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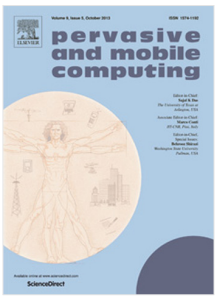

Range based algorithms for precise localization of terrestrial objects using a drone

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Range based Algorithms for Precise Localization of Terrestrial Objects using a Drone☆

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Abstract

In this paper we propose two algorithms, called Dir and Omni, for precisely localizing terrestrial objects, or more simply sensors, using a drone. Dir is based on the observation that, by using directional antennas, it is possible to precisely localize terrestrial sensors just applying a single trilateration. We extend this approach to the case of a regular omnidirectional antenna and formulate the Omni algorithm. Both Dir and Omni plan a static path for the drone over the deployment area, which includes a set of waypoints where distance measurements between the drone and the sensors are taken. Differently from previously proposed best-effort approaches, our algorithms prove that a guaranteed precision can be achieved by considering a set of waypoints, for each sensor, that are at a distance above a certain threshold and that surround the sensor with a certain layout. We perform extensive simulations to validate the performance of our algorithms. Results show that both approaches provide a comparable localization precision, but Dir exhibits a shorter path compared to Omni, being able to exploit the directional antennas.

Keywords: Drones, terrestrial localization, localization precision, directional antenna, IR-UWB, omnidirectional antenna.

1. Introduction

More and more objects around us have sensors embedded with wireless communications: street lights, parking and gas meters, just to mention a few [1]. To bound their cost, each of them cannot be equipped with GPS units, but reliably and accurately determining their locations has important benefits for several applications such as routing protocols, intrusion detection, mission assignment and selective activation [2, 3].

Many existing localization algorithms for Wireless Sensor Network (WSN) in the literature require a large number of fixed anchor points, i.e., sensors whose positions are known a-priori [4]. The number of the anchor points and the cost of their deployment grow with the size of the deployment area. Moreover, the anchor points must be deployed in advance, making the use of

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