UWB–based Positioning System Analysis and Applications in Mobile Robot Exploration

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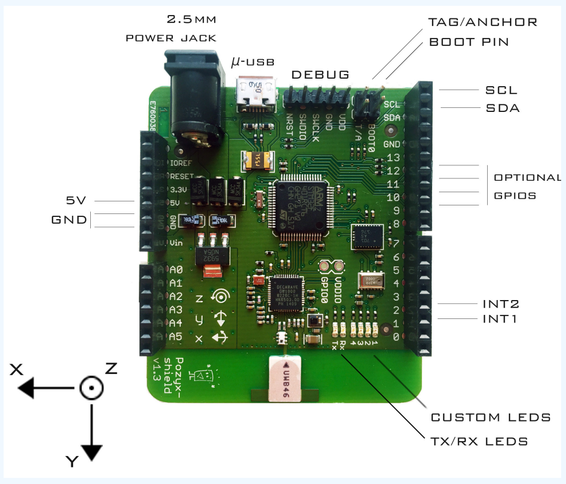
Introduction & Motivation

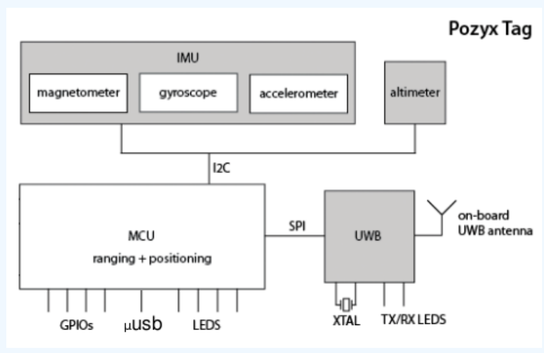
In DARPA SubT Challenge, the robots are required to navigate through challenging underground environments where satellite based system such as GPS fail entirely. Ultrawideband (UWB) - based system is a relatively new technology which claims to solve the problem with high precision.

This project seek to analyse the system as well as exploring its applications in mobile robot exploration.

Testbed

- Hardware: Pozyx Creator System (using Decawave DW1000 transceiver)





- Software: Pozyx Python API is used to communicate with Pozyx board through serial communication.

Analysis and Benchmark

- Range and Accuracy is measured with LOS condition.

Distance (m)	Mean Error (mm)	σ (mm)
1	90	31.69
2	53	34.12
4	77	34.83
10	140	40.98
50	142	107.25
80	150	79.31

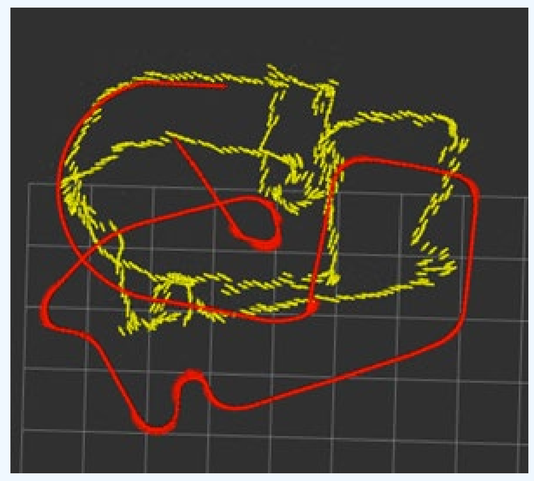
- Results shows that UWB is able to produce ranging results with centimetre accuracy and relatively small variance which is better than Bluetooth/WiFi based localization system.[1]
- However, UWB systems often are short range indoor applications due to low emission regulation.

[1] https://arxiv.org/pdf/1709.01015.pdf

Applications

1. UWB as Ground Truth for experiments

- Many localization algorithm is developed for autonomous vehicle. UWB can act as a ground truth for validations as it does not have error accumulation.
- In example: Wheel Odometry (Red) vs UWB (Yellow)
- We can see that Wheel Odometry has error accumulation over time where UWB does not.

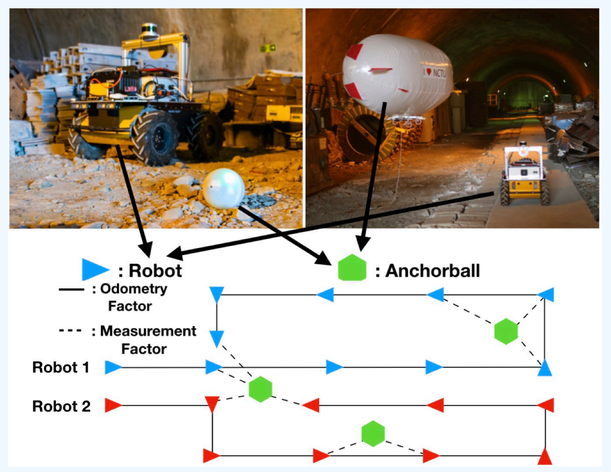


2. Integration with Wheel Odometry

- Wheel Odometry is improved by using UWB to update its position at an interval.

3. Anchorball Localization (Deployment in SubT Challenge)

- UWB is deployed in our Anchorball solution on creating loop closure for SLAM and visual/wheel odometry.
- Using smoothing and mapping algorithm (ISAM), shifting in odometry can be mitigated.



- Anchors also used as reference points for map merging of multiple robots.