Open Thesis / Project

Centimetre-Accurate Ranging in Non-Line-of-Sight Conditions

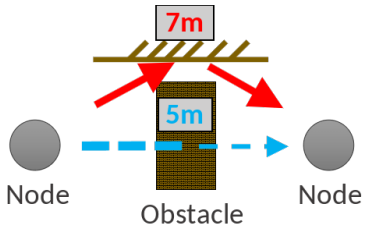
Thesis Type

Master Project / Master Thesis

Motivation

Ultra-wideband (UWB) has recently become the technology of choice to create centimetre-accurate ranging and indoor positioning applications. Its market is growing at a fast pace and is expected to hit 2.7 billion USD by 2025, fueled by the introduction of UWB radios into high-end smartphones and modern vehicles, as well as by the increasing adoption of the technology in asset tracking, robot navigation, and assisted-living applications.

Under optimal conditions, i.e., when no obstacles block the direct line-of-sight (LOS) between two devices, UWB radios typically achieve centimetre-level accuracy. However, in non-line-of-sight (NLOS) conditions, the direct path between two UWB devices is either attenuated by partially-blocking obstacles (i.e., blue arrow in the figure), causing ranging errors of a few decimetres, or entirely blocked (i.e., red arrow in the figure), causing ranging errors up to a few metres. NLOS conditions hence strongly affect the performance of UWB ranging and indoor positioning in real-world settings and these need be detected and or corrected. In our group, we have pioneered the first NLOS classification and error correction solution running directly on embedded UWB devices [1].



[1] `https://tinyurl.com/2sczcpuc`

Goals and Tasks

Within this context, students can explore several directions and perform different tasks, such as:

- Leveraging our framework "InSight" [1] to compare the performance of different approaches to detect NLOS conditions and correct NLOS-induced ranging errors.
- Creating their own approach to detect NLOS conditions and correct NLOS-induced ranging errors (e.g., by combining link indicators and/or machine learning techniques).
- Exploring ways to incorporate NLOS detection and error correction into existing indoor positioning solutions, so to improve their accuracy (e.g., by selecting only anchors in LOS).
- Experimenting with the new DW3000 radio to verify whether existing solutions to detect NLOS conditions and correct NLOS-induced ranging errors (which were mostly developed for the old DW1000 radio) retain their effectiveness.

Target Group

- Students of ICE/Telematics;
- Students of Computer Science;
- Students of Electrical Engineering.

Required Prior Knowledge

- Basic knowledge of machine learning;
- Solid skills in Python and C programming;
- Experience with microcontrollers.

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