Indoor Localization: Technologies and Android Apps

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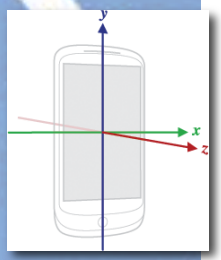
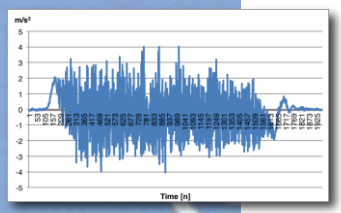
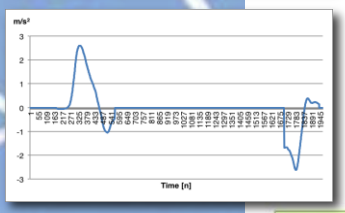
Overview

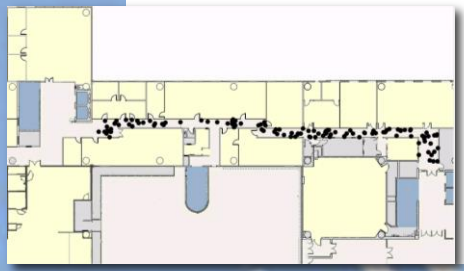
Accurate real-time location information of a user or a device is very valuable and significant for many applications such as Location-Based Services (LBS). The Global Positioning System (GPS) is now in every smartphone in the market, giving users convenient location services when they are outdoors. **Indoor localization**, however, remains a weak spot of smartphones because of the constraints of GPS.

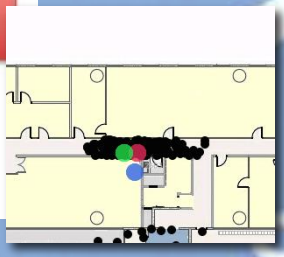
This FYP aims to deliver an accurate and highly available solution for **indoor localization** of common Android mobile devices by fusing **inertia navigation system (INS)** and **Wi-Fi fingerprinting** under **map constraint**.





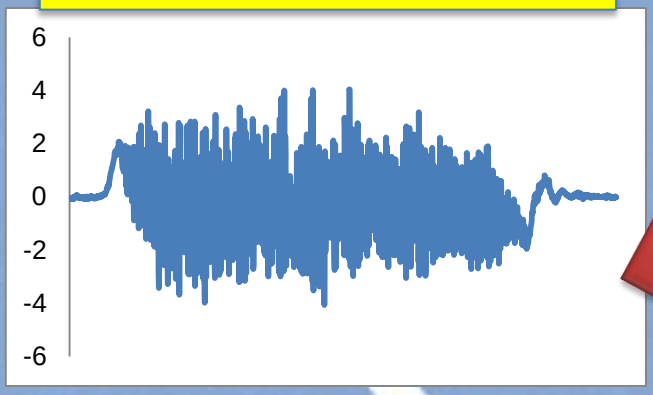




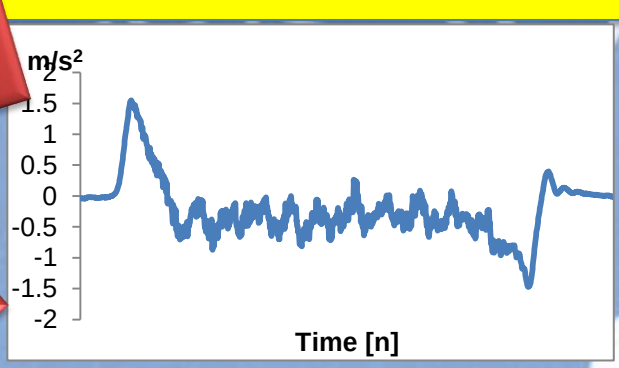


Inertia Navigation System Design

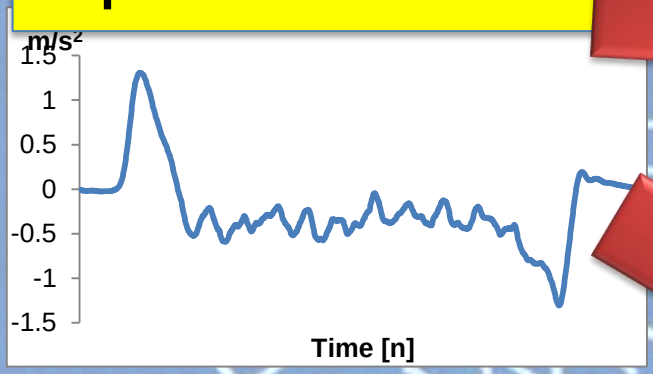
Linear Acceleration Along Y-axis



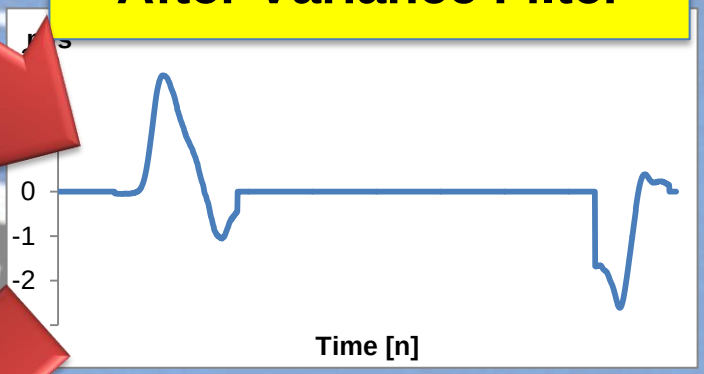
After Single Exponential Smoothing



After Double Exponential Smoothin

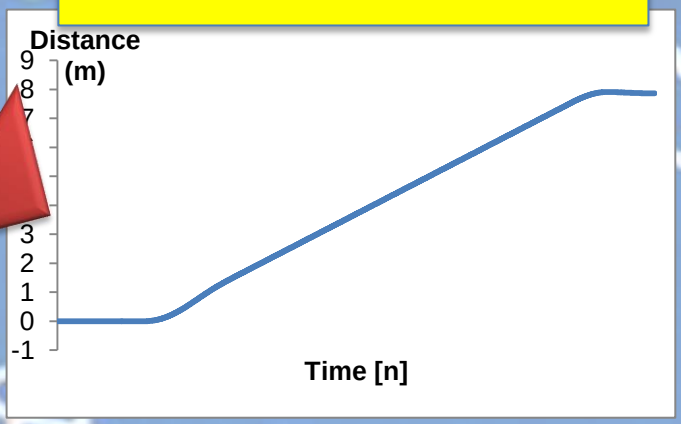


After Variance Filter



After Kalman Filter

Distance Estimation



Wi-Fi Fingerprinting + Inertia Navigation System

Advantages of Fusion:

1. Wi-Fi fingerprinting estimated positions usually have **drift** and **jump back and forth** when the device **remains at rest**. INS assists the device to have a smooth trajectory.
2. When **Wi-Fi signal** of some area is too **weak** for Wi-Fi fingerprinting, INS can assist the localization system to track the location continuously until reaching Wi-Fi covered area.
3. Under map constraint, the wall crossing is eliminated while WiFi fingerprinting estimation sometimes cross the wall.

Technique of Fusion - Particle Filter

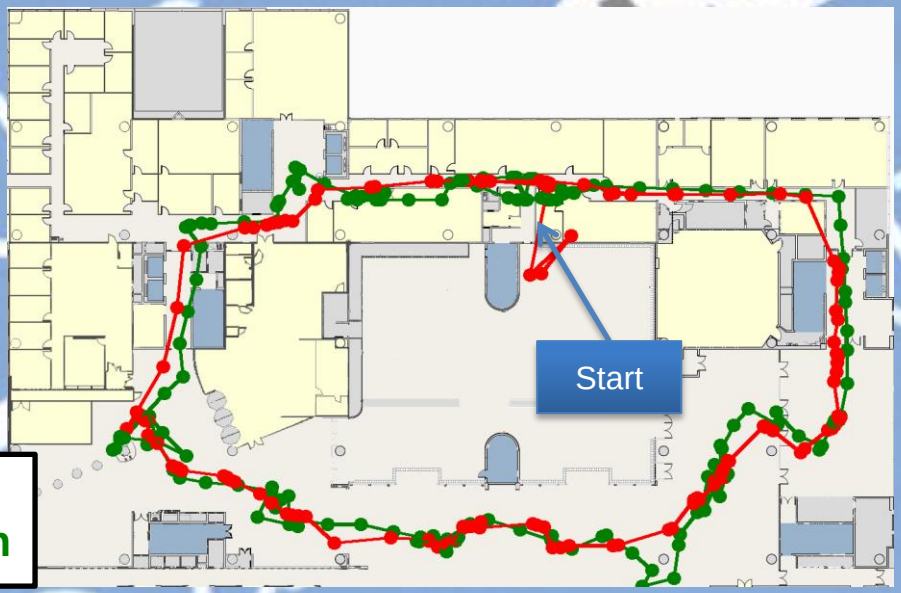
Initialization of Particle:
Every particle represents a probability of current position

Convergence of Particles:
Converging particles is estimating the current position (red dot)

Converged Particles:
Converged particles estimated the correct and stable position

Performance of Fusion vs Wi-Fi Fingerprinting

Wi-Fi fingerprinting estimated positions usually have **drift** and **jump back and forth** while fusion can have a **smooth trajectory**.



Red is fusion version
Green is Wi-Fi version