EXECUTIVE SUMMARY: Mind the (Mobility) Gap!

Figure 14 Visualization of panoptic segmentation from sampled image from CT 48201511100. The values associated with the labels associate a level of confidence in the classification.
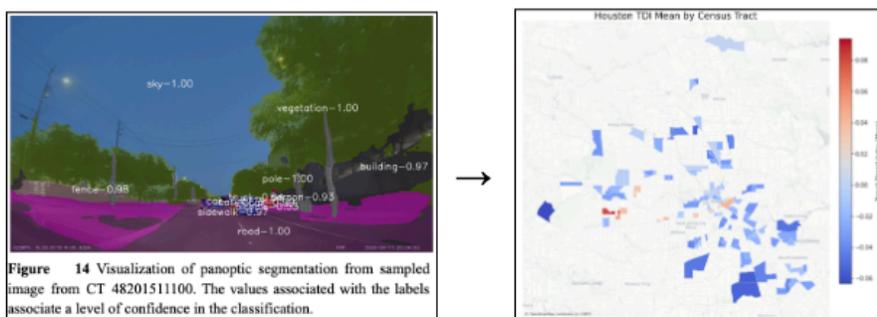
Aims:

This project proposes a novel method to improve fine-grained transit desert identification by integrating Street View Imagery (SVI) and Computer Vision (CV) to capture spatial and infrastructural nuances often overlooked in traditional census- and transit-schedule-based methods. By leveraging SVI-informed deep learning, this study explores a scalable, fine-grained approach to transit accessibility analysis, particularly in data-limited regions.

Background:

Urban mobility shapes socioeconomic equity, yet transit accessibility remains uneven. Existing research, focused on data-rich US cities, often overlooks ground-level barriers and indicators of mobility. Thus, this study integrates visual data analysis to provide a more context-aware approach to transit desert identification.

Methods:

SVI Processing: Collected 50,000+ images from Houston via Mapillary.

Segmentation & Feature Extraction: Used Mask2Former to identify transit-supportive infrastructure and barriers.

Data Integration: Merged SVI-derived features with ACS and census data, analyzing correlations with demographics and transit access.

Transit Desert Classification: Refined classification metrics by incorporating visual complexity and comparing with traditional models.

Results & Outcomes

- *Most* Houston *census tracts are not transit deserts*.
- Urban areas exhibit greater intra-tract variability, indicating tract-level aggregation may obscure local gaps.
- The SVI-based approach consistently yields lower Transit Desert Index (TDI) scores than Jiao's method, suggesting that traditional models may overestimate transit needs.

Conclusions & Recommendations:

- **Refined Analysis:** Future transit equity research should disaggregate spatial analyses to finer units (e.g., street or image level).
- **Contextual Indicators:** Infrastructure like sidewalks, signage, and built environment density should be core to any transit desert definition.
- **Future Work:** Expand the dataset across cities and integrate real-time transit data for dynamic, responsive modeling.

Mind the (Mobility) Gap! Computer Vision for Urban Transit Equity

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Abstract

Access to reliable public transportation is an important determinant of urban mobility and social equity, yet many cities experience transit deserts—areas where public transit fails to meet residents' needs. Traditional methods for identifying transit deserts rely on supply-demand calculations from census data and transit schedules, often overlooking spatial and infrastructural barriers that impact accessibility. This study introduces a Street View Imagery (SVI)-based approach, integrating computer vision and deep learning segmentation to assess transit accessibility at a

finer spatial scale.

Using 50,000+ images from Houston, TX, this research applies Mask2Former segmentation to extract urban features—including sidewalks, transit stops, pedestrian pathways, and road infrastructure—which are then combined with socioeconomic data to refine transit desert classifications. Results reveal that while most census tracts are not transit deserts, specific urbanized areas exhibit greater transit inaccessibility, aligning with prior research but offering a more nuanced, image-based assessment. Additionally, findings show higher transit accessibility variability in these areas, suggesting that transit conditions cannot always be accurately captured at the census tract level.

This study demonstrates both the advantages and limitations of an SVI-based approach, providing a data-driven framework that captures transit accessibility more dynamically than traditional methods, while being more computationally expensive. Future applications could focus on disaggregating transit desert classifications to street-level analyses, integrating real-time transit data, and expanding the methodology to diverse urban environments. By using observational heuristics and machine learning, this research contributes to more thorough and equitable transit planning solutions.

1. Background

1.1 Mobility as a Human Right

Collective human mobility is both a necessity and a human right. We move around every day, whether to commute to work, visit friends and family, or to go on an intercity excursion. Mobility is not only important for an individual's feelings of freedom, it is vital for enabling citizens' socioeconomic mobility and the overall functioning of society (Corwin, 2019).

The ease by which humans can move around is determined by the availability of transit-based technologies and infrastructure. As cities continue to outgrow previously walkable perimeters (Schipper et al., 2020), they require efficient solutions to uphold the mobility of citizens. Unfortunately, this is not an easy task.

Planning for mobility is complex, and must be analyzed at multiple levels to understand the mechanisms shaping urban movement. At the governmental and policy level, city-wide policies, infrastructure investments, and transit regulations define broad patterns of accessibility (Torres & Jesus, 2021). At the community level, neighborhoods, land use planning, and social behaviors influence how transportation systems are adopted and sustained. Finally, at the individual level, daily choices—such as whether to drive, take public transit, or walk—are shaped by convenience, affordability, and psychological perceptions of mobility.

Additionally, how we choose to map mobility—what we define as the fundamental unit of movement—determines not only our level of analysis