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Master's Thesis Proposal: Measuring Global Step-Free Accessibility in Public Transport

1. Introduction and Background

Public transport is widely promoted as a fair, sustainable, and equitable alternative to private vehicles. However, for wheelchair users and individuals relying on walking aids, public transit systems are only viable when the entire journey, including stops, vehicles, and the pedestrian pathways connecting them, is entirely step-free. While equitable mobility is a core pillar of sustainable urban development, current transport planning often fails to reflect the lived realities of mobility-impaired individuals.

2. Problem Statement

Existing accessibility studies exhibit three critical shortcomings:

- **The "Average Traveler" Assumption:** Most models assume a non-disabled traveler, ignoring the significant physical barriers faced by those with mobility impairments.
- **Data Incompleteness:** Studies heavily rely on official transit and municipal data, which frequently lack accurate, up-to-date information on wheelchair accessibility.
- **Lack of Comparative Analysis:** Current research is typically siloed by region or by specific transit agencies, rarely offering standardized comparisons across cities globally.

3. Research Objectives

This thesis aims to address these gaps by developing an open, reproducible computational pipeline that measures step-free accessibility to essential services in cities worldwide. The primary objectives are to:

1. Establish a globally scalable methodology to evaluate public transport data readiness for step-free routing.
2. Quantify the "accessibility gap" between standard transit networks and step-free transit networks across multiple international cities.
3. Develop a rigorous uncertainty model that explicitly accounts for and validates the presence of missing or inaccurate official accessibility data.

4. Methodology

The research will be conducted through a three-phase pipeline:

- **Phase 1: Global Data Screening and Ingestion**
  The study will initially screen 100 to 200 candidate cities worldwide to identify locations with usable data infrastructure. This involves processing public timetable feeds (GTFS), specifically querying wheelchair accessibility fields, integrating OpenStreetMap (OSM) data for pedestrian pathways, and mapping global urban boundary and population density layers.

- **Phase 2: Comparative Network Analysis**
  For cities that pass the initial data screening, travel-time accessibility to essential services will be computed across two distinct network models: a standard routing network and a strictly step-free network. The performance divergence between these two networks will be calculated and expressed as an *accessibility ratio*. Crucially, this ratio will include constructed uncertainty ranges to explicitly account for missing or ambiguous data points in the GTFS and OSM feeds.

- **Phase 3: Empirical Validation via Street-Level Imagery**
  To validate the official data and establish reliable error rates, the methodology will incorporate visual verification. Using a stratified sampling approach, open-source street-level imagery will be analyzed to manually assess the physical presence and condition of curb ramps, leveled pathways, and stop access, and cross-reference these ground-truth observations with the official transit data.

5. Expected Contributions

This research will deliver tangible academic and practical outcomes, including:

- **A Scalable Methodology:** A thoroughly documented pipeline capable of evaluating step-free accessibility far beyond standard European or North American contexts.

- **Global Data Readiness Assessment:** The first comprehensive global picture of how prepared municipal transport data is for accessible, inclusive routing.

- **Open-Source Deliverables:** Publication of the underlying code and all derived datasets to foster future research and allow civic tech developers to build better, more inclusive routing applications.

- **Empirical Findings:** A detailed report on which global cities can be accurately compared, the empirical size of the step-free accessibility gaps, and the extent to which these findings are sensitive to municipal data quality.