Machine Learning Data Set Collection and Analysis for Deep MIMO and DeepSense 6G

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Motivation

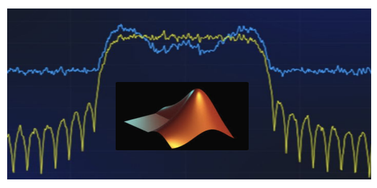
To ensure a successful transition from 5G to 6G, test datasets must be developed to:

- Take advantage of access to broader airwave bands
- Support communication in increasingly complex environments
- Accelerate the development of emerging technologies such as smart cities and driverless cars

Prior Work

Current efforts in this area by other institutions include:

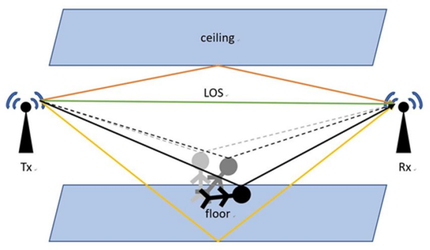
- USC, Information, Inference and Intelligence Group: Cognitive Radio, programmed to use best wireless channels in its vicinity
- NYU, NYU Wireless: Sub-THz and mmWave Channel Simulator in MATLAB and ns-3



Approach

The goal of the WI Lab at ASU and this project is to contribute unique comprehensive models by:

- Focusing on real-world environments
- Using multiple pieces of software to capture both the 'moving' and 'non-moving' parts of an environment
- Creating more indoor scenarios



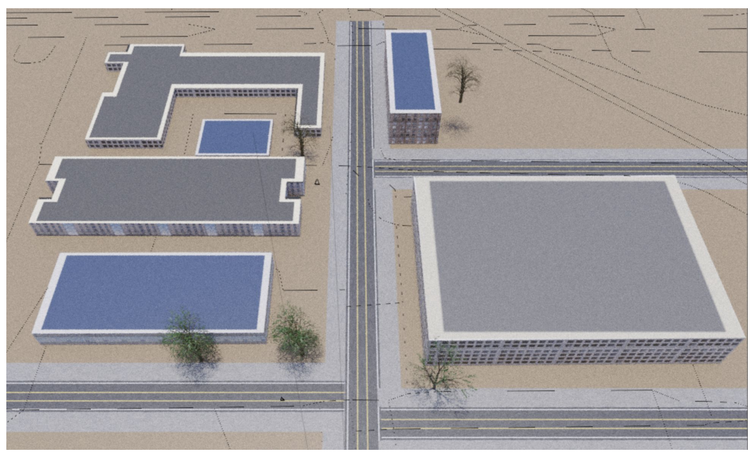
Scenario Development Overview

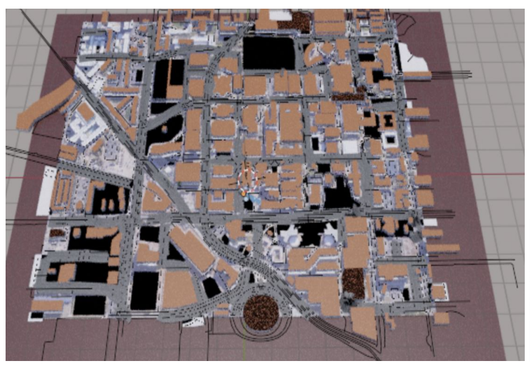
Blender and Carla Software
Non-moving parts of the model
Buildings, Roads, Trees/Greenery
Both textures + shape outlines

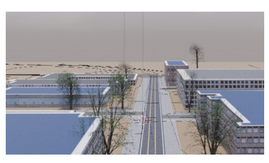
SUMO Traffic Generation
Outdoor models: Vehicle simulation (type of vehicle + movement)
Indoor models: Foot Traffic Simulation

Wireless Insite Ray Tracing
Import roads, buildings, traffic data
Setup transmitters, receivers, base stations

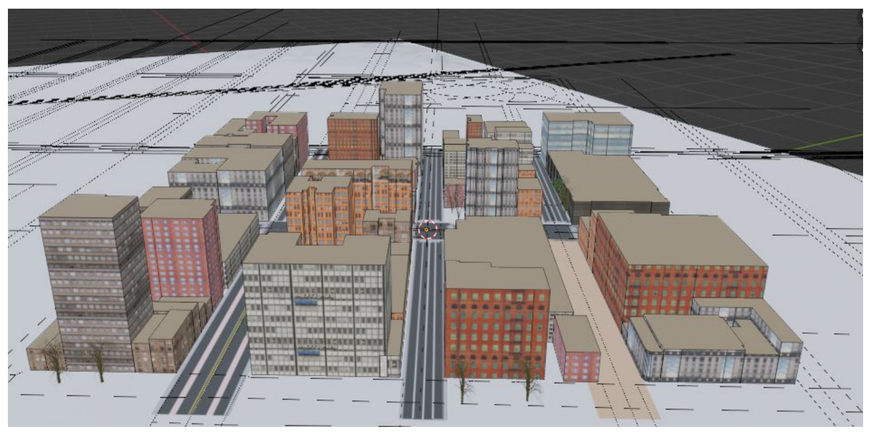
Type 1: ASU Based

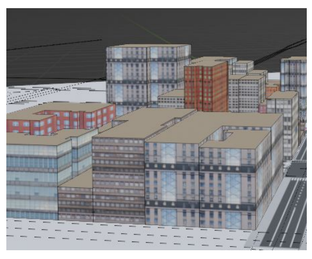




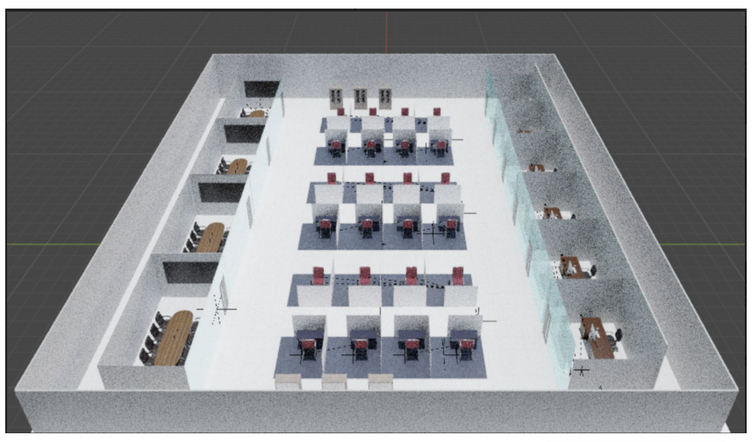


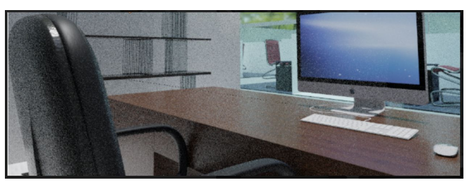
Type 2: Large City Based

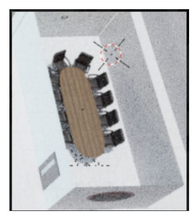


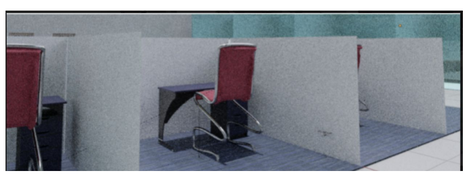


Type 3: Office Based

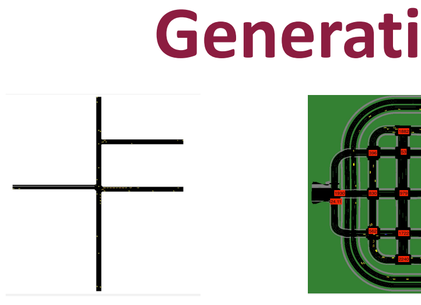


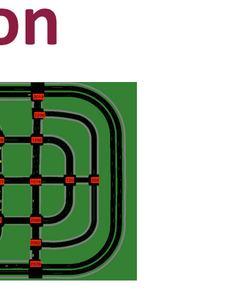






SUMO Traffic Generation

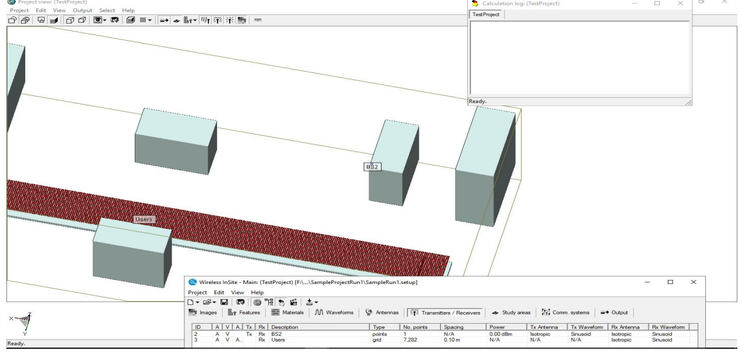




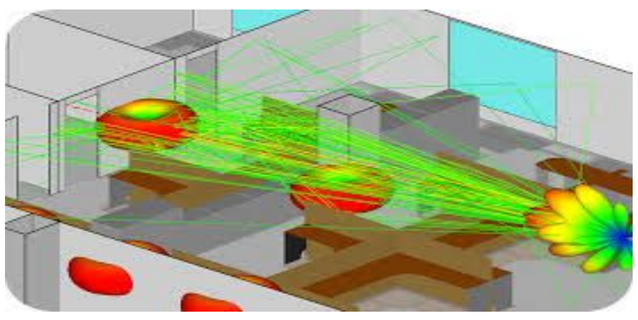
Traffic pattern for ASU model, Carla Town

Traffic pattern, sample area Germany

WI Imports, Carla



WI New York Model Import



Sample Ray Generation

Impact & Future Work

This project:

- Established framework to create comprehensive indoor/outdoor models
- Contributed to the DeepMIMO and DeepSense6G datasets

Future work can include:

- Automate the model generation process
- Generate more ray-tracing data on these models

References

[1]A. Alkhateeb, "DeepMIMO: A generic deep learning dataset for millimeter wave and massive MIMO applications," in Proc. of Information Theory and Applications Workshop (ITA), San Diego, CA, Feb 2019, pp. 1–8.
[2]Alkhateeb, A. et al. (n.d.). *A large-scale multi-modal sensing and communications dataset*. DeepSense. https://www.deepsense6g.net/
[3]*Carla Documentation*. CARLA Simulator. (n.d.). https://carla.readthedocs.io/en/latest/

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