Master Student Project Description

Robot-based measurement and modelling for 5G networks

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Background Description

Robots can play a crucial role in 5G measurements and planning by automating tasks that require high precision, consistency, and mobility. As 5G networks are designed to provide high-speed, low-latency communication with dense coverage, accurate testing and network planning are essential. Robots equipped with sensors can be deployed to collect real-time data on signal strength, latency, and coverage across different environments, such as urban areas or indoor settings. This data helps network operators optimize placement of base stations, antennas, and other infrastructure.
Ray tracing based softwares can further aid this process, by providing an understanding of active changes in the environment, which can help us approximate these changes better, without collecting fresh data.

Detailed Project Goal

In this project, the students will be provided with 5G equipment and a Turtlebot 3 robot. Some responsibilities would involve conducting measurements at different points in KTH R1 Reaktorhallen to build a dataset. Alongside this, we will use a MATLAB / Sionna ray tracer to understand signal quality (SINR / RSSI) changes for different positions. We'll finally see if can establish a calibration quotient for SINRs at different positions and can accurately forecast it with the Ray tracer. Some data modelling tools could potentially be used to estimate the calibration quotient and the SINR.

Course Task Planning

<u>Proposed Approach</u>:

1. Take measurements between static TX and RX and measure RSSI on Ray tracer.
2. Understand with ray tracer, how RSSI changes when Robots move into unknown environment by changing RX positions.
3. Collect measurements in new positions.
4. Compare model A with B
5. Model X: Main model built with data collected between original RX and TX.
6. Model A: Model X, but retrained with delta(RSSI) between new and old position <-- Ray tracer.
7. Model B: Fresh model like model X, built on new data from new positions.
8. Check if prediction model based on model A is viable by comparing to collected data.

Required Skills:

- Proficiency in programming languages such as MATLAB, python.
- Experience and eagerness to work with ROS, robots.

References and Background Material

[1] Turtlebot: https://turtlebot.github.io/turtlebot4-user-manual/setup/basic.html
[2] ExPECA: An Experimental Platform for Trustworthy Edge Computing Applications https://www.computer.org/csdl/proceedings-article/sec/2023/012300a294/1UlmPS8102c
[3] "Data-Driven Latency Probability Prediction for Wireless Networks: Focusing on Tail Probabilities," GLOBECOM 2023 https://ieeexplore.ieee.org/abstract/document/10437281