Indoor Positioning System with RF Signals

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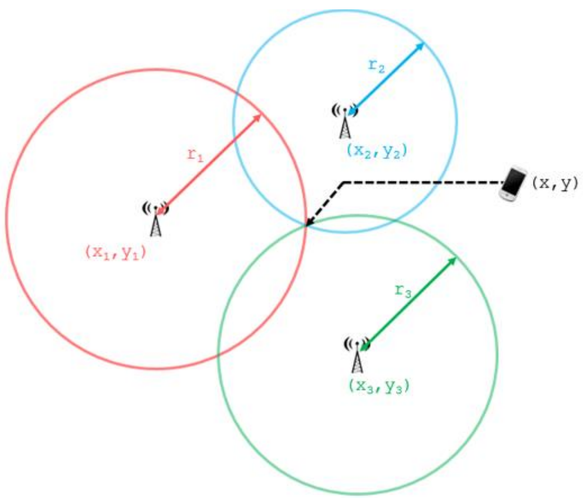
Introduction

Even tough location information plays a huge role in many applications such as equipment tracking and navigation, a robust and reliable system is yet to exist.

Our main goal is to design an indoor positioning system using radio frequency, which can locate and track people or objects in closed areas accurately.

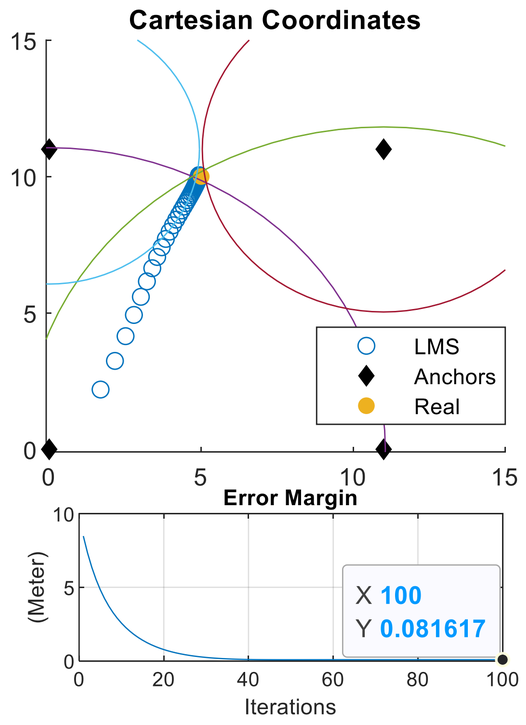


Methodology

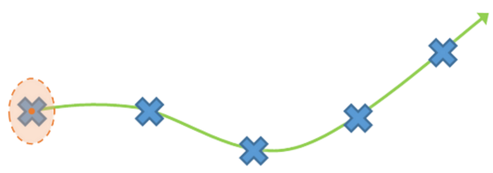
Our system is composed of at least 3 different anchor points and a one tag device that measures its distance to each anchor. Main idea is that in an ideal world we can detect the position of the tag device just by these three measurements. As expected in real life each measurement has an error value which we tried to minimize using different filters as explained below.

Gradient Descent Δf

We start by guessing a random point on the system and calculate its distance to each anchor. Subtracting these two values and taking the square of it gives us our error function. Taking the gradient of this we can find the **direction of the greatest change**. Then by going to the opposite direction of the gradient can find where this error function reaches a local minimum.



Kalman Filter



We have used a constant position Kalman filter which eliminates time from the modelling system and simplifies the computation time. With this filter we eliminate the «teleporting» effect and **obtained a more consistent and realistic tracking algorithm.**

Sensors

We have used **DWM1001** ultrawide-band modules with built in Bluetooth supplied by HAVELSAN. These modules uses two way ranging to measure the distance accurately.

Android Application

Using Bluetooth, we have built an android application that **shows real time position** with various features such as an engineering mode and custom background.

Application Areas

- ✓ Autonomous swarm drones
- ✓ Tracking special vehicles
- ✓ Mining Sites
- ✓ Museums
- ✓ Airports
- ✓ Hospitals

Scan the QR code to
see a working demo!