

AI for Transportation: From concepts to implementation

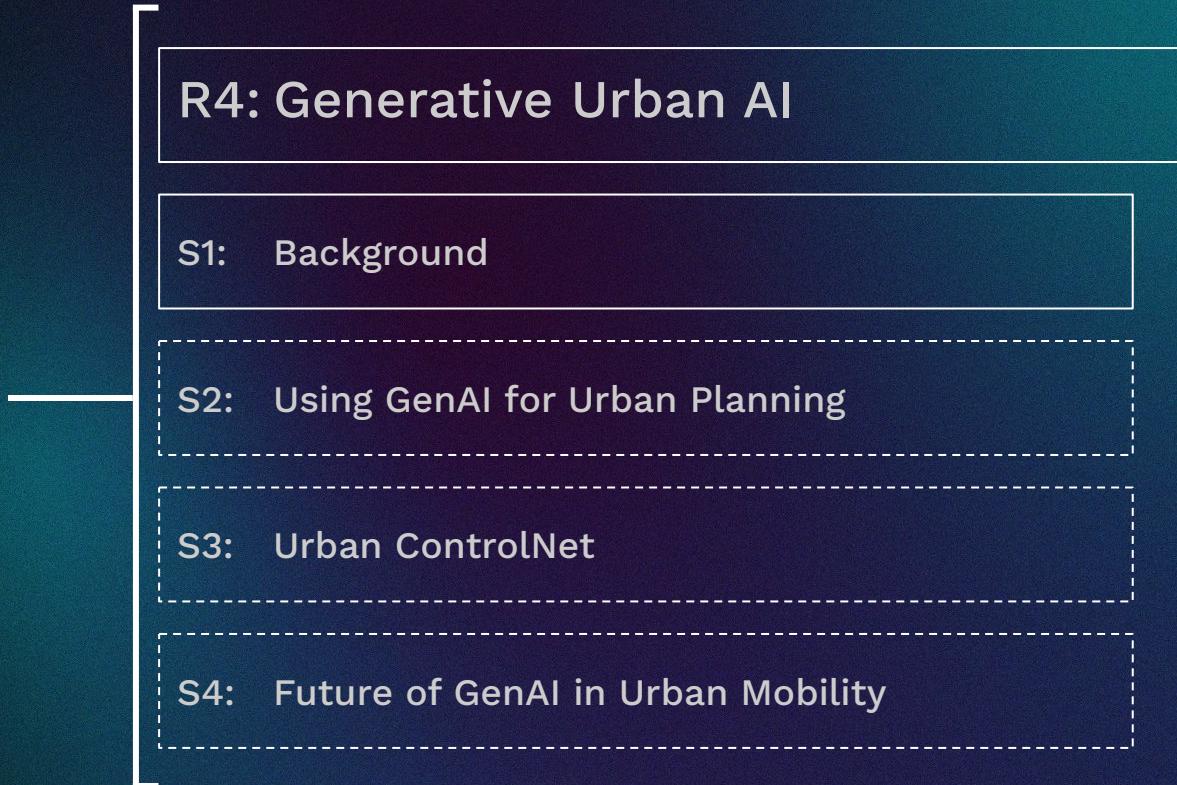


Recitation 4: Generative Urban AI

AI for Transportation

- R1: Introduction
- R2: Discrete Choice Modeling
- R3: Multimodal Machine Learning
- R4: Generative Urban AI**

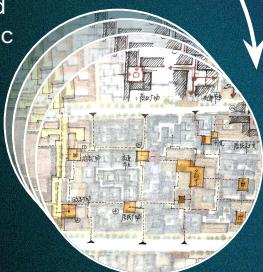
AI for Transportation



**Urban design is
iterative, labor-intensive,
time-consuming.**

**Design
Objectives
+
Existing
Constraints**

infrastructure, natural environment, and sociodemographic



**Design
Drafts**

**Adjusted
Design Strategies
+
Objectives**

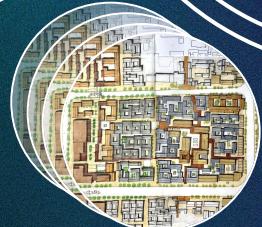
Public Engagement

Communicate with a multitude of stakeholders for feedback and iteration, including local government, community residents, urban planners, and real estate developers

Design Proposal

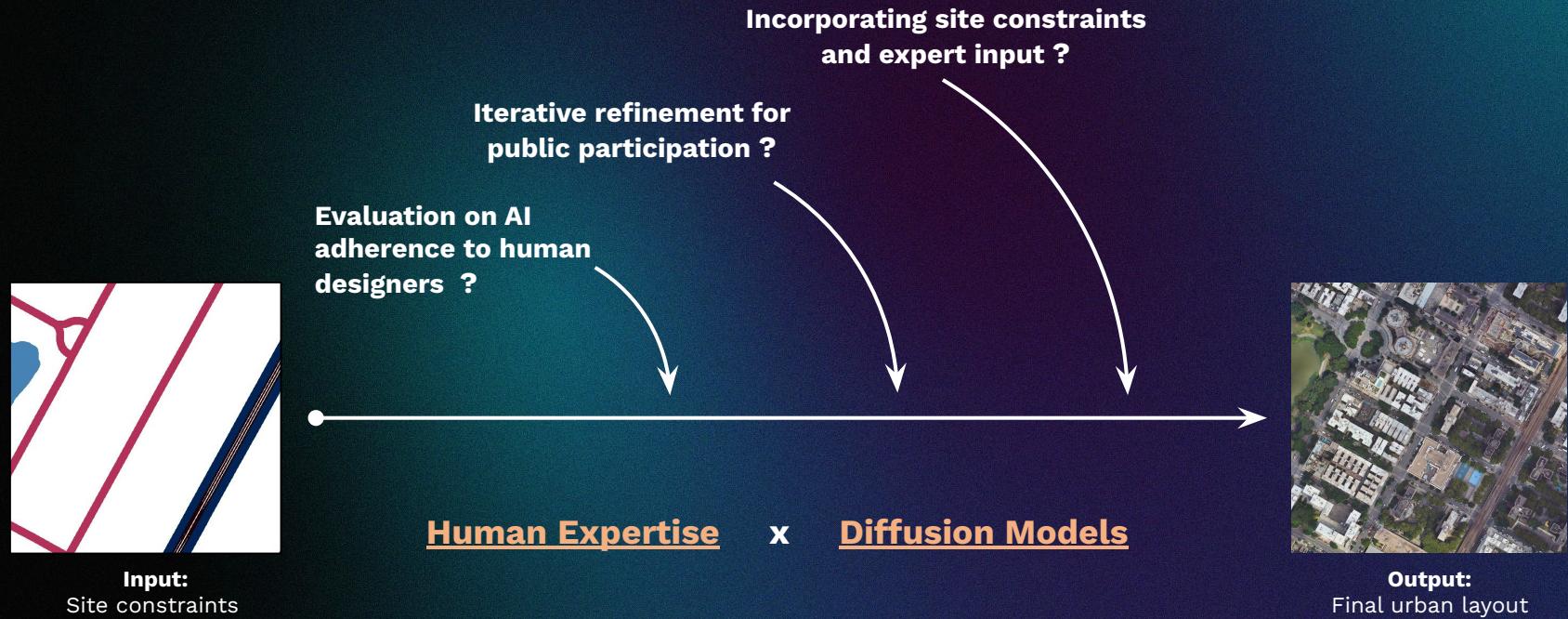
Visualize urban landscapes, which provide intuitive perspectives to the non-experts

Final Design Proposal



**Design
Schemes**

GenAI has potential to enhance design efficiency, support participatory design...



Generative AI: A new paradigm

1. **Text, images, audio, and video**

- a. Currently most promising approaches: Transformer- and Diffusion-based

2. **Directly applicable to urban planning and transportation**

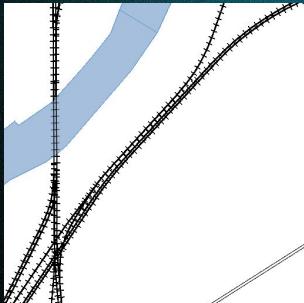
- a. Imagining new environments
- b. Processing big data
- c. Creating transportation data
- d. Knowledge production

Emergent Capabilities

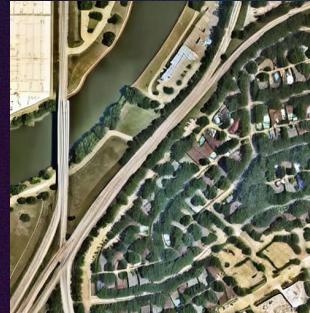
Descriptions

City in {city name}
40% residential
15% industrial,
15% commercial,
10% park,
5% open parking.
All houses.
Medium building coverage.

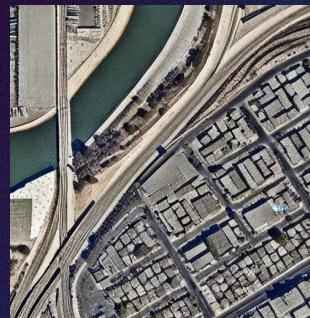
Constraints



Chicago



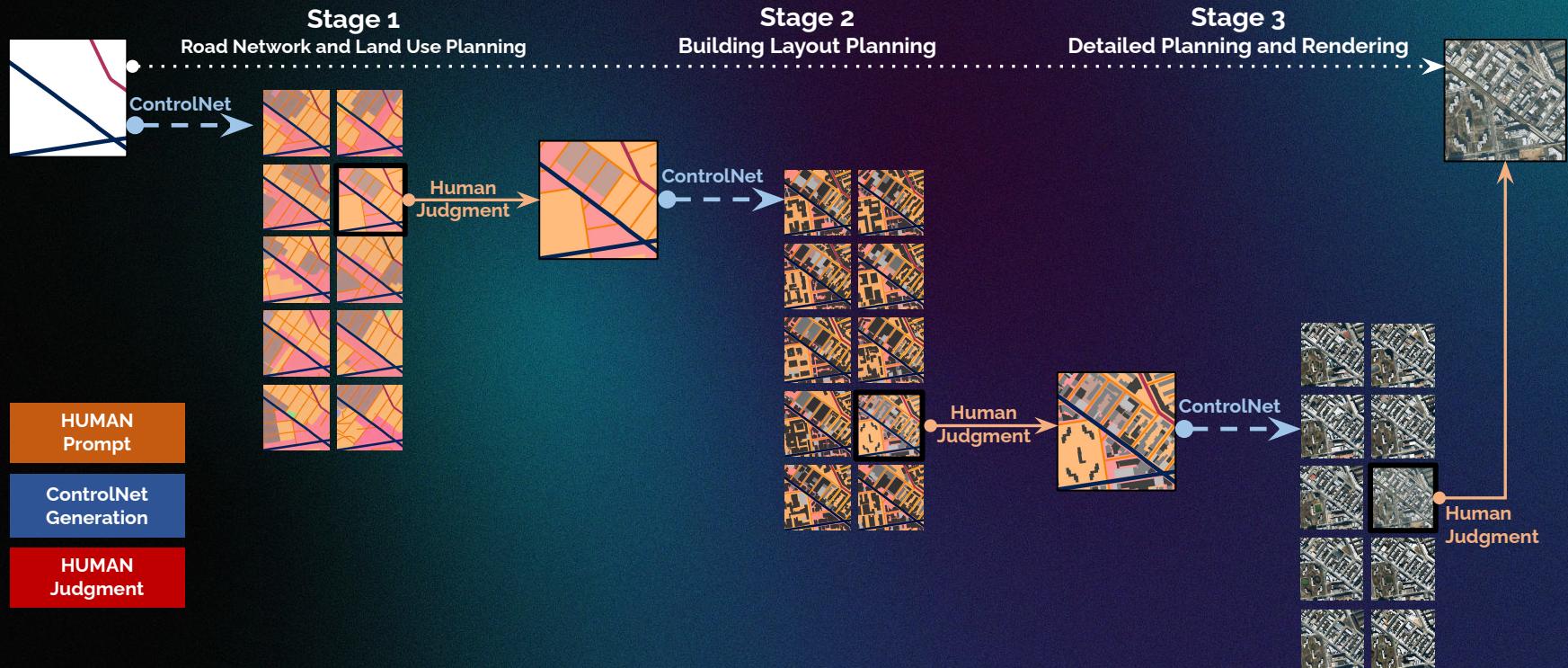
Dallas



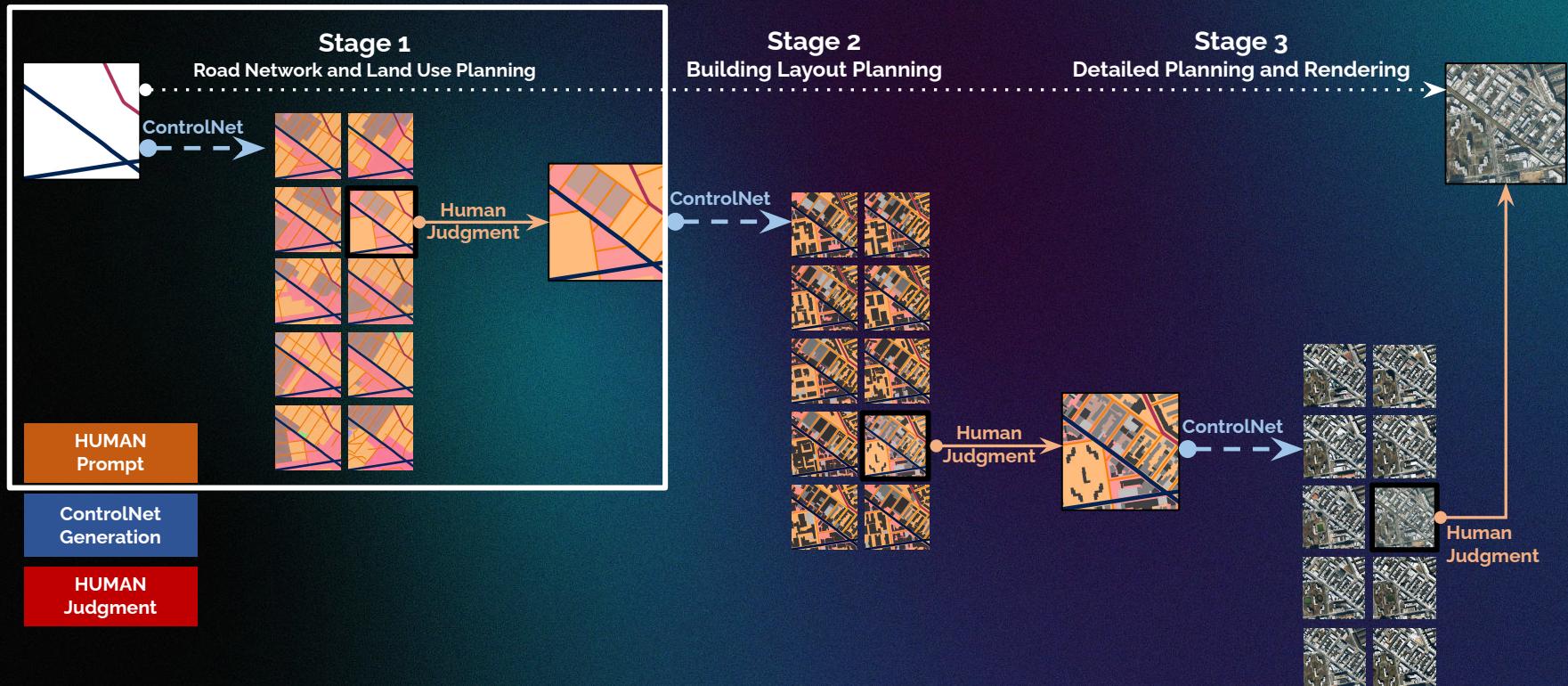
Los Angeles

7

Multi-stage guidance for inferenceç



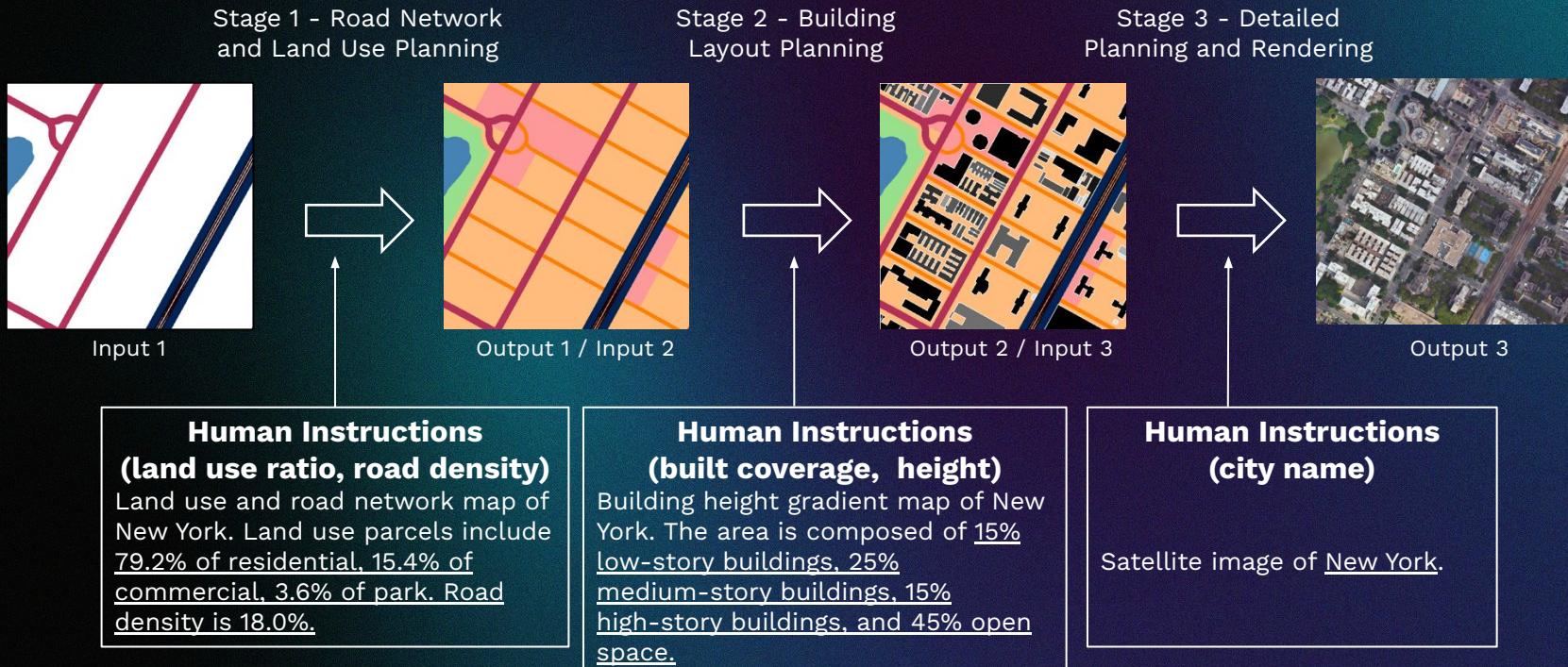
Multi-stage guidance for inferenceç



AI for Transportation



Integrating Human Expertise with Diffusion Models



Data collection and generation

Study Area:

- New York City
- Chicago

Data Source:

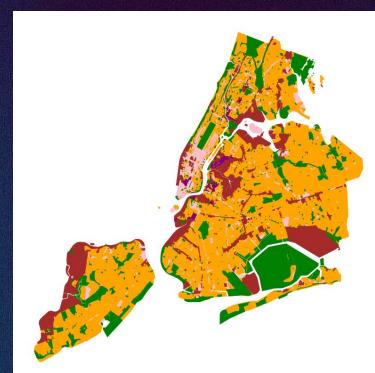
- OpenStreetMap (OSM)
- City official data hub



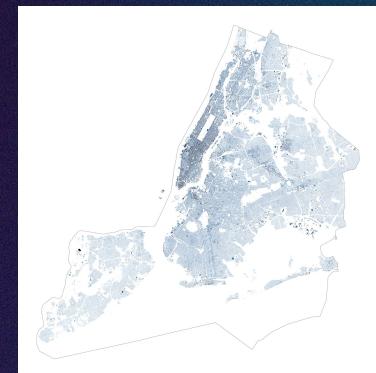
Basic data



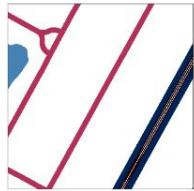
Road network data



Land use data

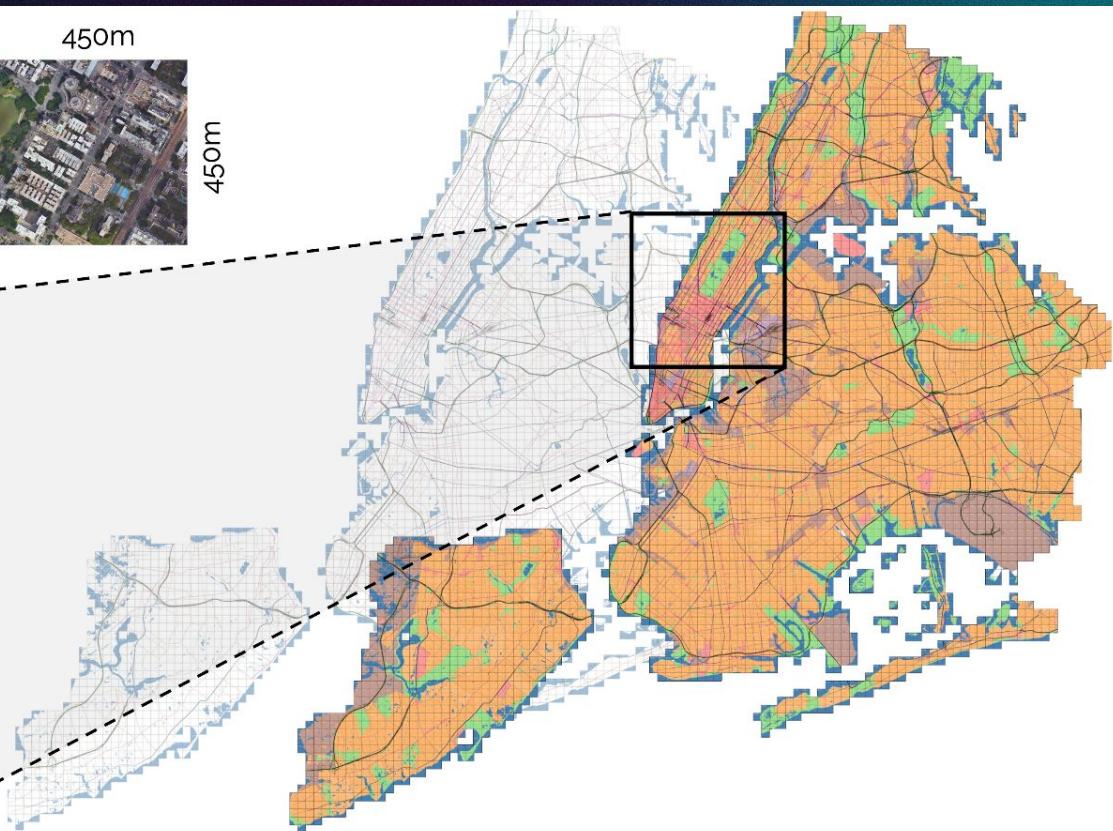
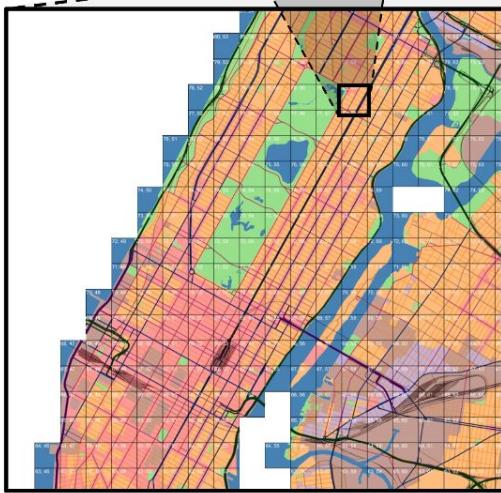


Building height data



450m

450m



AI for Transportation

R4: Generative Urban AI

S1: Background

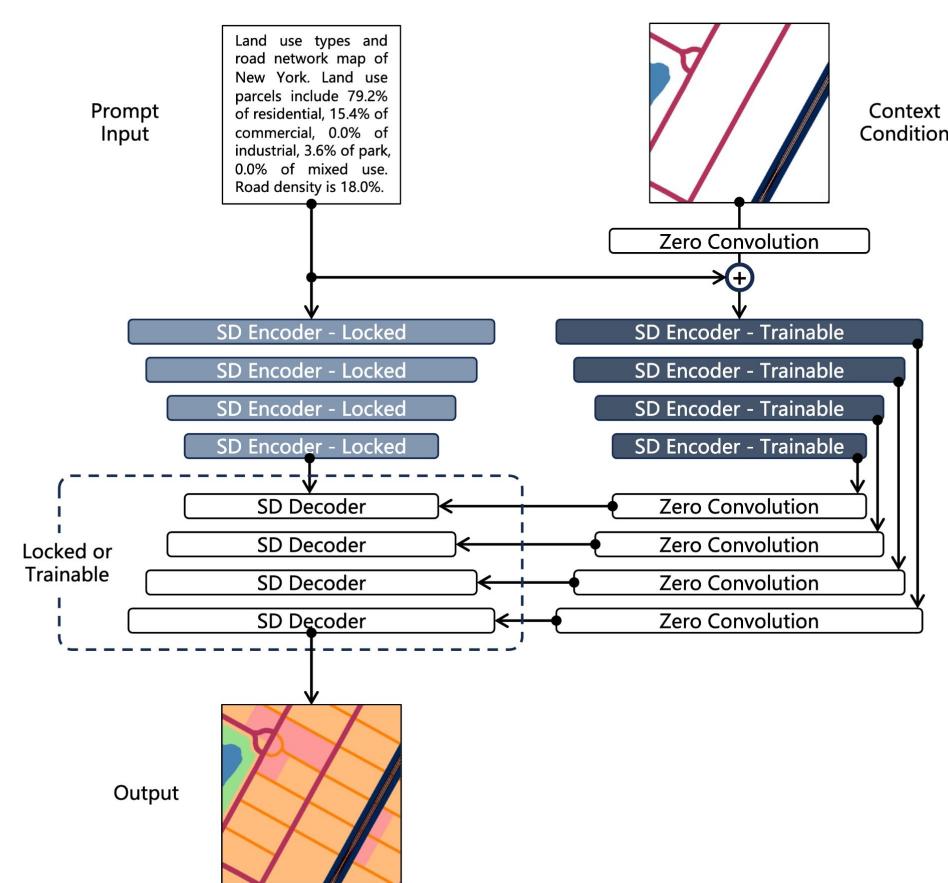
S2: Using GenAI for Urban Planning

S3: Urban ControlNet

S4: Future of GenAI in Urban Mobility

ControlNet

Zhang, Lvmi, Anyi Rao, and Maneesh Agrawala. "Adding conditional control to text-to-image diffusion models." Proceedings of the IEEE/CVF international conference on computer vision. 2023.



Urban ControlNet

Wang, Qingyi, et al. "Generative AI for Urban Planning: Synthesizing Satellite Imagery via Diffusion Models." arXiv preprint arXiv:2505.08833 (2025).

Planning and rendering



Satellite image of a city in New York.

ControlNet **strictly follows the constraint** of the input image while **generating diverse detailed planning**, such as landscape design, rooftop design, etc.



See it in action



AI for Transportation

R4: Generative Urban AI

S1: Background

S2: Using GenAI for Urban Planning

S3: ControlNet

S4: Future of GenAI in Urban Mobility

AI in transportation - Why now?

The **technological maturity** of AI has reached a threshold where industrial-scale deployment is feasible.



Market readiness is evident as investors and companies are placing significant capital behind AI strategies.



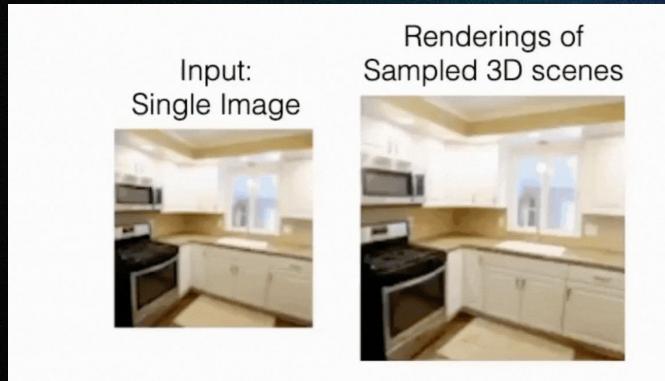
The **societal implications** has never been greater with climate, congestion, safety, and inequities intensifying pressure on governments and companies.



The **policy landscape is in flux** with governments struggling to pass legislation, standards, and frameworks to regulate AI.



New imaging capabilities

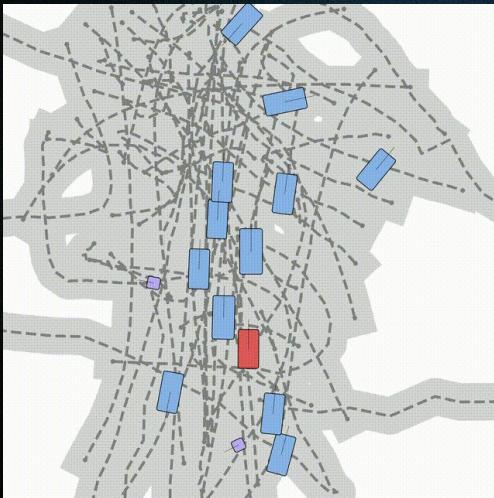


Tewari, Ayush, et al. "Diffusion with forward models: Solving stochastic inverse problems without direct supervision." *Advances in Neural Information Processing Systems* 36 (2023): 12349-12362.



Gao, Ruiyuan, et al. "MagicDrive-V2: High-resolution long video generation for autonomous driving with adaptive control." *arXiv preprint arXiv:2411.13807* (2024).

New scenario generation



Rowe, Luke, et al. "Scenario dreamer: Vectorized latent diffusion for generating driving simulation environments." Proceedings of the Computer Vision and Pattern Recognition Conference. 2025.

... what else is possible?

AI for Transportation

R1: Introduction

R2: Discrete Choice Modeling

R3: Real-World AI Case Studies

R4: Generative AI

AI for Transportation: From concepts to implementation

