

**CHENNAI – PONDICHERRY**

**Mercury: An Infrastructure-free System for Network Localization and Navigation**

**Abstract:**

Location awareness enables a variety of emerging applications on mobile devices. For indoor applications, a desirable way of obtaining real-time locations is by combining different sources of positional information, such as the inertial measurements, ranging measurements, and map information with an infrastructure-free system that does not rely on any customized hardware. These sources of information can be incorporated into the paradigm of network localization and navigation (NLN). However, there still lacks an infrastructure-free localization system that applies the insights of NLN to effectively fuse different types of information. In this paper, we present the Mercury system, which realizes the key ideas of NLN, including the exploitation of spatio-temporal cooperation and the use of environmental knowledge. We design a real-time belief propagation algorithm to fuse map information with the acceleration and angular velocity measurements as well as the range measurements among different users. We implement this algorithm in the Mercury system, which consists of only smartphones, and carry out experiments to evaluate its localization accuracy. Results show that Mercury provides reliable location information and that spatial cooperation remarkably reduces the location uncertainty of users. Moreover, the performance of Mercury is more robust to imperfect initial positional knowledge compared with that of existing systems.

**Existing System:**

Extensive research has been carried out on indoor localization. Based on the hardware requirement, we classify existing indoor localization systems into two categories, namely, infrastructure-based systems and infrastructure-free systems. The former refers to systems that include devices specially designed for localization (e.g., ultra-wide band (UWB) radios and ultrasound transceivers) whereas the latter refers to systems that consist of only commercial devices (e.g. smartphones and tablets) and existing facilities (e.g. WiFi access points (APs) and cellular base stations). Between these two types of systems, the infrastructure-free ones are more amenable for wide-scale commercial use. These systems use measurements obtained from only commercial devices and thus avoid additional hardware cost. In infrastructure-free localization systems, the algorithm used for measurement fusion is critical in determining the overall system performance.

**Proposed System:**

We propose a graphical model that represents the position, phone heading error, and the gyroscope bias of a user as a state vertex. Compared with models where the state vertex includes only the position, the proposed model enables more effective mitigation of the accumulated errors brought by the IMU.

We develop a BP algorithm that fuses the range measurements among different users obtained via acoustic signals, as well as the acceleration and angular velocity measurements obtained via the IMU in smartphones.

We fuse the map knowledge with location information from spatio-temporal cooperation by imposing positional constraints in the dynamic model of the BP algorithm.

We implement a real-time navigation system on smartphones, and demonstrate its performance improvements compared to existing systems via experimentation.