Yunlong Liu

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Research Interests: Urban Analytics, Digital Twin, Graph Neural Network, Multimodal Fusion, Large Language Model

Education

Southeast University, Nanjing, China Sep 2023 – Jun 2026
M.Arch in Urban Design, GPA: 3.7/4.0
Relevant Coursework: Programming Fundamentals for Architecture (90), Big Data Methods and Applications in Urban Planning (92), Urban Big Data Analysis and Intelligent Applications (91), Digital Technology Applications in Historic Environments (90)

Shandong Jianzhu University, Jinan, China Sep 2018 – Jun 2023
B.Arch in Architecture, GPA: 3.3/4.0
Relevant Coursework: Advanced Mathematics (91), Computer Fundamentals (92)

Research Experience

National Key R&D Program of China — Automatic generation and optimization of city-scale green performance models Nov 2024 – Present
Graduate Research Assistant

- **My Role:** Designing system architecture and integrating optimal models for multimodal data integration
- **Method:** Building LLM-enhanced urban knowledge graph to structure heterogeneous data, then training GNN on this graph to extract node features for urban performance prediction and optimization
- **Progress:** Completed initial framework design and data preprocessing pipeline, currently optimizing model performance at city scale

Independent Study: SAM-GPT semantic enhancement framework for street view imagery analysis Nov 2024
Self-directed Research

- **Contribution:** Developed framework addressing LLM inaccuracy in object localization for urban analytics
- **Method:** Integrated SAM's panoptic segmentation masks as spatial guidance for GPT models to improve object recognition accuracy
- **Achievement:** Achieved significant improvement in LLM object description accuracy; framework adopted by research colleagues for Architectural Society of China 2025 Annual Conference presentation

Master's Thesis Research: Multimodal data fusion for urban carbon emission simulation model — A case study of Nanjing Apr 2024 – Present
Independent Research under Prof. Yu Zhang

- **Contribution:** Designing multimodal fusion framework for city-scale carbon emission prediction, focusing on Nanjing as case study
- **Method:** Developing multimodal fusion strategy integrating meteorological time series, remote sensing, and statistical data with attention mechanism optimization
- **Progress:** Completed data collection from four modalities and framework design; implementing attention mechanism and model training

Publications

Y. Liu and Y. Zhang, "Decoding the 24-hour city: A framework for cross-domain impact prediction integrating knowledge graph and graph neural network," accepted for oral presentation at *the 59th ISOCARP World Planning Congress*, Riyadh, Saudi Arabia, Dec. 2025. **[Oral presentation forthcoming]**

- **Contribution:** Developed novel framework combining knowledge graphs and GNNs to integrate multimodal urban data (remote sensing, GIS, energy consumption) for predicting impacts across three urban sectors

- **Method:** Built urban ontology for data integration, constructed semantically-enriched knowledge graph, and implemented semantic-aware GNN for cross-domain reasoning
- **Achievement:** Achieved about 20% improvement in cross-domain prediction accuracy, enabling planners to anticipate cascading policy effects across urban systems

Y. Liu, S. Li, P. Liu, Y. Zhang, and R. Stouffs, "From pixels to predicates: Structuring urban perception with scene graphs," abstract accepted at *31st International Conference of CAADRIA*, 2026. **[Abstract accepted; Full paper submitted]**

- **Contribution:** Developed scene graph-based framework transforming street view imagery into structured relational data, bridging gap between low-level pixel analysis and high-level semantic understanding in urban analytics
- **Method:** Applied PSGTR model to extract scene graphs from SVIs, then trained Heterogeneous Graph Autoencoder (HeteroGAE) with unsupervised pre-training on the Place Pulse dataset (1.2M images) to learn relational embeddings; validated generalization on New York and Chicago street view datasets
- **Achievement:** Identified novel micro-scale urban patterns through relational analysis, discovering safety-perception correlations like "(graffiti)-[painted on]->(wall)" that are undetectable by conventional pixel-based methods; demonstrated robust cross-city transferability

Y. Tang, **Y. Liu**, P. Wang, J. Yin, S. Li, P. Liu, L. Li, P. F. Yuan, and R. Stouffs, "Chinese superblocks regeneration: Street network learning with an edge-centered unsupervised graph neural network," abstract accepted at *31st International Conference of CAADRIA*, 2026. **[Abstract accepted]**

- **My Role:** Developed edge-centered unsupervised GNN framework analyzing 7,000 street segments across seven Chinese cities for superblock regeneration
- **Method:** Constructed ego-graphs with 250m buffer zones using route structure theory, employed multi-layer GCNs with contrastive learning to generate 128-dimensional embeddings
- **Achievement:** Identified four distinct structural types (accessibility hubs, transitional connectors, inward-facing branches, peripheral buffers) enabling targeted regeneration strategies and cross-city transfer

Y. Liu and Y. Zhang, "Research on regional urban development level based on club convergence phenomenon: A case study of the Yangtze River Delta urban agglomeration," in *Proceedings of the China Urban Planning Annual Conference*, June 2024. **[Published]**

- **Contribution:** Analyzed regional urban development patterns in Yangtze River Delta using club convergence theory
- **Method:** Applied Markov transition matrix and spatial Markov chain analysis to examine urban development trajectories and spatial spillover effects
- **Achievement:** Identified "poverty trap" risks in western cities while eastern cities showed higher upward mobility, providing strategic insights for regional policy

Technical Skills

Programming & ML: Python, Git, Graph Neural Networks, Deep Learning
Spatial Analysis & Data Processing: GIS (QGIS, ArcGIS), Remote Sensing, Multimodal Data Fusion, Knowledge Graph
Languages: Mandarin Chinese (native), English (fluent)

Academic Activities & Honors

Participant, DigitalFutures Workshop – Habitat Representation: Graph Neural Networks for Urban Examination and Urban Design, Tongji University, 2025

Participant, DigitalFutures Workshop – Computational Design with shape Grammar, Tongji University, 2023

Participant, Southeast University–University of Pennsylvania Joint Summer Workshop, 2024

First Prize, University-level Regional Planning and Design Project — Shunde Village Redevelopment, 2024

Academic Merit Scholarship, Southeast University, 2023, 2024

Outstanding Bachelor's Thesis Award, Shandong Jianzhu University, 2023