Track5 – Long system description

BUPTer

In recent years, the indoor location system has emerged as a pivotal component in societal infrastructure. It leverages a variety of technologies to approximate users' location information. Commonly employed methods encompass GPS, image and video processing, inertial unit navigation, along with WiFi and BLE fingerprint matching. Nonetheless, every sensor carries its limitations, which remain unresolved. For instance, GPS systems are incapable of receiving signals in indoor environments; image-based positioning is significantly influenced by ambient illumination. RSSI necessitates prior known signal source location for accurate positioning, and filtration could undermine the algorithm's real-time performance. Moreover, an IMU-based pedestrian dead reckoning approach can precipitate system errors. Consequently, multi-sensor fusion can compensate for the insufficiencies of a singular sensor and secure a superior positioning outcome.

Our project is centered on smartphones and utilizes a combination of different built-in sensors to enable user positioning. The primary inputs for positioning are generated by the embedded IMU module and the pose sensor. The reason for this is that, compared to other sensor data emitted by smartphones, these inputs possess a higher frequency, resulting in superior real-time performance and enabling more accurate location estimations.

Moreover, an inherent integration process exists in the PDR solution steps predicated on IMU and navigation, inducing cumulative errors over time and resulting in deviations from the intended positioning route. Furthermore, the IMU's magnetometer is influenced by the earth's magnetic field and the surrounding environment, potentially causing signal mutations or fluctuations during motion. The mobile phone's IMU is also susceptible to user movements, generating irrelevant redundant data. Bearing these factors in mind, our project initially executes mutation removal and chattering elimination on the IMU sensor, mitigating environmental impacts.

In this competition, we are challenged to optimize our model with a limited range of data types, which presents a significant challenge. This requires us to carefully select the most relevant and informative data types to incorporate into our model, while also ensuring that our model remains efficient and effective in generating accurate predictions.

To meet this challenge, we will need to leverage our expertise in data analysis and modeling techniques to extract meaningful insights from the available data. We will also need to explore innovative approaches and techniques to maximize the value of the limited data types at our disposal.

Height estimation is achieved using the smartphone's built-in barometer, where filtered air pressure values facilitate floor height calculation. GNSS information is also utilized for outdoor environments. Our project intends to implement a dual-mode positioning strategy for both indoor and outdoor contexts. For outdoor calibration, we integrate IMU with GNSS, while for indoor environments, we match IMU and WiFi.

Additionally, light sensors and GNSS signals provide an effective means of discerning whether the environment is indoor or outdoor.

Predicated on smartphones, this project integrates a variety of sensors and autonomously selects suitable sensors and algorithms according to varying scenes and environmental characteristics. This strategy enables high-precision positioning across extensive indoor and outdoor environments.