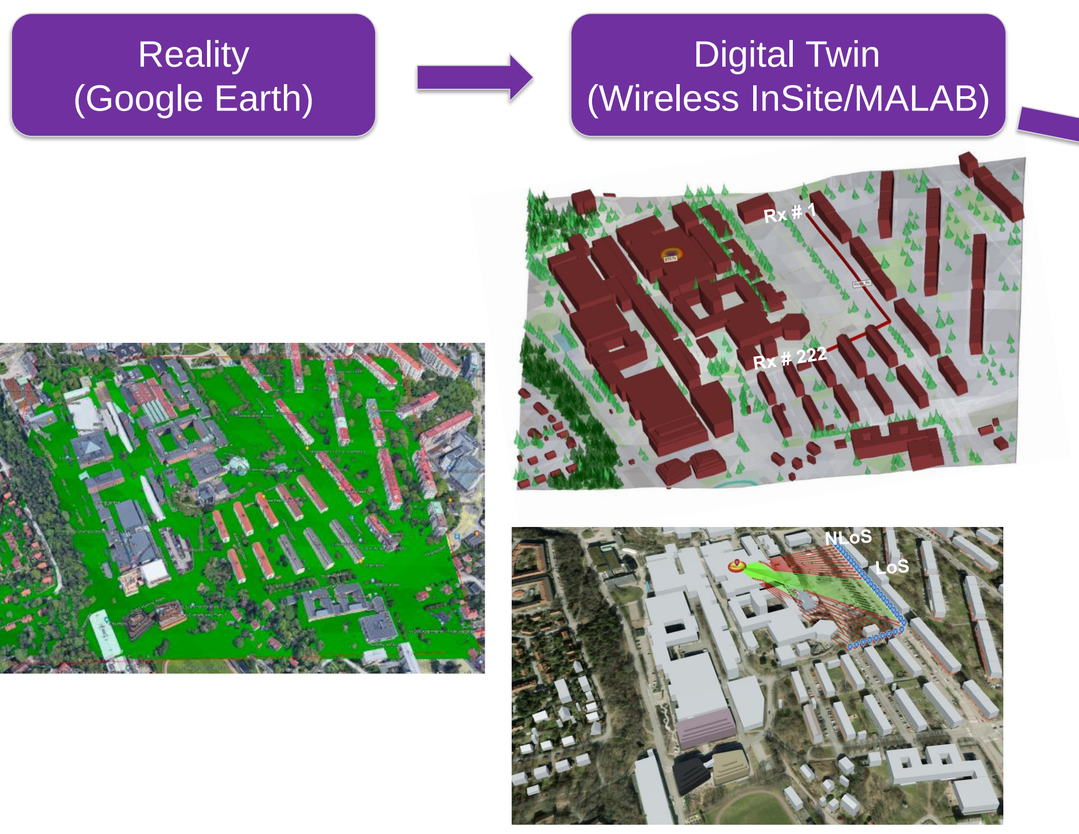
DIGITAL TWINNING FOR 6G WIRELESS NETWORKS OPTIMIZATION: A Simulation-Based Analysis of Building Designs and Deployment Strategies

Morteza Ghaderi Aram†, Hao Guo†,‡, Mingsheng Yin‡, and Tommy Svensson†

INTRODUCTION

- Digital twinning is becoming increasingly vital in the design and real-time control of future wireless networks where building arrangements can critically impact network performances.
- Here, we utilize and compare two commercial ray-tracing software packages to gain insight into how such factors as building positioning influence wireless propagation.



The parking lot in front of the E2 department and its 3D CAD model extracted from OpenStreetMap for simulations in Wireless InSite and MATLAB.

METHODS & MATERIALS

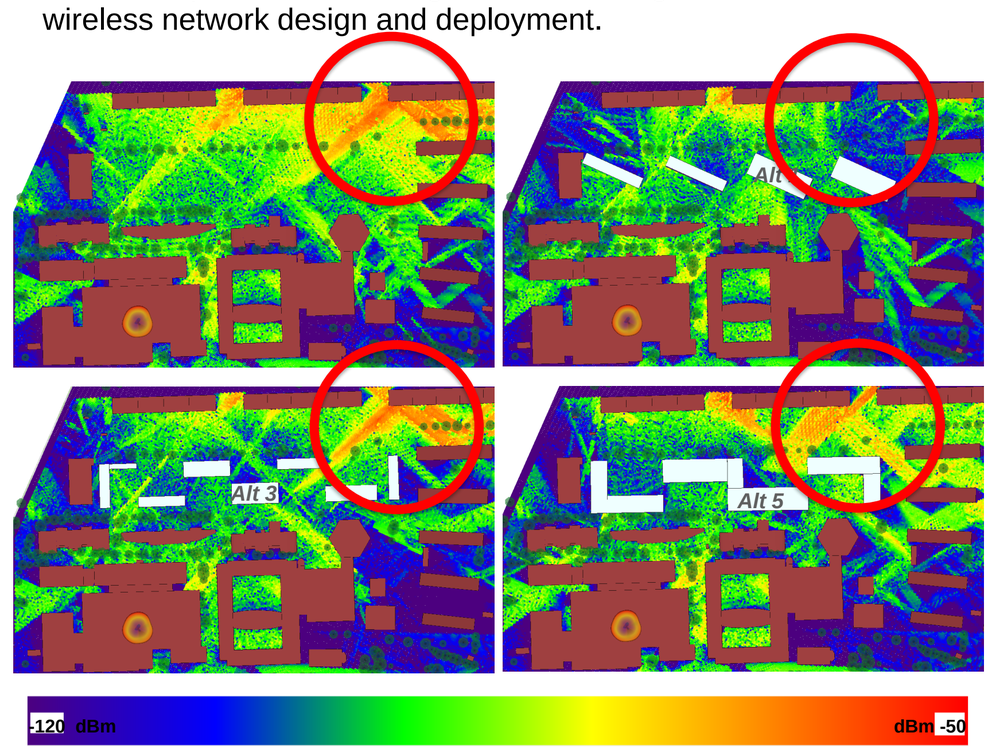
- Using Wireless InSite, Remcom®, and MATLAB's Raytracer
- Considering reflections, diffraction, and foliage loss as well as atmospheric absorption
- Outputting channel characteristics such as path loss, delay spread, direction of arrival/ departure, and the channel response
- Using an add-on to the open-source software package Blender, called Blosm, to extract from OpenStreetMap the premises around the Electrical Engineering department of Chalmers University in downtown Gothenburg with roughly 0.5×0.5 square kilometers.

RESULTS

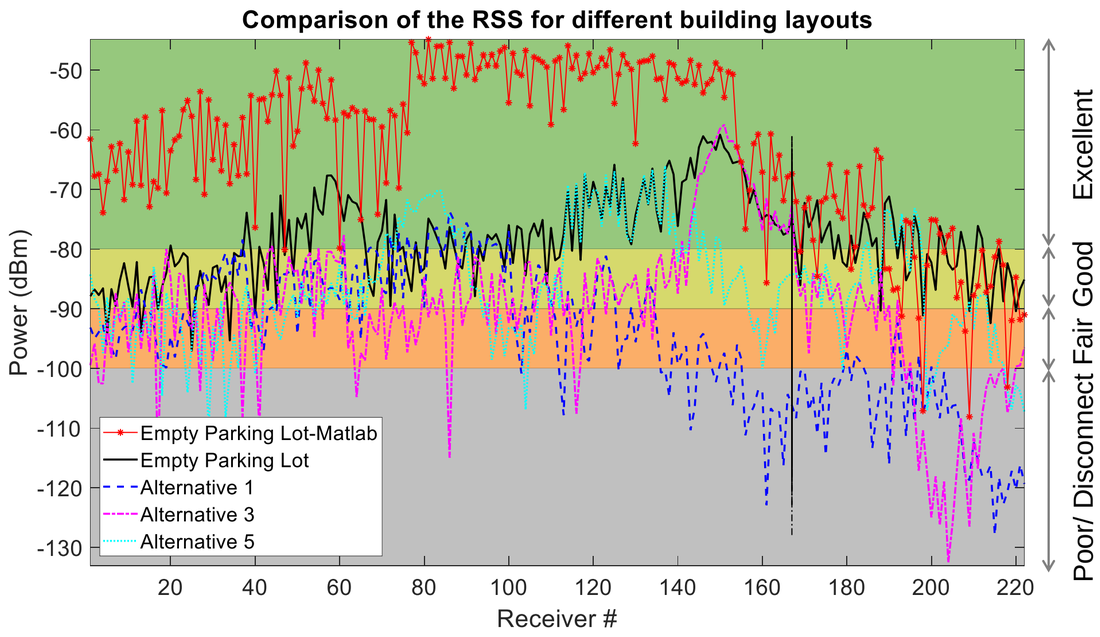
The coverage maps for different building options as well as the received signal strength (RSS) along a chosen route are shown and compared below.

THE MAIN POINTS

- The results demonstrate the efficiency of the digital twin workflow, showing smooth and timely simulations that reveal the impact of different building designs on wireless signal behavior.
- By analyzing radio heat maps alongside antenna patterns, we can gain valuable insights into optimizing wireless deployment strategies.
- This study highlights the potential of digital twinning as a critical tool for urban planners and engineers, enabling informed decisions in wireless network design and deployment.



Coverage maps computed by Wireless InSite for the empty parking lot, building alternatives 1, 3, and 5, respectively (the building alternatives are taken from [1]).



Received signal strength compared along the route shown in the map for all the scenarios simulated in MATLAB and Wireless InSite.

[1] Gonzalez-Caceres, Alex, et al. "Towards digital twinning for multi-domain simulation workflows in urban design: a case study in Gothenburg." Journal of Building Performance Simulation (2024): 1-22.

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†Department of Electrical Engineering Wireless Systems Group | Chalmers

‡Tandon School of Engineering, New York University

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