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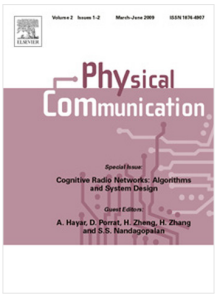

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A New Wi-Fi/ GPS Fusion Method for Robust Positioning in Urban Environments

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Abstract

This paper presents a tracking framework for enhancing the positioning accuracy of a mobile device by fusing the positions provided by a GPS navigation system and those obtained using Wi-Fi signal strength measurements, in urban environments. To achieve an efficient fusion, a structure based on two particle filters and a Multiple Model (MM) approach is proposed. It fuses the information coming from these two independent technologies, to overcome their own drawbacks. Indeed, the Wi-Fi and GPS are viewed as two models, whose probabilities are calculated using a Transition Probability Matrix (TPM) and a Mixing Likelihood Function (MLF). These probabilities are then used to combine the mobile state estimates, provided by the two particle filters. Matched to the two models, these filters interact by exchanging a part of their particles. The proposed architecture is experimentally evaluated and compared with the pure Wi-Fi and GPS positioning systems and other fusion methods. The results indicate that the positioning errors of the proposed scheme are the lowest.

Keywords

Wi-Fi localization; GPS; Received Signal Strength; Data fusion; Particle filter.

1. Introduction

Over the past decades, substantial efforts have been made by researchers and companies to design efficient positioning systems. Global Navigation Satellite Systems (GNSS), such as the Global Positioning System (GPS), provide an accurate positioning in open-sky environments. However, these systems do not work in indoor environments, due to the weakness of their signals that cannot penetrate the obstacles. In the so-called urban environments, which are environments adjoined to buildings or with many high buildings, the multipath phenomena and the frequently outages of GPS signals can limit the location performance. In these situations, radio frequency based systems (Wi-Fi, Bluetooth, Ultra Wideband (UWB), and Radio Frequency Identification (RFID)) [1], and Inertial Navigation Systems (INS) [2] can be used. However, each system has its own drawbacks. Indeed, the RF positioning techniques are influenced by