

2018 Microsoft Indoor Localization Competition Submission Abstract

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ABSTRACT

Using UWB as a scalable precise real-time indoor localization technology.

1. INTRODUCTION

Ultra-wideband (aka UWB IEEE 802.15.4-2011) is a very low energy radio technology for short-range, high-bandwidth communications over a wide portion of the radio spectrum.

UWB uses short-duration pulses spread over a spectrum of frequencies from 3.1 GHz to 10.6 GHz. Generating extremely short pulses that can be measured very precisely. Using time-of-flight measurement calculations, UWB devices achieve precise location within the 10 to 30-centimeter range.

2. METHOD

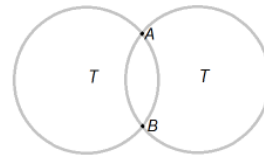
TWR or ToF - One-way ToF, or two-way ranging TWR. UWB positioning methods exploit the precise distances measured between two or more UWB capable modules to create a map and determine likely positions of one or more UWB participants. UWB modules transmit and receive signals, and the time of flight (ToF) of these messages is the time it takes for the radio signal to travel from one transmitter to another receiver. Radio signals travel with known velocity, so the ToF can be employed to calculate the distance between the transmitter and receiver.

$$T_{\text{prop}} = T_R - T_T$$

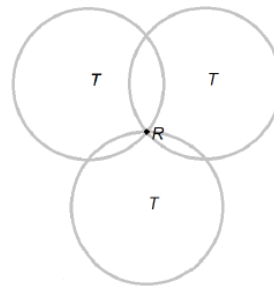
where T_{prop} is the ToF, T_T is the time when the transmitter sent the signal and T_R is the time when the receiver received the signal. Obviously, a robust ToF solution requires synchronized clocks on both devices.

An alternative to the transmitter/receiver configuration is the use of transceiver capable devices. Transceiver activity going both ways allows for TWR solutioning as the roundtrip time, which is the time elapsed between a device sending a message and the moment a response is received, eliminates the need for synchronized clocks.

With only 2 participants, distances measured will plot 2 possible intersections where the radio spheres overlap and satisfy plotting calculations.



3 or more devices will reduce ambiguity and build a deterministic 3D sphere within which the object to be localized is found (R).



3. OBSTACLES & OBJECTIVES

Measuring "z".

The above method imposing at least 3 fixed devices for whom the center point and radius of each of the three spheres generated are known will position a 4th mobile device of unknown position and deliver relevant x and y coordinates. However, the trilateration algorithm providing x, y and z coordinates will give calculated x and y positions and a derived z as this component is not measured by the object device relative to the ground plane.

Precise z elevation measurements cannot depend entirely on this method.

Our objective is to provide valid 3D resolution for x, y and z