Big Data and AI for Urban Mobility

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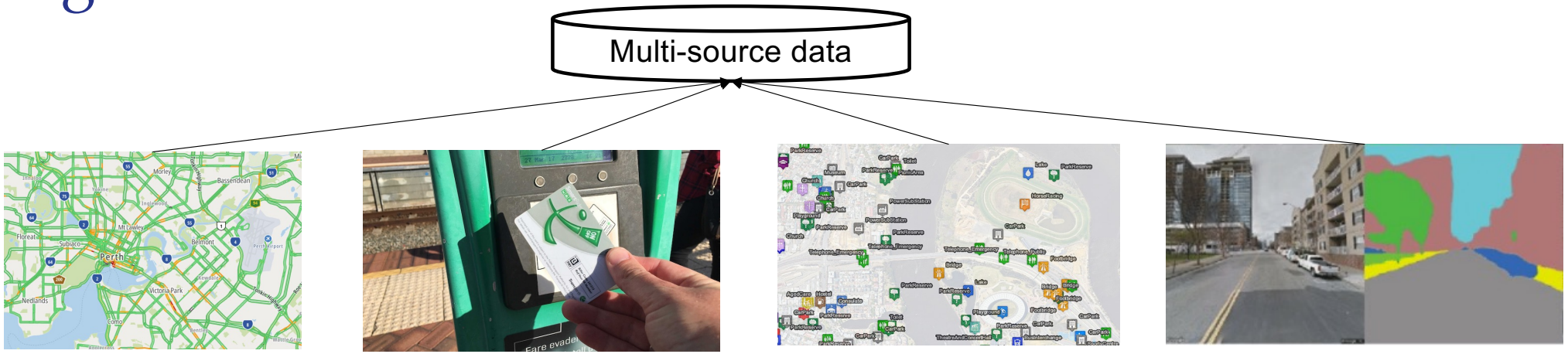
Key Challenges in Urban Mobility

Easy Access

Traffic Safety

These challenges highlight the urgent need for innovative urban mobility solutions that prioritize accessibility and safety.

Big Data

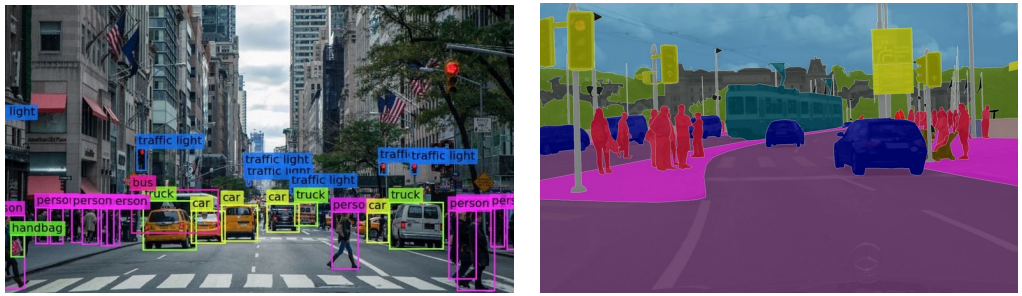


Advantages of Big Data:

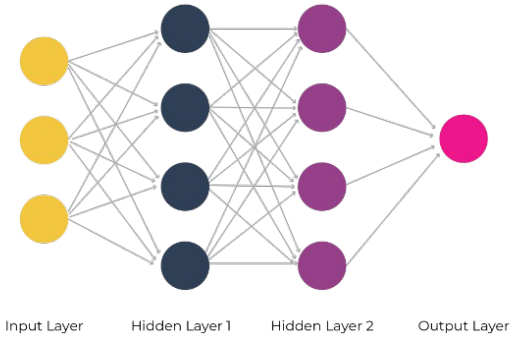
- Real-time data collection
- Comprehensive and large-scale data
- Dynamic analysis

Integrating diverse data sources enables smarter, data-driven urban mobility decisions.

The Role of AI



Computer Vision



Data-driven Modeling

Advantages of AI:

- Automates the extraction of built-environment and mobility features
- Models complex and non-linear relationships
- Supports prediction and evidence-based decision-making

Big data provides the foundation, and AI supports actionable insights.

Two Case Studies

Walkability for Elderly People

Crash Analysis

Study 1: 15-Minute Community Life Circle

Why study this topic?

- The 15-min community life circle (CLC) is widely discussed in urban planning globally (e.g., China, Europe).
- Over 21.1% of China's population is over 60 years old.
- Walking is a fundamental mode of transit for older adults.

Key research questions:

- How to measure walkability in urban communities?
- Which factors influence walkability (e.g., services, environment)?

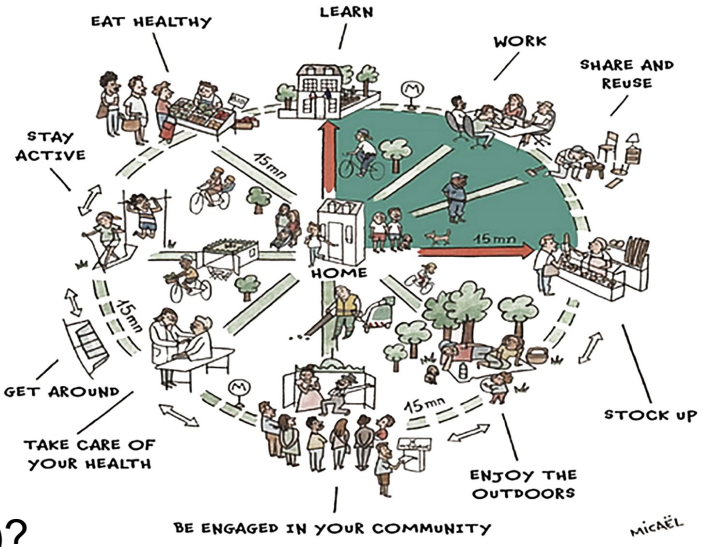
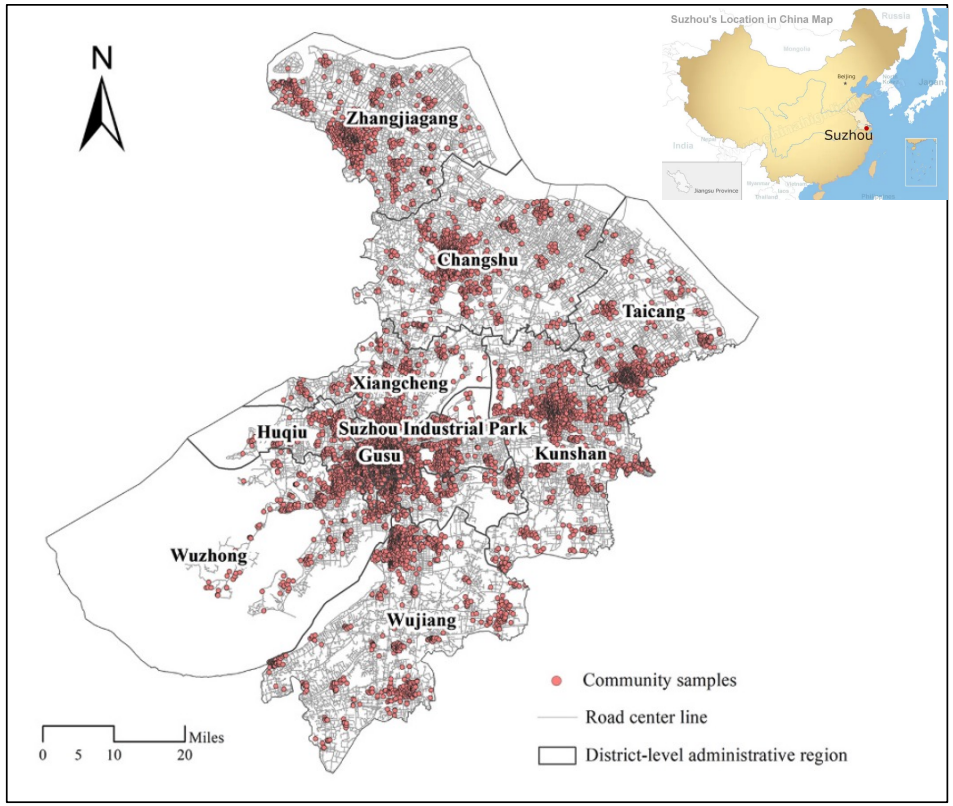


Illustration of the 15-Minute CLC

Jiang, Z., Wu, C., & Chung, H. (2025). The 15-minute community life circle for older people: Walkability measurement based on service accessibility and street-level built environment–A case study of Suzhou, China. *Cities*, *157*, 105587.

Study 1: Study Area and Data

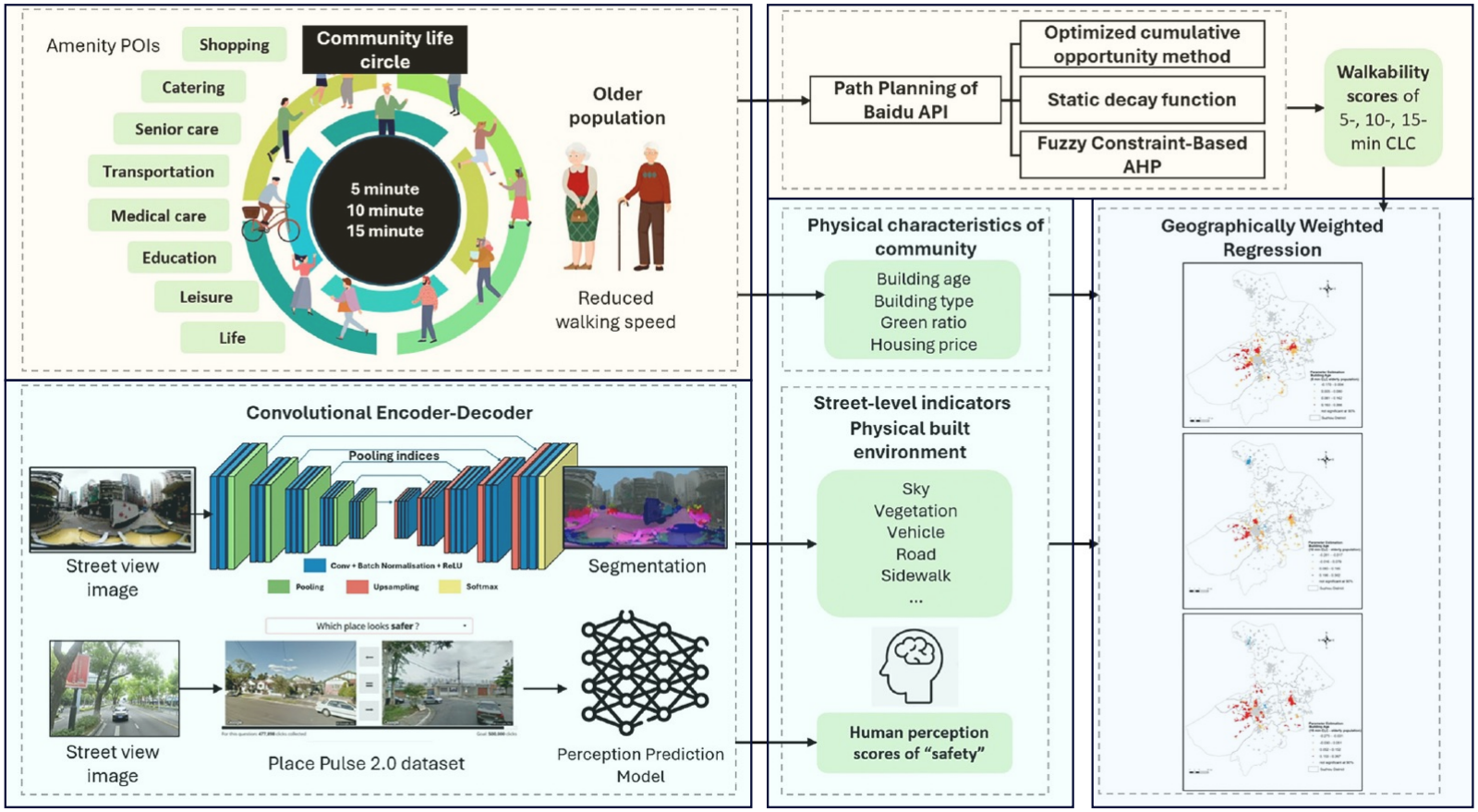


Suzhou, China

Data Sources:

- ❑ Points of Interest (POIs): Life services, transportation, medical care, senior care.
- ❑ Community Characteristics: Building age, housing price and types.
- ❑ Street View Images: Extracted for environment features.

Study 1: Methodology

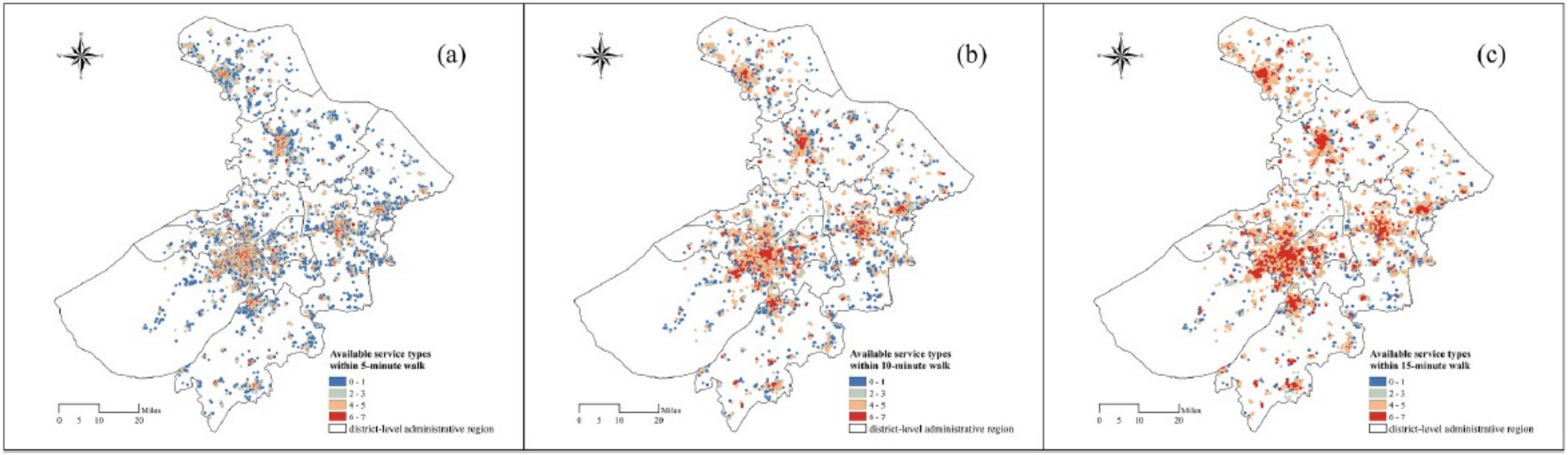


Research Framework

Study 1: Key Findings

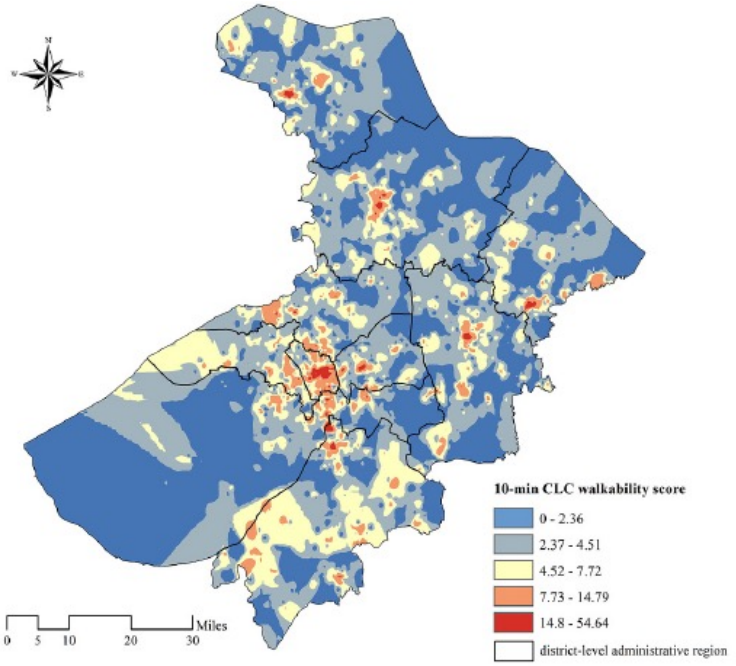
Service Coverage:

- 15-minute coverage is good overall.
- Significant gaps in 10-minute coverage, especially senior care.



Available service types within 5-,10-, and 15-min CLC for older people.

Study 1: Key Findings



Spatial distribution of walkability scores

Walkability Scores

- Walkability scores showed spatial heterogeneity and a multi-core distribution pattern.
- Most (69%) of the communities scored below 10, revealing a significant imbalance in facility configuration.

Study 1: Key Findings

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Results of Global Regression

Variables	15-min CLC		VIF
	Coef.	P-value	
Intercept	−34.538	0.000	
Community-level variables			
Building age	0.137	0.000	1.25
Building type	0.124	0.228	1.15
Green ratio	−0.057	0.000	1.19
Housing price	0.029	0.000	1.34
Human perception variable			
Safety scores	1.393	0.000	1.85
Street-level environmental variables			
Sky	−46.097	0.000	3.55
Sidewalk	76.162	0.000	1.15
Road	−32.669	0.000	2.56
Vehicle	182.771	0.000	1.90
Vegetation	−20.006	0.000	2.12
	0.419		
Adjusted	0.418		
AICc/AIC	37,369.112		

Influential Factors

- Street-level characteristics (e.g., greenery, road quality and perceived safety) significantly influence walkability.
- Excessive vegetation can reduce facility density, affecting accessibility.

Study 2: Spatiotemporal Crash Analysis

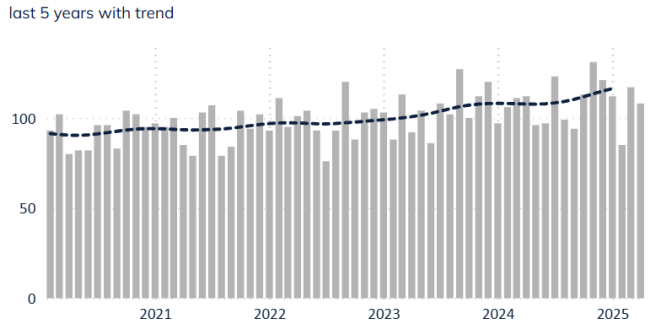
Why study this topic?

- Road deaths remain high despite Vision Zero goals in Australia.
- Limited resources require smarter investment in road safety.
- Current studies lack spatial and temporal insights to guide targeted planning.

Key research questions:

1. How does crash density vary spatially across the city?
2. Do the spatial effects of these factors differ across time?
3. How can spatial-temporal variation in crash density guide more targeted infrastructure investment?

Monthly Road Death in Australia



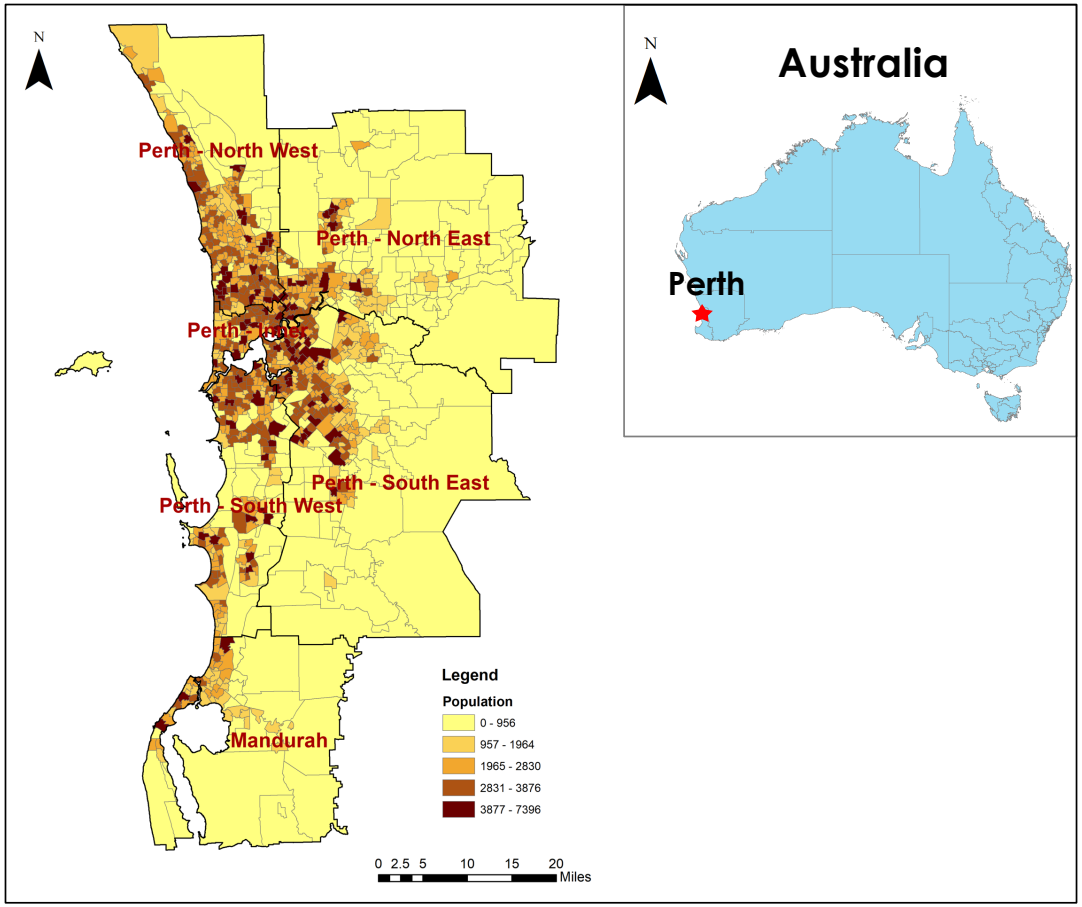
Source: Department of Transport, Australia (2025)

Wu, C. (2025). Spatiotemporal Effects of Road Infrastructure on Crash Densities in Greater Perth, Australia. In *57th Universities' Transport Study Group (UTSG) Conference*.

Study 2: Study Area

Urban Context

- Location: Greater Perth, Australia
- Population: 2.1 million
- Area: 6,400 km^2
- Urban Form: low density, car-dominated city
- Road infrastructure varies across subregions in terms of density, connectivity and control types



Greater Perth, Australia

Study 2: Methodology

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Data Collection → **Variable Construction** → **Spatial Analysis**

- Crash Data
- Population Data
- Traffic Sign
- Road Network
- Points of Interest
- Public Transport Stop

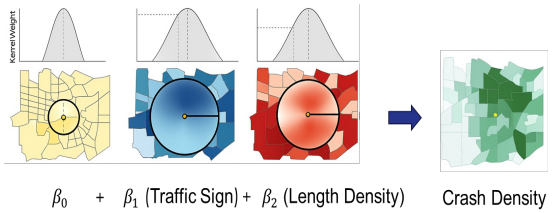
Crash Outcome
- Crash Density (Day/Night)

Road Network and Structure
- Road Length Density
- Intersection Density
- Roundabout Density
- Average Degree

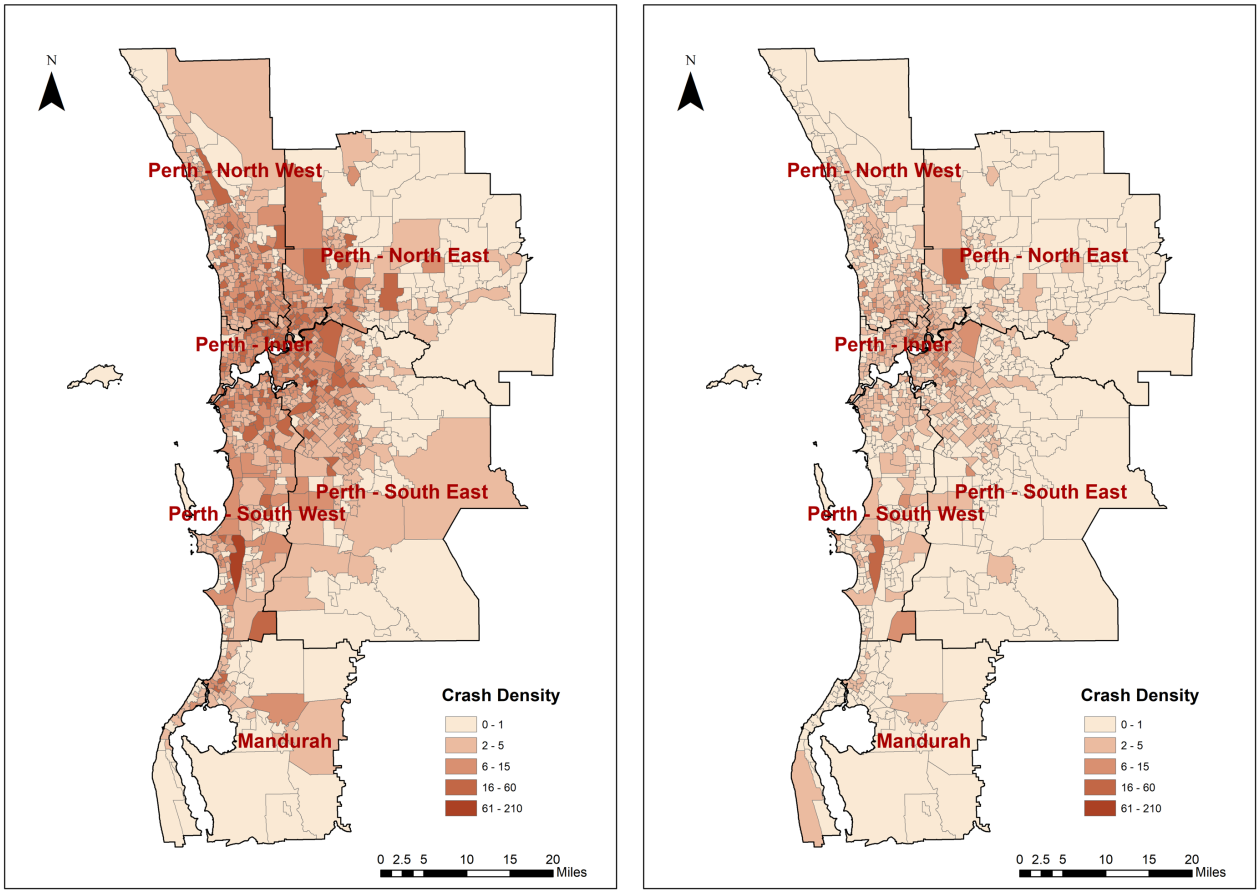
Traffic Control Features
- Traffic Signal Density
- Stop Sign Density
- Give-way Sign Density
- Speed limit Sign Density

Demographic and mobility exposure
- Population Density
- Bus Stop Density
- POI Density

Multiscale Geographically Weighted Regression



Study 2: Results



Spatial Distribution of Crash Density (Day vs Night)

Key Findings

- Daytime crashes are denser in urban areas.
- Night crashes are more evenly distributed and lower in density.
- High day-night contrast reflects varying effects of road infrastructure under different traffic conditions.

Study 2: Results

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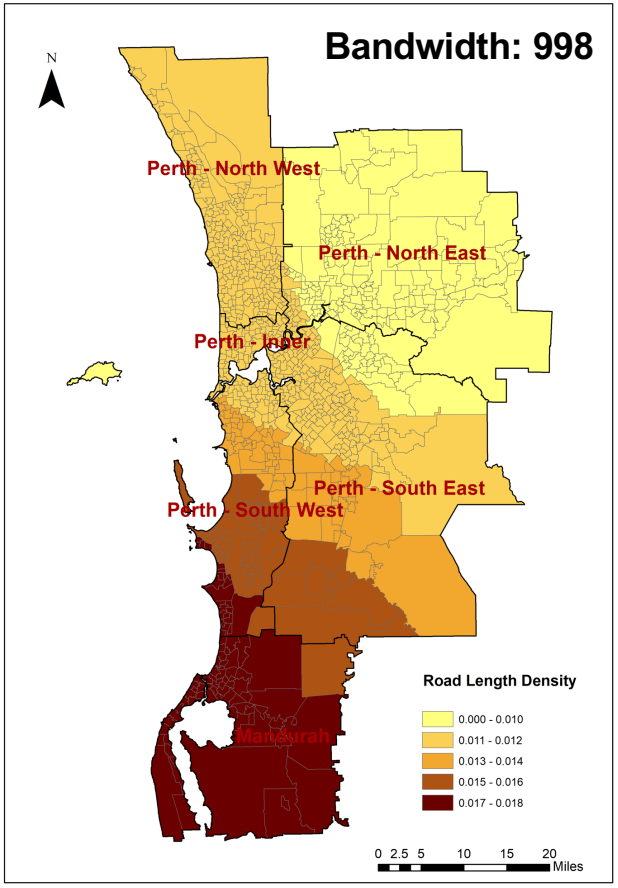
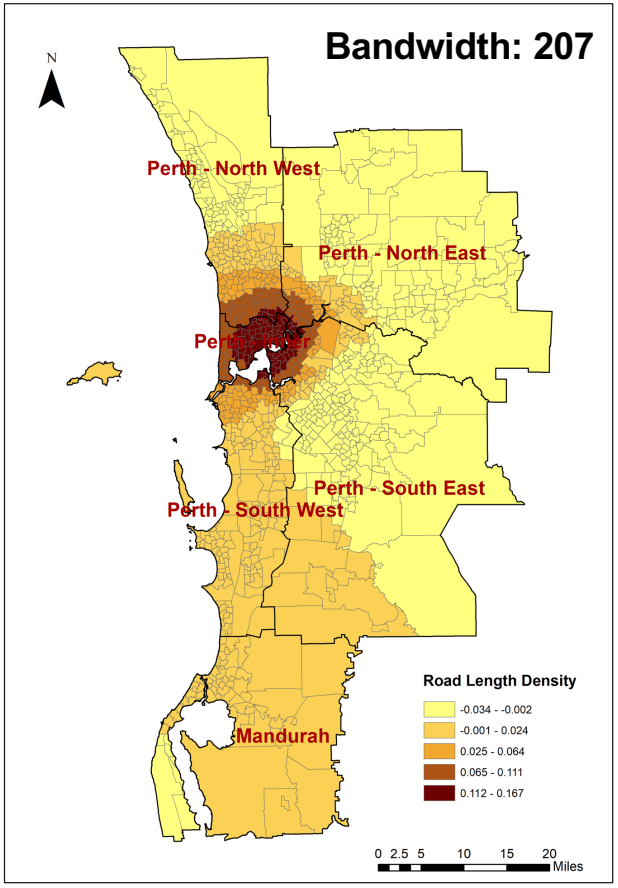
Standardized OSL Coefficients – Day vs Night

Variable	β (Day)	p (Day)	β (Night)	p (Night)	Direction Change
Road Length Density	0.001	0.967	0.051	0.027 *	No
Intersection Density	0.081	0.003 *	-0.052	0.031 *	Yes
Roundabout Density	-0.097	0.000 *	-0.017	0.367	No
Average Degree	0.110	0.000 *	-0.005	0.788	Yes
Traffic Signal Density	0.455	0.000 *	0.343	0.000 *	No
Stop Sign Density	0.113	0.000 *	0.021	0.277	No
Give-way Sign Density	0.047	0.069	-0.096	0.000 *	Yes
Speed limit Sign Density	0.104	0.000 *	0.018	0.309	No
Population Density	-0.030	0.302	-0.081	0.002 *	No
Bus Stop Density	0.027	0.338	0.386	0.000 *	No
POI Density	-0.024	0.285	0.048	0.015 *	Yes

Study 2: Results



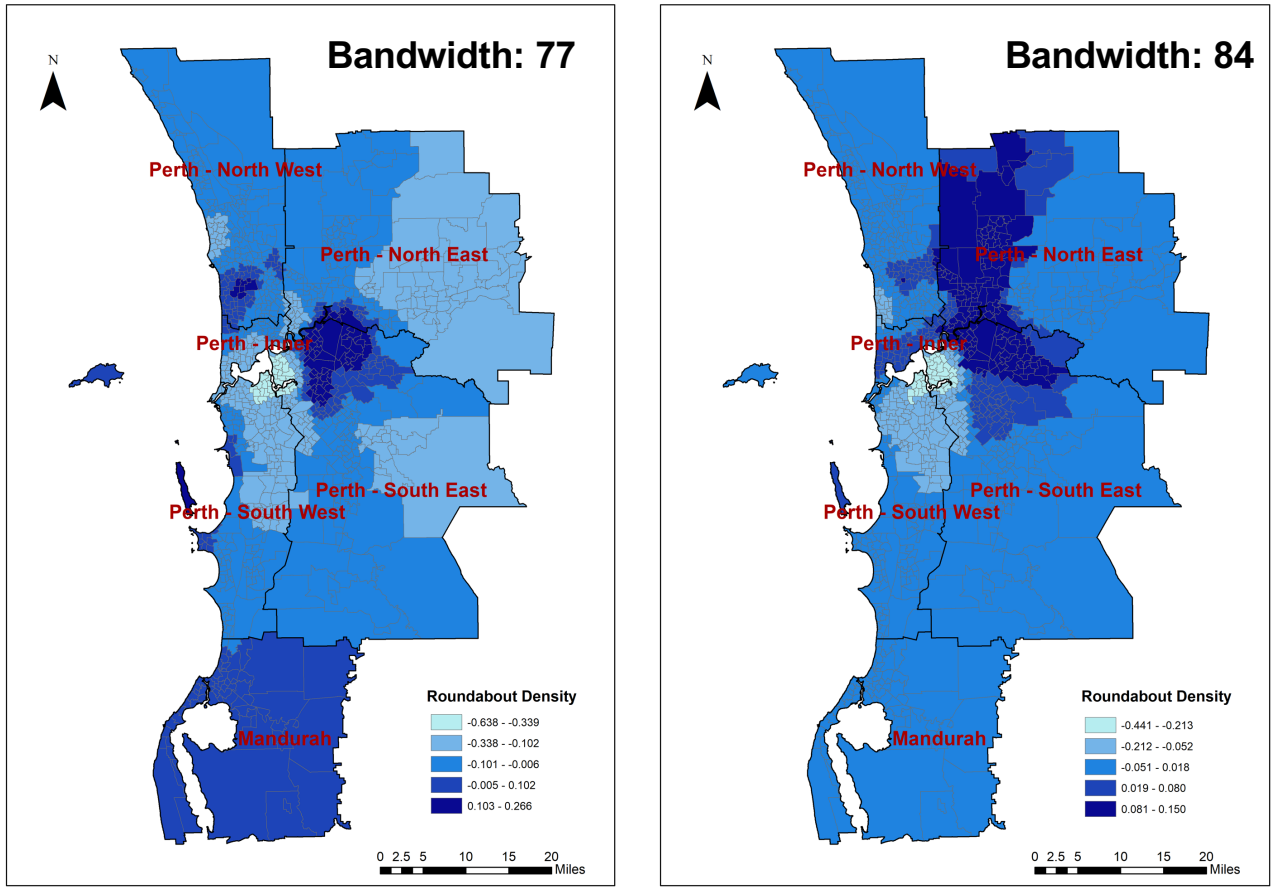


Key Findings

- Nighttime crash density is more sensitive to road length density in central Perth.
- Daytime effects are more uniform, while nighttime impacts are highly localized.

Spatial Distribution of the Estimated Coefficient for Road Length Density (Day vs Night)

Study 2: Results



Key Findings

- Roundabout density shows a negative association with crash density, especially during daytime in central Perth.
- At night, the negative effect of roundabout density becomes weaker and more dispersed.

Spatial Distribution of the Estimated Coefficient for Roundabout Density (Day vs Night)

Let's work together to build safer and more sustainable cities!

Thank You

Q&A

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