Indoor Localization via Multiple Sensor Fusion

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ABSTRACT

In this paper, we propose a particle filter-based data fusion approach for indoor localization using mobile smartphones. The system runs locally on a smartphone and relies at its core on a particle filter that fuses the information of the sensors available on the phone (Wi-Fi chipset, accelerometers and magnetic field sensor). In contrast to previous work, we provide a probabilistic model for location estimation that is formulated directly on a fully discretized, graph-based representation of the indoor environment.

Keywords

Data Fusion, Particle Filtering, Indoor Localization

1. INTRODUCTION

Indoor positioning has gained great importance since technology allows for affordable realtime sensing and processing systems.

Unlike outdoor environments, which are covered by GNSS to a satisfiable extent, indoor navigation faces additional challenges, depending on the underlying measurement system, such as occlusions, reflections and attenuation.

Researchers have explored the use of WiFi beacons, magnetometer, camera, or ultrasound for coarse level indoor positioning. But few of them have achieved the needed meter-level accuracy for the above mentioned applications. Besides, WiFi and other infrastructure assisted approaches rely on installation of beacons. Other approaches rely on inertial sensors(e.g., accelerometer, gyro) to track a user by continuously estimating displacement from a known location without the need for infrastructure assistance. However, the accumulated error have big effect on the localization accuracy.

2. OUR METHOD

Precise indoor localization of moving targets is a challenging activity which cannot be easily accomplished without combining different sources of information[1, 2, 3, 4]. There is a great variety of sensors and measuring principles, however, in practice every single measuring technique suffers from deficits. While RF and (ultra-)sound are subject to multipath propagation, optical systems are intolerant to NLOS conditions. Some systems require setting up beacons, while others are self-calibrating and easy-toinstall. Data fusion can overcome the limitations mentioned before by combining complementary, and redundant sensing techniques.

Consider that using multiple sensor data from the smartphone, such as accelerometer, gyroscope and Wi-Fi,magtetic, in the IPSN 2015 Indoor Localization Competition, We will propose a graph-based, low-complexity sensor fusion approach for robust, accurate, indoor localization with mobile smartphones. The main work are as follows:

(1) data fusion algorithm

Due to the large variety of technologies and standards involved, a data fusion algorithm typically needs to account for several communication channel models, bandwidths, sampling rates, as well as asynchronicity of the recorded data. Online fusion approaches that have been proposed are based on the Bayesian filtering methodology, including variants of the Kalman filter and particle filter. Consider that particle filter allows for a general way of coping with severe nonlinearities and non-Gaussianities and of forcing the solution to be inside a map, we will adapt particle filtering as the tool for data fusion.

(2) Indoor floor plan construction

Consider the importance of floor plan in indoor localization, we plan to use the Simultaneous localization and mapping (SLAM) technology to the construct the indoor floor plan and fingerprint database.

3. REFERENCES

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