Master Thesis

Indoor Positioning Through Machine Learning of Directional Radio Transmission Fingerprints

Indoor positioning is a field of research that enables location aware services for consumers, as well as industry. As such, smartphone users may be navigated to a desired product in a large shopping centre. In the industry and healthcare sector, the tracking of assets enables real-time processes analysis and assistance functions for workers, patients and management.

Bluetooth is a commonly used technology in the field of indoor positioning. However, common signal strength (RSSI) based approaches to localization are unreliable and require multiple base stations with a line of sight to the locating device. The new Bluetooth standard 5.1 introduces directional radio sensing and transmission. This functionality is specifically designed for indoor positioning applications and can be leveraged to improve or replace existing systems based on RSSI measurements.

This project aims to employ the measurements of location specific radio signals using a mobile transmitter and multiple fixed base stations with directional radio sensing capability. The goal is to implement a system that samples and compares the location specific "fingerprints" of directed radio transmissions to find the position of a mobile transmitter without the need for a direct line of sight to any base stations. This will be achieved by a systematic analysis of various given methods and by the development of new a neural network based method.

The following tasks should be completed:

- Acquisition of basic knowledge regarding indoor positioning using radio signal fingerprints, Bluetooth 5.1 and its direction finding features, as well as neural networks for location fingerprinting.
- Familiarization with, and application of, a given set of fingerprinting (machine learning) algorithms in Python and Matlab as a benchmark
- Extension of the given algorithms to use Bluetooth 5.1 specific radio properties (Angle of Arrival)
- Conception and implementation of a new fingerprinting method based on artificial neural networks
- Evaluation of the accuracy and performance of the positioning system
- Documentation of the results

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Date of start: 01.10.2022

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