

Open Thesis / Project

Evaluating and Improving the Real-World Performance of UWB Ranging and Localization Systems

Thesis Type

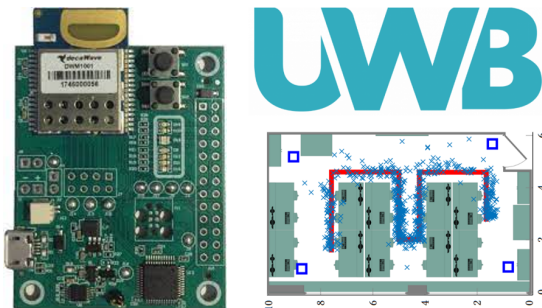
Bachelor Thesis / Master Project / Master Thesis

Motivation

Ultra-Wideband (UWB) is an emerging radio technology for building location-aware IoT applications. Its high bandwidth allows a high timing resolution of the received signal, which leads to excellent time-of-flight (ToF) ranging capabilities enabling sub-decimeter accurate distance measurements. Accurate wireless distance measurement and localization are critical for many applications, including indoor positioning and asset tracking, secure access control (e.g., door unlocking or vehicle entry), as well as autonomous-vehicle navigation.

Unfortunately, the performance of UWB systems deployed in real-world environments still falls short in non-line-of-sight (NLOS) conditions, and is often affected by clock drift and synchronization issues, as well as specific antenna/device configurations.

Leveraging our motion capture system. Our group has access to a Qualisys optical motion capture system, which can deliver ground-truth positioning measurements with sub-millimeter accuracy. Using the Qualisys, we can benchmark the real-world performance of UWB systems in different conditions, identify key limitations, quantify trade-offs (e.g., between latency, energy efficiency, and accuracy), as well as evaluate the effectiveness of custom-built techniques/algorithms.



Goals and Tasks

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

- Evaluating in detail the performance of UWB systems (e.g., the reference implementation by Qorvo) in the real-world using the Qualisys motion-capture system;
- Testing the robustness of UWB systems to NLOS conditions;
- Improving existing techniques to classify and/or mitigate NLOS conditions (e.g., by applying dataset distillation methods to SVM models), and evaluating their effectiveness;
- Improve the robustness of UWB systems, for instance, by focusing on outlier rejection methods, or on refined anchor selection.

Target Group

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

Required Prior Knowledge

- Solid skills in Python and C programming;
- Experience with microcontrollers, wireless communications and embedded systems;
- If working on NLOS classification/mitigation, basic knowledge of machine learning (ML).

Contact Person

- Dr. Jesús Pestana Puerta
jesus.pestanapuerta@tugraz.at
- Assoc.Prof. Carlo Alberto Boano
cboano@tugraz.at

