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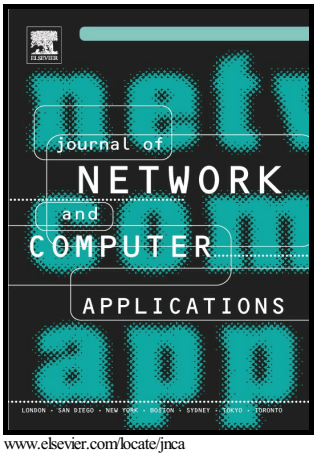

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Mobile Anchor Nodes Path Planning Algorithms using Network-density-based Clustering in Wireless Sensor Networks

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Abstract

Motivated by the improvement of the localization performance and the utilization rate of virtual beacons in heterogeneous WSNs, in this paper, we propose three Mobile Anchor nodes Path Planning (MAPP) algorithms, namely, IMAPPP-NDC, SMAPP-NDC and MMAPP-NDC. Different from most of the existing MAPP algorithms which divide the region of interest (ROI) into several layers or areas and make mobile anchor nodes traverse the ROI layer by layer or one area after another, the proposed MAPP algorithms combine network-density-based clustering, inter-cluster path planning and intra-cluster path planning together to improve localization performance and the utilization rate of virtual beacons based on the mathematical analysis of the relationship between the communication range r of a sensor node and the side length a of the regular hexagon movement trajectory. In addition, SMAPP-NDC and MMAPP-NDC algorithms employ obstacle avoidance mechanisms to steer clear of obstacles and provide non-collinear beacon points around obstacles.

Keywords: wireless sensor network, mobile anchor node, path planning, clustering, obstacle avoidance.

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1. Introduction

Wireless Sensor Networks (WSNs) consist of a set of physically small sensor nodes deployed in a given region of interest (ROI) to fulfill monitoring tasks and have been widely used in many fields such as environment surveillance, intelligent home system, precision agriculture, industrial automatic control, etc., [1].

Localization is one of the key technologies in WSNs, since it provides fundamental support for many location-aware protocols, such as location-based routing protocols, where the location information is critical for sensor nodes to make optimal routing decisions [2]. The problem of localization is the process of finding location information of the sensor nodes in a given coordinate system. Localization algorithms can be classified into range-based localization algorithms and range-free localization algorithms based on the distance measurement techniques [3].

Movement trajectories of mobile anchor nodes are closely related to the localization performance of WSNs. A lot of researchers have engaged in Mobile Anchor nodes Path Planning (MAPP) algorithms, which use several mobile anchor nodes (MANs) equipped with GPS units moving

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