, and the rest are more relevant to routing.

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Then, we developed an indicator for attribute completeness by examining the tags related to the attributes mentioned above and whether the relevant information is available. The basic level of attribute completeness offers a first impression of the road data quality in a region (Figure 1).

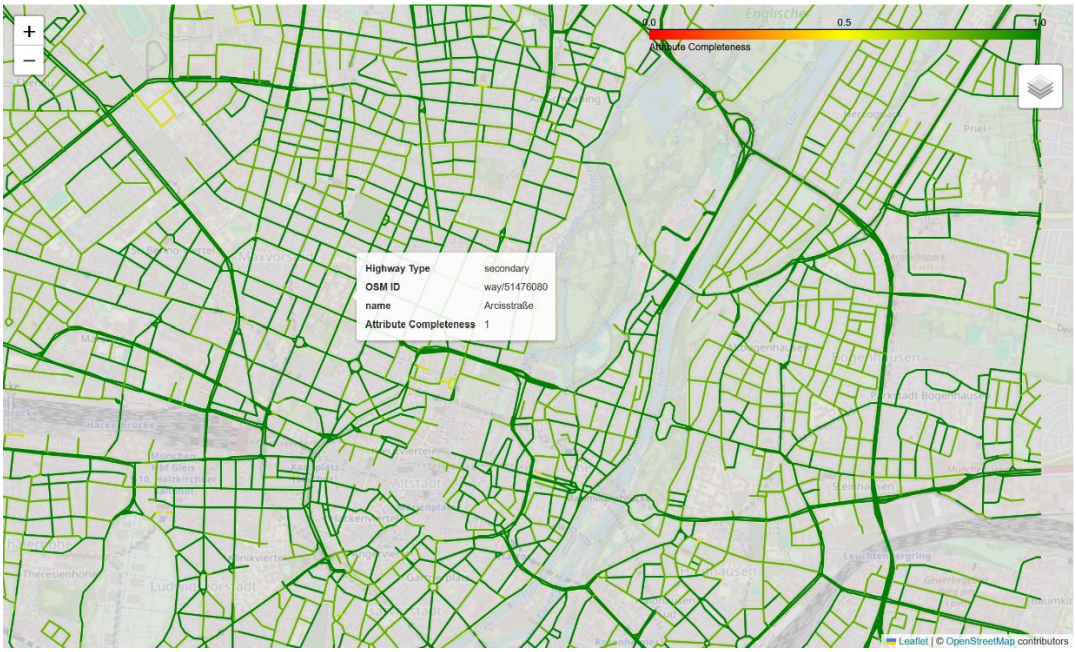

Figure 1. The average car driving related road attribute completeness of Munich centre is 92.214%.

For attribute accuracy, speed limits were chosen as the initial focus, due to the importance in both routing and guidance for car driving. Traffic laws in each country define default speed limits for various road classes, which can be used as rules to verify the accuracy of speed limit data in OSM. Road segments that deviate from these rules are flagged as inaccurate. The total inaccuracy rate is calculated as the proportion of road segments with invalid speed limit values relative to the total road segments with speed limit information. At the current stage of our work-in-progress, we defined rules for Germany and validated our method in Munich, where the inaccuracy rate is very low.

This study aims to intrinsically assess OSM road data's attribute completeness and accuracy, with car driving as the starting scenario. Current work-in-progress proposed indicators and verified them in Germany. Future work will leverage machine learning methods and community knowledge to extend the methodology globally. By providing an intrinsic assessment method, this study enables OSM users to evaluate road data quality in terms of attribute completeness and accuracy before intended usage. Additionally, the findings aim to inform strategies for improving OSM road data quality, particularly for navigation.

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